

A  
DICTIONARY  
OF  
CHEMICAL SOLUBILITIES  
INORGANIC

FIRST EDITION.

BY

ARTHUR MESSINGER COMEY, PH.D.

SECOND EDITION

ENLARGED AND REVISED

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New York  
THE MACMILLAN COMPANY  
1921

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Set up and printed

Published February, 1921

## PREFACE TO FIRST EDITION

FOR many years a need has been felt by chemists for a book which shall collect into convenient form for ready reference the various data concerning the solubility of chemical substances that have been published from time to time in chemical periodicals and elsewhere.

The first mention that can be found of such a plan was made in 1731, when Peter Shaw delivered Chemical Lectures in London, as may be seen from the following:—

EXTRACTS from PETER SHAW'S Chemical Lectures, publicly read at London in 1731 and 1732. London. Second Edition, London 1755. 8vo.

Page 97 Experiment I.—That Water as a Menstruum dissolves more of one body and less of another.

[He shows that two ounces of water dissolve two ounces of Epsom salt, five drachms of common salt, and eight grains of cream of tartar. Only in the latter case much remained undissolved until boiled.]

"It might be proper for the further Improvement of Chemistry and Natural Philosophy to form a Table of the Time and Quantity wherein all the known Salts are dissolvable in Water. . . . Such a Table regularly formed might ease the Trouble of refining Salts, by shewing at once without future Trial or Loss of Time how much Water each Salt required to dissolve it for Clarification, Filtration, or Crystallization. It would likewise supply us with a ready and commodious Way of separating any Mixture of Salts, by shewing which would first shoot out of the Mixture upon Crystallization. . . . The same Table might also direct us to a ready and commodious Method of separating two Salts without waiting for Crystallization. . . ."

It was many years, however, before the scheme suggested by Peter Shaw was put into execution. Professor F. H. Storer published the first work that undertook to carry out the idea in its entirety, in 1864, in a book, which he entitled "First Outlines of a Dictionary of Solubilities of Chemical Substances," and which contained a compilation of nearly all the data on the subject published before 1860. It was at once recognized as a most valuable contribution to chemical literature; but for many years it has been difficult to obtain this work, as the limited edition which was published was soon wholly exhausted. Since then nothing has appeared on the subject except the brief tabulations found in various reference books, and no attempt has been made to cover the whole subject.

It is needless to state that the growth of chemical science since the publication of Professor Storer's book has been so enormous that that work has lost, at least to a great extent, the practical value it possessed thirty years ago. This growth has been indeed so great, and the data which have accumulated since 1860 so far surpass the earlier in volume, that a simple revision of Professor Storer's book was impracticable, and it therefore seemed best to start afresh.

With the facilities offered by the various scientific libraries at Harvard University, the Massachusetts Institute of Technology, and other libraries in Boston, it has been possible to collect nearly all the data relating to the subject. For the work before 1860 Professor Storer's work has been found invaluable.

The method pursued has been to form a preliminary list of compounds with more or less data by consulting the two most complete works on inorganic chemistry—Gmelin-Kraut's "*Handbuch der anorganischen Chemie*" and Graham-Otto-Michaelis's "*Lehrbuch*." These statements have been verified and elaborated by consulting the original memoirs in all the periodicals devoted to chemical literature which were obtainable. The "*Jahresbericht der Chemie*" also has been used extensively in tracing references, but the original memoirs have always been consulted and references given to them when possible.

It has been found impracticable to draw any distinction as to reliability between the various data given by different observers. It was manifestly impossible to attempt to verify experimentally the statements of those who have carried on the researches, for the most assiduous labor of many could only cover a small portion of the attested facts. Therefore, even when two statements are directly contradictory, both have been given with the authority for each. The only exception to this has been made when more recent discoveries have shown beyond any reasonable doubt the falsity of previous work. In this way some of the older manifestly inaccurate work has been omitted. In a majority of cases the more recent work may be considered to be the more accurate, but this is not the invariable rule. A Synchronistic Table of the more common periodicals is given in the Appendix, whereby it is easy to determine the date of the publication of a research to which reference is made.

It may be objected by the practical chemist that most of the work previous to 1850 might well have been omitted, but a great deal of this work possesses at least a historical value, and often furnishes facts which have not since been verified. Much of the earlier work, when obviously of less importance, has been printed in smaller type.

The aim has been to include in this volume all analyzed inorganic substances, that is, all substances which do not contain carbon, but exception has been made in the case of  $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{CS}_2$ , the carbonates, cyanides, ferro-cyanides, etc., which are here included.

The work has been brought up to March, 1894, when this volume went to press, and the results of researches published since that time are not included in the present edition.

It is hoped that this book will fill to some extent the want that has been felt by chemists for a compilation of this nature. While it has been attempted to make the book as free from errors as possible, nevertheless it is naturally impossible to avoid many mistakes, and the compiler will be very grateful to those who may call his attention to any errors or omissions.

## PREFACE TO SECOND EDITION

DURING the twenty-five years which have elapsed since the publication of the first edition of this dictionary, a very large amount of work has been published in chemical periodicals, containing data concerning the solubility of inorganic chemical compounds. As it was impossible for the compiler of the first edition to devote the time necessary for the collecting of the published data, it was necessary to employ assistance, and Dr. Dorothy A. Hahn, Professor of Chemistry, Mt. Holyoke College, was engaged for this work. Dr. Hahn has collected the larger part of the material in this book, which work in spite of its arduous and tedious nature, she has performed in a most painstaking manner.

The compilation and arrangement of the data collected by Dr. Hahn, which devolved upon the original author, took much time. This, together with difficulties in printing, caused by the general conditions after the war, has delayed the publication until the present year, although the work was begun in 1916, and it has only been brought up to January 1st of that year.

Since the publication of the first edition of this work, Dr. Atherton Seidell has brought out two editions of his book, entitled "Solubilities of Inorganic and Organic Substances," which covers quite a different field, as he considers only quantitative data and those only for the commoner substances. Dr. Seidell has followed the plan in most cases where there are several available solubility determinations of a substance, of selecting and averaging the more reliable results, and embodying them in tables. Although this undoubtedly facilitates ready reference, it has seemed better to adhere to the original plan of the first edition, and to publish all the data in the form of the original authorities with references and dates, so that the user may be at liberty to use his own judgment in selection. Some few of the tables arranged by Dr. Seidell, however, have seemed to possess decided advantages over any other published data and they have been incorporated in the present volume. It is desired also to acknowledge indebtedness to Dr. Seidell's work for certain other tables where the original sources were not available to the present compilers.

The same plan and arrangement used in the first edition has been followed with certain elaboration, however, of the arrangement of data on the solubility of two or more salts in a solvent, which is explained in the Explanatory Preface.

Data published since the first edition on the cobalt and chromium ammonia compounds and those of the platinum group have been omitted, as it seemed that solubility data on those compounds possessed very little general interest.

As stated in the preface of the first edition, while every possible attempt has been made to avoid errors, it is manifestly impossible to avoid many mistakes in a work of this nature, and the compiler will be glad to have his attention called to any errors or omissions.

WILMINGTON, Del., Jan., 1921.

A. M. C.



## EXPLANATORY PREFACE

IN order to reduce this volume to a convenient size the subject-matter has been abbreviated and condensed as far as seemed compatible with clearness; but it has been the aim not to use any abbreviations which are not at once intelligible without consulting the explanatory table. The more common chemical formulæ have been universally used, thereby saving a large amount of space without detracting from ready intelligibility to chemists.

The solubility of the substance in water is first given, the data being arranged chronologically in the longer articles. Then follow the specific gravities of the aqueous solutions, and also any data obtainable regarding their boiling-points; other physical data concerning solutions are not included. Following this is the solubility of the substance in other solvents—first the inorganic acids, then alkali and salt solutions, and finally organic substances.

Owing to the great increase of data, published during the last twenty years, on the simultaneous solubility of two or more salts in a given solvent, it has been found necessary to plan some arrangement, whereby such data can easily be found, and the plan adopted is as follows: The data for the solubility of two salts in a solvent is placed under the salt which comes first according to the alphabetical arrangement in this dictionary, and the order of the data on various salts under the same heading follows the alphabetical order of the salts considered. Thus the data on the solubility of  $\text{NH}_4\text{Cl} + \text{BaCl}_2$ ,  $\text{NH}_4\text{Cl} + \text{CuCl}_2$ , and  $\text{NH}_4\text{Cl} + \text{PbCl}_2$ , and  $\text{NH}_4\text{Cl} + (\text{NH}_4)_2\text{SO}_4$  are placed under Ammonium Chloride and arranged in the given order. Certain exceptions have been made to this rule, where the data directly concerns the solubility of a salt in a solution of another salt, in which case, it is placed under the former. Numerous cross references, however, are given, which it is hoped will avoid confusion.

In many cases no definite distinction can be drawn between the phenomena of solution and decomposition. At present the theory of solution is in a confused state, and until what really takes place when a substance dissolves is thoroughly understood no distinct line can be drawn. The whole subject is unsettled at the present time; for while many chemists believe in the so-called "dissociation" theory, yet the "hydrate" theory is not without its supporters. It is not my intention to discuss the theoretical side of the question, which has been so well treated in many recent works. It is, however, obvious that the phenomena are essentially different, when, for example, sodium carbonate is dissolved in water, in which case the original salt is deposited on evaporation, and when iron is dissolved in sulphuric acid, and the solution deposits a sulphate of iron. Yet it is still the custom to speak of iron as soluble in sulphuric acid, although it would be much more accurate to say that the sulphuric acid was decomposed by the iron. It has thus been found impracticable to draw a sharp line between solu-

tion and decomposition, and the term "soluble" has in general been used where a solution of some sort is formed by the action of the solvent.

The matter of alphabetical arrangement of chemical compounds, in the present somewhat confused state of chemical nomenclature, has been a difficult question to decide. The plan followed has been practically that of the standard Dictionaries of Chemistry, whereby the compounds of metals with one of the non-metallic elements have been classified under the metals, while the salts of the other acids (the oxygen acids so called and some few others) have been arranged alphabetically under the acids. Thus barium chloride is found under barium, while barium chlorate is found under chloric acid. No exception has been made in the case of the rare metals, as is usually the custom in Dictionaries of Chemistry. Double salts are to be found under the word which comes first alphabetically; thus, "common alum," potassium aluminum sulphate, is found under aluminum sulphate as aluminum potassium sulphate (under sulphuric acid), but ammonia chrome alum is found under ammonium sulphate as ammonium chromium sulphate. In the same way the double sulphate and chromate of potassium is found under potassium chromate (chromic acid), and not under potassium sulphate (sulphuric acid). The double chloride of ammonium and magnesium is found under ammonium chloride (ammonium), while the double chloride of potassium and magnesium is found under magnesium chloride (magnesium). An exception is made, however, in the case of double compounds of salts of oxygen acids with salts containing a single non-metallic element, in which case they are always found under the oxygen acid. Thus the double sulphate and chloride of lead,  $\text{PbSO}_4$ ,  $\text{PbCl}_2$ , is found under lead sulphate (sulphuric acid), and not under lead chloride (lead).

The above method in some cases widely separates analogous compounds, but it was found to be the only practical way to a strictly alphabetical arrangement, which is no necessary in a book containing so many very short articles.

The ammonia addition-products furnished another difficulty. While their nature is more or less definitely understood in the cobalt, platinum, etc., compounds, and a definite nomenclature is in general use, there is an absolute lack of anything of the kind in the less definite compounds. It is good usage to speak of cuprammonium compounds, but how shall we designate the analogous cadmium compounds? "Cadmammonium" has not yet received the sanction of chemists, and  $\text{AlCl}_3$ ,  $\text{NH}_3$  is a still worse case for naming. I have, therefore, not attempted to name these compounds, but classified them all under the salts to which the ammonia is added, affixing the word ammonia, thus: aluminum chloride ammonia, cadmium chloride ammonia, and also cupric chloride ammonia for the salt now almost universally known as cuprammonium chloride.

The ammonia compounds of cobalt, chromium, mercury, and the platinum metals are arranged alphabetically according to their universally accepted names, a list of which is given under each of those elements.

It has further been necessary to settle arbitrarily the question whether a substance should be considered as a double salt or a salt of a compound acid con-

taining one of the metals. For example, "fluosilicates" (or silicofluorides, as some may prefer) is the general name for the double fluorides of  $\text{SiF}_4$  and a metal, but this unanimity in usage gradually disappears as the basic elements become more nearly alike, so that it is impossible to draw a line between such compounds and a compound such as the double chloride of magnesium and potassium, for which indeed the name "potassium chloromagnesate" has been proposed. The aim has been in all these cases to follow the best usage rather than make an absolutely homogeneous system of nomenclature out of the existing confusion.

In the matter of formulæ no attempt at uniformity has been made. Thus in the case above some chemists write the formula of the double chloride of magnesium and potassium as  $\text{KMgCl}_2$ , others as  $\text{KCl, MgCl}_2$ . The form here used has been in most cases that of the author from whom the data are taken.

The prefixes mono, di, tri, ortho, pyro, etc., have in general been disregarded in the alphabetical arrangement, and have been printed in italics. Exceptions to this have been made, however, in the cobalt, chromium, etc., ammonium compounds, and in a few others, as dithionic, perchloric, etc., acids. Cross references have been used, so as to prevent any confusion arising from lack of uniformity in this respect.

In the Appendix will be found formulæ and tables for the conversion of the degrees of various hydrometer scales into specific gravity, and a Synchronistic Table of the Periodicals to which references are most frequently made.



## ABBREVIATIONS

abs.—absolute.  
 atmos —atmosphere.  
 b.-pt.—boiling-point.  
 comp.—compound.  
 conc.—concentrated.  
 corr.—corrected.  
 cryst.—crystallized, crystalline  
 decomp —decompose, decomposes,  
       decomposition, etc.  
 dil —dilute.  
 eutec.—eutectic.  
 insol.—insoluble.  
 M.—a univalent Metal.  
 Min.—Mineral.  
 mol.—molecule.

m.-pt.—melting-point.  
 ord.—ordinary.  
 n.—normal.  
 ppt., pptd., etc.—precipitate, pre-  
       cipitated, etc.  
 pt.—part.  
 sat —saturated.  
 sl.—slightly.  
 sol.—soluble.  
 sp. gr.—specific gravity.  
 supersat.—supersaturated.  
 t° = temperature in Centigrade degrees.  
 temp.—temperature.  
 tr. pt.—transition point.  
 vol.—volume.



## ABBREVIATIONS OF REFERENCES

- A.—*Annalen der Pharmacie*, edited by Liebig and others, 1832-39; continued as *Annalen der Chemie und Pharmacie*, 1840-73; continued as Justus Liebig's *Annalen der Chemie*, 1874-1915+. 403 vols.
- A. ch.—*Annales de Chimie et de Physique*. Paris. 1st series, 1789-1816, 96 vols.; 2nd series, 1817-40, 78 vols.; 3rd series, 1841-63, 69 vols.; 4th series, 1864-73, 30 vols.; 5th series, 1874-83, 30 vols.; 6th series, 1884-93, 30 vols.; 7th series, 1893-1903, 30 vols.; 8th series, 1904-13, 30 vols.; 9th series, 1914+, 3 vols.
- Acta Lund.—*Acta Universitatis Lundensis*, or *Lunda Universitets Års-akrift*. Lund, 1864+.
- Am. Chemist.—*The American Chemist*. New York, 1870-77. 7 vols.
- Am. Ch. J.—*The American Chemical Journal*, edited by Remsen. Baltimore, 1879-1913. 50 vols.
- Am. J. Sci.—*American Journal of Science and Arts*, edited by Silliman, Dana, and others. New Haven. 1st series, 1818-45, 50 vols.; 2nd series, 1846-70, 50 vols.; 3rd series, 1871-95, 50 vols.; 4th series, 1896-1915+, 40 vols. Also numbered consecutively, 190 vols.
- Analyst.—*The Analyst*. London, 1876-1915+. 45 vols.
- Ann. chim. farm.—*Annali di chimica e di farmacologia*. Milan, 1886-90. 5 vols.
- Ann. des Mines.—*Sec Ann. Min*.
- Ann. Min.—*Annales des Mines*. Paris.
- Ann. Phil.—*Annals of Philosophy*. London. 1st series, 1813-20, 16 vols.; new series, 1821-26, 12 vols.
- Ann. Phys.—See Pogg and W. Ann.
- Apoth. Z.—*Apotheker-Zeitung*. Berlin.
- Arb. Kais. Gesundheitsamt.—*Arbeiten aus dem Kaiserlichen Gesundheitsamte*.
- Arch. Néer. Sc.—*Archives Néerlandaises des Sciences exactes et naturelles*.
- Arch. Pharm.—*Archiv der Pharmacie*, continued from *Archiv des Apothekervereins in Norddeutschland*, which forms the 1st series. 1st series, 1822-34, 50 vols.; 2nd series, 1835-72, 150 vols.; 3rd series, 1873-94+, 32 vols. Also numbered consecutively, which system is exclusively used after 3rd series, vol. 253 (1915).
- Arch. sc. Phys. nat.—*Archives des sciences physiques et naturelles de la Bibliothèque universelle de Genève*.
- A. Suppl.—*Annalen der Chemie und Pharmacie Supplement-Bande*. Vol. i. 1861; vol. ii, 1862-63; vol. iii. 1864-65; vol. iv. 1865-66; vol. v. 1867, vol. vi. 1868; vol. vii. 1870; vol. viii. 1872.
- B.—*Berichte der deutschen chemischen Gesellschaft*. Berlin, 1868-1915+. 48 vols.
- Att. Acc. Linc.—*Atti della reale accademia dei Lincei, rendiconti, etc.*
- B. A. B.—*Sitzungsberichte der königlichen preussischen Akademie der Wissenschaften zu Berlin*.
- Belg. Acad. Bull.—*Bulletin de l'Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique*.
- Berz J. B.—*Jahresbericht über die Fortschritte der physischen Wissenschaften*, edited by Berzelius. 1822-47. 30 vols.
- Br. Arch.—*Archiv des Apothekervereins im nördlichen Teutschland, etc.*, edited by Brandes. 1st series, 1822-31, 39 vols., corresponds to 1st series of Arch. Pharm.
- Bull. Acad. Crac.—*Bulletin international de l'Académie des Sciences de Cracovie*.
- Bull. Ac. St. Pétersb.—*Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg*.
- Bull. Soc.—*Bulletin des Séances de la Société chimique de Paris*. 2nd series, 1864-88, 50 vols.; 3rd series, 1889-1906, 36 vols.; 4th series, 1907-15+, 18 vols.
- Bull. Soc. chim. Belg.—*Bulletin de la Société chimique Belgique*.
- Bull. Soc. ind. Mulhouse.—*Bulletin de la Société industrielle de Mulhouse*. 1828-49. 22 vols.
- Bull. Soc. Min.—*Bulletin de la société française de Minéralogie*. 1878-1915+. 37 vols.
- C. A.—*Chemical Abstracts*. American Chemical Society. New York.
- C. C.—*Chemisches Centralblatt*, continued from *Pharmaceutisches Centralblatt*.
- C. B. Miner.—*Centralblatt für Mineralogie, Geologie und Paläontologie*. Berlin.
- Chem. Ind.—*Die Chemische Industrie*, edited by Jacobsen. Berlin.
- Chem. Soc.—*Journal of the Chemical Society of London*. 1st series, 1849-62, 15 vols.; 2nd series, 1863-78, 17 vols.; new series, 1878-1915+. The vols. are numbered consecutively, from 1849. 1878 = vol. 32. Total, 108 vols.

- Chem.-tech. Centr.-Anz.—Chemisch-technischer Central-Anzeiger.  
 Chem. Weekbl.—Chemiker Weekblad  
 Chem. Z.—See Ch. Z.  
 Chem. Zeitschr.—Chemische Zeitschrift.  
 Ch. Gaz.—The Chemical Gazette. London, 1843-59. 17 vols.  
 Ch. Kal.—Chemiker Kalender, edited by Biedermann.  
 Ch. Z.—Chemiker Zeitung.  
 Ch. Z. Repert.—Chemisches Repertorium Beiblatt zur Chemiker-Zeitung. Göttingen.  
 Cim.—Il Cimento. Turin, 1852-54. 6 vols.  
 C. N.—The Chemical News. London, 1860-1915+. 112 vols.  
 Comm.—Commentar zur Pharmacopoea germanica by Hager. Berlin, 1883.  
 Compt. chim.—Comptes-rendus mensuels des Travaux chimiques, edited by Laurent and Gerhardt. 1845-51. 7 vols.  
 C. R.—Comptes-rendus hebdomadaires des Séances de l'Académie des Sciences. Paris, 1835-1915+. 161 vols.  
 Crell. Ann.—Chemische Annalen für die Freunde der Naturlehre, etc., edited by Crell. 1784-1803. 40 vols.  
 Dansk Vid. For.—Oversigt over det kgl. danske Videnskabernes Selskabs Forhandlinger. Copenhagen.  
 Dingl.—Dingler's Polytechnisches Journal, edited by Dingler and others. 1820-1915+. 330 vols.  
 Edinb. Trans.—Transactions of the Royal Society of Edinburgh. 1788-1915+. 51 vols.  
 Ed. J. Sci.—The Edinburgh Journal of Science. 1st series, 1824-29, 10 vols.; 2nd series, 1829-32, 6 vols. Continued as Phil. Mag.  
 Electrochem. Ind.—Electrochemical Industry (Oct., 1902, to Dec., 1904) later Electrochemical and Metallurgical Industry. New York.  
 Elektrochem. Z.—Elektrochemische Zeitschrift. Berlin.  
 Eng. Min. J.—The Engineering and Mining Journal. New York.  
 Gazz. ch. it.—Gazzetta chimica italiana. Palermo, 1871-1915+. 45 vols.  
 Gilb. Ann.—Annalen der Physik, edited by Gilbert. 1st series, 1799-1808, 30 vols.; 2nd series, 1809-18, 30 vols.; 3rd series, 1819-24, 26 vols. Also numbered consecutively. 76 vols. Continued as Pogg.  
 Gm.-K.—Gmelin-Kraut's Handbuch der anorganischen Chemie, 6te Auflage. 1877-1905. 7te Auflage, 1907-1915+.  
 Gr.-Ot.—Graham-Otto's ausführliches Lehrbuch der anorganischen Chemie, 5te Auflage, by Michaels. 1878-89.  
 Jahrb. Miner.—Jahrbuch für Mineralogie, Geologie und Palaeozoologie. Heidelberg. 1830-1832. Then. Neues Jahrbuch für Mineralogie. Stuttgart.  
 Jahrb. d. Pharm.—Jahresbericht der Pharmacie.  
 J. Am. Chem. Soc.—Journal of the American Chemical Society. New York, 1876-1915+. 37 vols.  
 J. Anal. Appl. Ch.—The Journal of Analytical and Applied Chemistry, edited by Hart. 1887-93. 7 vols.  
 J. B.—Jahresbericht über die Fortschritte der Chemie, u. s. w.  
 J. Chim. méd.—Journal de Chimie médicale, de Pharmacie, et de Toxicologie. 1st series, 1825-34, 10 vols.; 2nd series, 1835-44, 10 vols.; 3rd series, 1845-54, 10 vols.; 4th series, 1855-64, 10 vols.; 5th series, 1865-76. 12 vols.  
 Jena. Zeit.—Jenaische Zeitschrift für Medicin und Naturwissenschaften.  
 J. Pharm.—Journal de Pharmacie et de Chimie. Paris. 2nd series, 1815-41, 27 vols.; 3rd series, 1842-64, 46 vols.; 4th series, 1865-79, 30 vols.; 5th series, 1879-94; 6th series, 1895-1909, 30 vols.; 7th series, 1910-15+, 10 vols.  
 J. Phys.—Journal der Physik, edited by Gren. 1790-98. 12 vols. Continued as Gilb. Ann.  
 J. Phys. Ch.—The Journal of Physical Chemistry. Ithaca, N. Y.  
 J. pr.—Journal für praktische Chemie, edited by Erdmann, Kolbe, and v. Meyer. Leipzig. 1st series, 1834-69, 108 vols.; 2nd series, 1870-1915+. 92 vols.  
 J. russ. phys. Chem. Soc.—Journal de la Société physico-chimique russe. St. Pétersbourg.  
 J. Russ. Soc.—Journal of the Russian Chemical Society. St. Petersburg, 1869-1915+. 47 vols.  
 J. Soc. Chem. Ind.—Journal of the Society of Chemical Industry. London, 1882-1915+. 34 vols.  
 J. S. C. I.—See above.  
 J. Tok. Chem. Soc.—Journal of the Tokyo Chemical Society.  
 Kastn. Arch.—Archiv für die gesammte Naturlehre, edited by Kastner. Nuremberg, 1824-35. 25 vols.  
 Listy Chemické.—Listy Chemické, edited by Preis and others. Prague.  
 Lond. R. Soc. Proc.—See Roy. Soc. Proc.  
 Lund. Univ. Arsk.—Lunds Universitets Års-skrift. Lund.

- M.—*Monatshefte für Chemie und verwandter Theile der anderer Wissenschaften* Vienna, 1880-1915+. 36 vols
- M. A. B.—*Sitzungsberichte der mathematisch-physikalischen Classe der kgl. bayerischen Akademie der Wissenschaften zu München*
- Mag. Pharm.—*Magazin der Pharmacie* 1823-31 36 vols.
- Mém. Acad. St Pétersb.—*Mémoires de l'Académie Impériale des Sciences de Saint-Pétersbourg*
- M. Ch.—See M.
- Mém. Coll. Sci. Kyoto.—*Memoirs of the College of Science, Kyoto.*
- Metall.—*Metallurgie.* Halle.
- Miner. Jahrb.—*Neues Jahrbuch für Mineralogie, etc* 1833-73. 40 vols.
- Miner. Mag.—*Mineralogical Magazine* London.
- Miner. Mitt.—*Mineralogische und petrographische Mitteilungen.* Wien
- Monit. Scient.—*Le Moniteur Scientifique*, edited by Quenesville Paris.
- N. Arch. Sc. ph. nat.—*Nouvelles Archives des Sciences physiques et naturelles* Geneva.
- N. Cim.—*Il nuovo Cimento* Pisa, 1855-61 14 vols.
- N. Edinb. Phil. J.—*New Edinburgh Philosophical Journal.* 1819-64. 90 vols.
- N. Jahrb. Miner.—*Neues Jahrbuch für Mineralogie.* Stuttgart.
- N. Jahrb. Pharm.—*Neues Jahrbuch der Pharmacie* 1796-1840. 42 vols
- N. J. Pharm.—*Neues Journal der Pharmacie für Aerzte, etc*, edited by Trommedorff. 1817-34. 27 vols.
- N. Rep. Pharm.—*Neues Repertorium für Pharmacie* 1852-76. 25 vols
- Pharm. Centralbl.—*Pharmaceutisches Centralblatt* 1830-49. 20 vols. Continued as C. C.
- Pharm. Era.—*Pharmaceutical Era.*
- Pharm. J. Trans.—*Pharmaceutical Journal and Transactions.*
- Pharm. Post.—*Pharmaceutische Post* Wien
- Pharm. Vierteljb.—*Pharmaceutische Vierteljahresberichte*
- Pharm. Weekbl.—*Pharmaceutisches Weekblad.*
- Pharm. Ztg.—*Pharmaceutische Zeitung*
- Phil. Mag.—*The Philosophical Magazine.* London 1st series, 1814-26, 26 vols.; 2nd series, 1827-32, 11 vols.; 3rd series, 1832-50, 37 vols.; 4th series, 1851-75, 50 vols.; 5th series, 1876-1900, 60 vols.; 6th series, 1901-1915+, 30 vols.
- Phil. Mag. Ann.—*The Philosophical Magazine and Annals of Chemistry, etc.* Corresponds to Phil. Mag. 2nd series.
- Phil. Trans.—*The Philosophical Transactions of the Royal Society of London.* 1665-1915+.
- Phys. Rev.—*The Physical Review.*
- Pogg.—*Annalen der Physik und Chemie*, edited by Poggendorf. 1st series, 1824-43, 60 vols.; 2nd series, 1844-53, 30 vols.; 3rd series, 1854-63, 30 vols.; 4th series, 1864-73, 30 vols.; 5th series, 1874-77, 10 vols. Continued as W. Ann.
- Polyt. Centralbl.—*Polytechnisches Centralblatt.* 1st series, 1835-46, 12 vols.; 2nd series, 1847-73, 30 vols
- Proc. Am. A. A. S.—*Proceedings of the American Association for the Advancement of Science.*
- Proc. Am. Acad.—*Proceedings of the American Academy of Arts and Sciences.* Boston, 1846-1915+. 50 vols.
- Proc. Am. Phil. Soc.—*Proceedings of the American Philosophical Society.* Philadelphia.
- Proc. Chem. Soc.—*Proceedings of the Chemical Society of London.*
- Proc. K. Akad. Wet.—See Ver. K. Akad. Wet.
- Proc. Soc. Manchester.—*Proceedings of the Literary and Philosophical Society of Manchester*
- Proc. Roy. Soc.—See Roy. Soc. Proc.
- Q. J. Sci.—*Quarterly Journal of Science.* London, 1816-26. 22 vols.
- Rass. Min.—*Rassegna mineraria, metallurgica e chimica.*
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A DICTIONARY OF CHEMICAL SOLUBILITIES  
INORGANIC



# DICTIONARY

OF

## CHEMICAL SOLUBILITIES

### INORGANIC

#### Actinium emanation.

Solubility coefficient of actinium emanation in  $H_2O$  at room temp. is 2.

If the solubility of actinium emanation in  $H_2O$  is made = 1, the relative solubility of the emanation in sat.  $KCl$ - $Aq$  = 0.9; in conc.  $H_2SO_4$  = 0.95; in ethyl alcohol = 1.1, in amyl alcohol = 1.6; in benzaldehyde = 1.7; in benzene = 1.8; in toluene = 1.8, in petroleum = 1.9; in  $CS_2$  = 2.1 at 18°.

(Hevesy, Phys. Zeit. 1911, 12, 1221.)

#### Air, Atmospheric.

See also Nitrogen and Oxygen.

100 vols  $H_2O$  at 15° and 760 mm. absorb about 5 vols atmospheric air (Saussure)

1 vol.  $H_2O$  at t° and 760 mm. pressure absorbs V vols atmospheric air reduced to 760 mm. and 0°

t°	V	t°	V	t°	V
0	0.02471	7	0.02080	14	0.01822
1	0.02408	8	0.02084	15	0.01795
2	0.02345	9	0.01992	16	0.01771
3	0.02287	10	0.01958	17	0.01750
4	0.02237	11	0.01916	18	0.01732
5	0.02179	12	0.01882	19	0.01717
6	0.02128	13	0.01851	20	0.01701

(Bunsen's Gasometry.)

1 l.  $H_2O$  absorbs cc. N and O from air at t° and 760 mm. pressure

t°	cc. N	cc. O	cc. N+O
0	16.09	8.62	24.71
5	14.18	7.60	21.78
10	12.70	6.79	19.49
15	11.67	6.26	17.92
20	11.08	5.93	17.01

(Bunsen, Gasometr. Methoden, 2te Aufl. 209, 220.)

1 l.  $H_2O$  absorbs cc. N and O from air at t° and 760 mm. pressure (dry).

t°	cc. N	cc. O	N+O	%O
10	15.47	7.87	23.34	33.74
15	13.83	7.09	20.92	33.86
20	12.76	6.44	19.20	33.55
25	11.78	5.91	17.69	33.40

(Roscoe and Lunt, Chem. Soc. 55, 568.)

1 l.  $H_2O$  absorbs cc. N and O from air at t° and 760 mm.

t°	cc. N	cc. O	%O
0	19.53	10.01	33.88
6.0	16.34	8.28	33.60
6.32	16.60	8.39	33.35
9.18	15.58	7.90	33.60
13.70	14.16	7.14	33.51
14.10	14.16	7.05	33.24

(Pettersson and Söndén, B. 22, 1439.)

1 l.  $H_2O$  absorbs cc. N (0° and 760 mm.) from atmospheric air at t° and 760 mm. pressure (dry)

t°	cc. N	t°	cc. N	t°	cc. N
0	19.14	10	15.14	20	12.63
2	18.20	12	14.53	22	12.27
4	17.34	14	13.98	24	11.95
6	16.54	16	13.48	25	11.81
8	15.81	18	13.03		

(Hamburg, J. pr. (2) 33, 447.)

1 l.  $H_2O$  absorbs cc. N from air at t° and 760 mm. pressure.

t°	cc. N	t°	cc. N	t°	cc. N
0	19.29	10	15.36	20	12.80
5	17.09	15	13.95	25	11.81

(Dittmar, Challenger Expedition, vol. 1, pt. 1.)

1 l. H<sub>2</sub>O sat. with air at t° and 760 mm. contains cc. O (red. to 0° and 760 mm.)

t°	cc. O	t°	cc. O	t°	cc. O
0	10.187	11	7.692	22	6.114
1	9.910	12	7.518	23	5.999
2	9.643	13	7.352	24	5.886
3	9.387	14	7.192	25	5.776
4	9.142	15	7.038	26	5.669
5	8.907	16	6.891	27	5.564
6	8.682	17	6.730	28	5.460
7	8.467	18	6.614	29	5.357
8	8.260	19	6.482	30	5.255
9	8.063	20	6.356		
10	7.873	21	6.233		

(Winkler, B. 22. 1773)

1 vol. H<sub>2</sub>O absorbs 0.01748 vol. air at 24.05° and 760 mm. pressure (Winkler, B. 21. 2861.)

Composition of the absorbed air between 0° and 24° is 34.91% O and 65.09% N (Bunsen); between 15° and 16°, 32.17% O and 67.83% N (König and Kranch, Z. anal. 19. 259); 32% O and 68% N (Regnault), at 0°, 35.1% O; 10°, 34.8% O, 20°, 34.3% O, 25°, 33.7% O (Winkler, B. 21. 2483). See also Roscoe and Lunt, and Pettersson and Söndén, page 1.

Solubility of atmos. oxygen and nitrogen in 1000 cc. H<sub>2</sub>O at 760 mm. pressure (calc.).

Temp	Oxygen	Nitrogen	Temp	Oxygen	Nitrogen
t°	cc.	cc.	t°	cc.	cc.
0°	10.19	18.45	20°	5.33	10.30
1	9.91	17.99	30	5.24	10.15
2	9.64	17.55	31	5.15	9.99
3	9.39	17.12	32	5.07	9.83
4	9.14	16.71	33	4.99	9.67
5	8.91	16.30	34	4.91	9.52
6	8.68	15.91	35	4.83	9.37
7	8.47	15.54	36	4.76	9.22
8	8.26	15.18	37	4.69	9.08
9	8.06	14.83	38	4.62	8.94
10	7.87	14.50	39	4.55	8.81
11	7.69	14.19	40	4.48	8.67
12	7.52	13.89	41	4.42	8.55
13	7.35	13.61	42	4.35	8.43
14	7.19	13.33	43	4.28	8.31
15	7.04	13.07	44	4.22	8.20
16	6.89	12.83	45	4.15	8.09
17	6.75	12.57	46	4.09	7.97
18	6.61	12.34	47	4.03	7.87
19	6.48	12.12	48	3.97	7.76
20	6.35	11.91	49	3.91	7.65
21	6.23	11.71	50	3.85	7.55
22	6.10	11.52	51	3.79	7.45
23	5.98	11.33	52	3.74	7.34
24	5.86	11.14	53	3.68	7.24
25	5.75	10.96	54	3.62	7.13
26	5.64	10.79	55	3.56	7.03
27	5.54	10.62	56	3.51	6.92
28	5.43	10.46	57	3.45	6.81

Solubility of atmos etc.—Continued

Temp	Oxygen	Nitrogen	Temp	Oxygen	Nitrogen
t°	cc	cc	t°	cc	cc
58°	3.39	6.71	80°	1.97	4.03
59	3.34	6.60	81	1.89	3.88
60	3.28	6.50	82	1.81	3.73
61	3.22	6.39	83	1.73	3.57
62	3.16	6.27	84	1.65	3.41
63	3.10	6.16	85	1.57	3.24
64	3.04	6.05	86	1.48	3.07
65	2.98	5.94	87	1.39	2.89
66	2.92	5.82	88	1.30	2.71
67	2.85	5.70	89	1.21	2.52
68	2.79	5.59	90	1.11	2.32
69	2.73	5.47	91	1.02	2.12
70	2.66	5.35	92	0.92	1.91
71	2.60	5.23	93	0.81	1.70
72	2.53	5.10	94	0.71	1.48
73	2.47	4.98	95	0.60	1.25
74	2.40	4.85	96	0.48	1.01
75	2.33	4.72	97	0.37	0.77
76	2.26	4.59	98	0.27	0.52
77	2.19	4.45	99	0.13	0.27
78	2.12	4.32	100	0.00	0.00
79	2.04	4.18			

(Winkler, B. 1901, 34. 1440)

Absorption of atmospheric air by H<sub>2</sub>O at t° and 760 mm. pressure.  $\beta$  = coefficient of absorption.  $\beta_1$  = "Solubility." (See under oxygen.)

t°	$\beta$	$\beta_1$	t°	$\beta$	$\beta_1$
0	0.02881	0.02864	55	0.01259	0.01059
5	2543	2521	60	1216	0978
10	2264	2237	65	1182	0892
15	2045	2011	70	1156	0801
20	1869	1826	75	1137	0705
25	1724	1671	80	1126	0600
30	1606	1539	85	1119	0481
35	1503	1420	90	1113	0343
40	1418	1315	95	1109	0185
45	1351	1224	100	1105	0000
50	1297	1140			

(Winkler, B. 1901, 34. 1409.)

Sea-water absorbs less O and N from air than pure H<sub>2</sub>O, but the ratio between O and N remains constant. In sea-water sat. with air at 6.22° the oxygen was 33.50% of the total gas absorbed. (Pettersson and Söndén.)

1 l. sea-water absorbs cc N and O from air at t° and 760 mm. pressure.

t°	cc N	cc O	N+O	% O
0	14.41	7.77	22.18	35.03
5	13.22	6.93	20.15	34.39
10	12.08	6.29	18.37	34.24
15	11.01	5.70	16.71	34.11

(Törnø, Norwegian North Atlantic Exped. Chem. 18.)

1 l. sea water absorbs cc N from air at  $t^{\circ}$  and 760 mm

$t^{\circ}$	cc N	$t^{\circ}$	cc N	$t^{\circ}$	cc N
0	15.60	10	12.47	20	10.41
5	13.86	15	11.34	25	9.62

(Dittmar)

1 l sea-water absorbs cc N ( $0^{\circ}$  and 760 mm) from atmospheric air at  $t^{\circ}$  and 760 mm. pressure (dry)

$t^{\circ}$	cc N	$t^{\circ}$	cc N	$t^{\circ}$	cc N
0	14.85	10	12.06	20	10.25
2	14.20	12	11.62	22	9.98
4	13.60	14	11.23	24	9.73
6	13.04	16	10.87	25	9.62
8	12.53	18	10.54		

(Hamburg.)

Absorption of air which is free from carbonic acid by  $H_2SO_4$  at  $18^{\circ}$  and 760 mm.  $\alpha$  = coefficient of solubility

$H_2SO_4$	$\alpha$	$H_2SO_4$	$\alpha$
98%	0.0173	70%	0.0055
90%	0.0107	60%	0.0059
80%	0.0069	50%	0.0076

(Tower, Z. anorg. 1906, 50, 388.)

Absolute alcohol absorbs 0.11 vol. gas from air,  $\frac{1}{2}$  of which is O and  $\frac{1}{2}$  N. On mixing with an equal vol.  $H_2O$ ,  $\frac{1}{2}$  of the dissolved gas is given off. (Doberiner)  
100 vols. alcohol (95.1 %) absorb 14.1 vols. air. (Robinet, C. R. 88, 608)  
100 vols. petroleum absorb 6.8 vols. air  
" " oil of lavender " 8.89 " "  
" " benzene " 14.0 " "  
" " oil of turpentine " 24.18 " "  
(Robinet, Lc.)

1 vol. ether at 760 mm. pressure absorbs 0.290 vols. air at  $0^{\circ}$ ; 0.287 vols. at  $10^{\circ}$ ; 0.286 vols. at  $15^{\circ}$ . (Christoff, Z. phys. Ch. 1912, 79, 459.)

**Alcohol.**  $C_2H_5OH$ .

Sp. gr. of pure ethyl alcohol + Aq. at  $25^{\circ}$ .

% alcohol	Sp. gr.	% alcohol	Sp. gr.
0	0.997077	55	0.898502
2	0.993359	60	0.886990
5	0.988166	65	0.875269
6	0.986563	70	0.863399
10	0.980434	75	0.851336
15	0.973345	80	0.839114
20	0.966392	85	0.826596
25	0.958946	90	0.813622
30	0.950672	95	0.799912
35	0.941459	98	0.791170
40	0.931483	99	0.788135
45	0.920850	100	0.785058
50	0.909852	—	—

(Osborne, McKelvy and Pearce, Bureau of Standards, Sci. Paper No. 197.)

**Alum, Ammonia.**

See Sulphate, aluminum ammonium.

**Alum, Chrome.**

See Sulphate, aluminum chromium.

**Alum, Iron.**

See Sulphate, aluminum ferric.

**Alum, Potash.**

See Sulphate, aluminum potassium.

**Alumina.**

See Aluminum oxide.

**Alumic acid,**  $H_2Al_2O_4 = Al_2O_3, H_2O$ .

Aluminum hydroxide possesses acid properties, and salts corresponding to an acid of the above formula exist.

See Aluminum hydroxide.

**Aluminates.**

All aluminates are insol. in  $H_2O$  except those of K and Na (Fremy) and Ba (Beckmann, J. pr. (2) 26, 385)

**Barium aluminate,**  $BaAl_2O_4 + 4H_2O$ .

Sol. in 10 pts  $H_2O$ , can be recryst. from alcohol. (Deville, J. pr. 87, 299.)

+  $5H_2O$ . Sl. sol. in  $H_2O$  with decomp. (Allen, Am. Ch. J. 1900, 24, 313)

+  $7H_2O$ . Sl. sol. in cold, not completely sol. in hot  $H_2O$ . Sol. in cold dil. HCl + Aq (Beckmann, J. pr. (2) 26, 385.)

$Ba_2Al_2O_5 + 7H_2O$ . Sol. in 20 pts.  $H_2O$  by boiling. (Beckmann, B. 14, 2151.)

Insol. in alcohol

Sl. sol. in  $H_2O$  with decomp.; insol. in alcohol. (Allen, Am. Ch. J. 1900, 24, 311)

$Ba_2Al_2O_5 + 7 - 11H_2O$ . Sol. in 15 pts.  $H_2O$  with decomp. into  $Ba_2Al_2O_5 + 5H_2O$ , insol. in alcohol. (Beckmann)

**Barium aluminate bromide,**  $BaAl_2O_4, BaBr_2 + 11H_2O$ .

Sol. in  $H_2O$  (Beckmann, J. pr. (2) 26, 385, 474)

**Barium aluminate chloride,**  $BaAl_2O_4, 3BaCl_2 + 6H_2O$ .

Sol. in  $H_2O$ . (Beckmann, l.c.)

$Ba_2Al_2O_5, BaCl_2 + 11H_2O$ . Sol. in  $H_2O$ . (Beckmann, l.c.)

**Barium aluminate iodide,**  $BaAl_2O_4, BaI_2$ .

Sol. in  $H_2O$ . (Beckmann, l.c.)

**Calcium aluminate,**  $CaO, Al_2O_3$ .

Decomp. by  $H_2O$  but does not "set." Sol. in HCl; insol. in  $HNO_3$ ,  $H_2SO_4$ , and HF. (Dufau, C. R. 1900, 131, 543.)

$Ca_2Al_2O_5 + 7H_2O$ . Slowly decomp. by  $H_2O$ ; sl. sol. in  $H_2O$ . (Allen, Am. Ch. J. 1900, 24, 316.)

$Ca_2Al_2O_5$ . Insol. in  $H_2O$ ; not decomp. by KOH + Aq; sol. in acids. (Tissier, C. R. 48, 627.)

+6H<sub>2</sub>O. Ppt. sl. sol. in H<sub>2</sub>O; insol. in alcohol (Allen, Am. Ch. J. 1900, 24, 316.)

3Al<sub>2</sub>O<sub>3</sub>·4CaO+3H<sub>2</sub>O. Ppt. (Friedel, Bull. Soc. Min. 1903, 26, 121; C. C. 1904, I, 430.)

**Cobalt aluminate.**

"*Thenard's* or "*Leuthner's* blue." Insol. in H<sub>2</sub>O.

CoAl<sub>2</sub>O<sub>4</sub>. Insol. in H<sub>2</sub>O and acids. (Ebelmen.)

**Cobalt magnesium aluminate, [MgCo]Al<sub>2</sub>O<sub>4</sub>.**

"*Spinel Blue*" Insol. in H<sub>2</sub>O or HCl+Aq. (Ebelmen.)

**Glucinum aluminate, GlAl<sub>2</sub>O<sub>4</sub>.**

Min. *Chrysoberyll*. Not attacked by acids, but decomp. by KOH+Aq.

**Iron (ferrous) aluminate, FeAl<sub>2</sub>O<sub>4</sub>.**

Min. *Hercynite*. Not attacked by acids.

**Lithium aluminate, LiAlO<sub>2</sub>.**

Sol. in H<sub>2</sub>O (Weyberg, C. C. 1906, II, 1659.)

**Lithium hydrogen aluminate, LiHAl<sub>2</sub>O<sub>4</sub>+5H<sub>2</sub>O**

Sl. sol. in H<sub>2</sub>O; decomp. on boiling (Allen, Am. Ch. J. 1900, 24, 310.)

**Magnesium aluminate, MgAl<sub>2</sub>O<sub>4</sub>.**

Min. *Spinel*. Insol. in H<sub>2</sub>O.

Insol. in HNO<sub>3</sub>+Aq; very sl. sol. in HCl+Aq; partly sol. in H<sub>2</sub>SO<sub>4</sub> at boiling temp. (Abich, Pogg. 23, 316.)

Sol. by standing 2 hours at 210° with a mixture of 3 pts H<sub>2</sub>SO<sub>4</sub> and 1 pt. H<sub>2</sub>O, or by boiling with this mixture together with HF. (Mitscherlich, J. pr. 81, 108.)

Sl. sol. in HCl, HF, and H<sub>2</sub>SO<sub>4</sub>; insol. in HNO<sub>3</sub>. (Dufau, Bull. Soc. 1901, (3) 25, 669.)

**Manganous aluminate.**

Insol. in H<sub>2</sub>O and acids. (Ebelmen, A. ch. (3) 22, 225.)

MnAl<sub>2</sub>O<sub>4</sub>. Insol. in HCl+Aq; readily attacked by HF, HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>.

Decomp. by fusion with alkali chlorate, nitrate, oxide or carbonate. (Dufau, C. R. 1902, 135, 963.)

**Nickel aluminate.**

Insol. in H<sub>2</sub>O.

**Potassium aluminate, K<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>+3H<sub>2</sub>O.**

Decomp. by dissolving in pure H<sub>2</sub>O with separation of Al<sub>2</sub>O<sub>3</sub>. (Freymy, A. ch. (3), 12, 362.) Can be recrystallised from water containing a little alkali, without decomposition. (Freymy.)

Insol. in alcohol.

**Sodium aluminate, Na<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>.**

Easily and completely sol. in cold H<sub>2</sub>O. (Schaffgotsch, Pogg. 43, 117.)

+4H<sub>2</sub>O. Insol. in alcohol. (Allen, Am. Ch. J. 1900, 24, 308.)

Na<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>. Miscible with hot H<sub>2</sub>O, and as sol. as NaOH in cold H<sub>2</sub>O. Insol. in alcohol but decomp. thereby. (Tissier, C. R. 43, 102.)

**Strontium aluminate, Sr<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>+6H<sub>2</sub>O.**

Sl. sol. in H<sub>2</sub>O (with slow decomp. in Aq. solution) (Allen, Am. Ch. J. 1900, 24, 314.)

**Thallium aluminate, Tl<sub>4</sub>Al<sub>2</sub>O<sub>4</sub>+7H<sub>2</sub>O.**

Not completely sol. in, but slowly hydrolysed by H<sub>2</sub>O.

Readily sol. in dil. acids and in the fixed alkalies.

Insol. in abs. alcohol. (Hawley, J. Am. Chem. Soc. 1907, 29, 303.)

**Zinc aluminate, ZnAl<sub>2</sub>O<sub>4</sub>.**

Insol. in acids or alkalies.

Min. *Gahnite* (*Automolite*).

+xH<sub>2</sub>O. Sol. in KOH, and NH<sub>4</sub>OH+Aq. (Berzelius.)

**Aluminicoantimoniotungstic acid.**

**Ammonium aluminicoantimoniotungstate,**  
6(NH<sub>4</sub>)<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 3Sb<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+17H<sub>2</sub>O

A shellac-like gum. (Daniels, J. Am. Chem. Soc. 1908, 30, 1856.)

**Barium aluminicoantimoniotungstate, 5BaO,**  
2Al<sub>2</sub>O<sub>3</sub>, 3Sb<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+6H<sub>2</sub>O.

Somewhat insol. in dil. HCl. (Daniels, J. Am. Chem. Soc. 1908, 30, 1857.)

**Silver aluminicoantimoniotungstate, 6Ag<sub>2</sub>O,**  
2Al<sub>2</sub>O<sub>3</sub>, 3Sb<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+12H<sub>2</sub>O

Ppt.

Sol. in NH<sub>4</sub>OH+Aq but requires HNO<sub>3</sub> (1:10) to dissolve it (Daniels, J. Am. Chem. Soc. 1908, 30, 1857.)

**Aluminicoarseniotungstic acid.**

**Ammonium aluminicoarseniotungstate,**  
6(NH<sub>4</sub>)<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 3As<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+14H<sub>2</sub>O.

Sparsely sol. in H<sub>2</sub>O. (Daniels, J. Am. Chem. Soc. 1908, 30, 1854.)

**Barium aluminicoarseniotungstate, 4BaO,**  
2Al<sub>2</sub>O<sub>3</sub>, 3As<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+12H<sub>2</sub>O.

Very sl. sol. in H<sub>2</sub>O.

Sol. in very dil. HCl or HNO<sub>3</sub>. (Daniels, J. Am. Chem. Soc. 1908, 30, 1855.)

**Cadmium aluminicoarseniotungstate, 4CdO,**  
2Al<sub>2</sub>O<sub>3</sub>, 3As<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+17H<sub>2</sub>O.

Sol. in dil. mineral acids and in strong NH<sub>4</sub>OH+Aq. (Daniels, J. Am. Chem. Soc. 1908, 30, 1855.)

**Aluminicomolybdic acid.**

**Ammonium aluminicomolybdate, 3(NH<sub>4</sub>)<sub>2</sub>O,**  
Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+19H<sub>2</sub>O.

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29, 696.)

+20H<sub>2</sub>O. More sol. in H<sub>2</sub>O than potassium

aluminicomolybdate (Struve, Bull. Acad. St. Petersb. 12. 147.)

+2H<sub>2</sub>O (Marekwal, Dissert. 1895.)

Barium aluminicomolybdate, 4BaO, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+14H<sub>2</sub>O

Ppt (Hall, J. Am. Chem. Soc. 1907, 29. 712.)

Lead aluminicomolybdate, 4PbO, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+21H<sub>2</sub>O.

Ppt (Hall, J. Am. Chem. Soc. 1907, 29. 712.)

Potassium aluminicomolybdate, 3K<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+20H<sub>2</sub>O.

1 pt. of the salt is sol in 40.67 pts. H<sub>2</sub>O at 17°. Very difficultly sol. in acids (Struve) H<sub>2</sub>Al(MoO<sub>4</sub>)<sub>3</sub>, 2KHMnO<sub>4</sub>. Sol in H<sub>2</sub>O. (Parmentier, C. R. 94. 1713.)

Silver aluminicomolybdate, 4Ag<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+16H<sub>2</sub>O.

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 712.)

Sodium aluminicomolybdate, 3Na<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+22H<sub>2</sub>O.

Efflorescent. Easily sol. in H<sub>2</sub>O (Gentile J. pr 81. 413)

### Aluminicophosphotungstic acid.

Ammonium aluminicophosphotungstate, 9(NH<sub>4</sub>)<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+13H<sub>2</sub>O.

Sl. sol. in cold and in hot H<sub>2</sub>O. (Daniels, J. Am. Chem. Soc. 1908, 30. 1851)

Barium aluminicophosphotungstate, 4BaO, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+13H<sub>2</sub>O.

Sl. sol. in H<sub>2</sub>O. Sol. in very dil. HCl or HNO<sub>3</sub>. (Daniels, J. Am. Chem. Soc. 1908, 30. 1853)

Silver aluminicophosphotungstate, 4Ag<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+6H<sub>2</sub>O.

Nearly insol. in H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH and in dil. HNO<sub>3</sub>. Insol. in acetic acid (Daniels, J. Am. Chem. Soc. 1908, 30. 1852.)

Zinc aluminicophosphotungstate, 5ZnO, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+11H<sub>2</sub>O.

Sol in dil. acids and in a large quantity of conc. ammonia when NH<sub>4</sub>Cl is present (Daniels, J. Am. Chem. Soc. 1908, 30. 1853.)

### Aluminicotungstic acid.

Ammonium aluminicotungstate, 3(NH<sub>4</sub>)<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+4H<sub>2</sub>O.

Sol in conc. HNO<sub>3</sub> and in conc. HCl. When the solution in conc. HCl was boiled, a yellow colored ppt separated. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1230)

Ammonium silver aluminicotungstate, 11Ag<sub>2</sub>O, 21(NH<sub>4</sub>)<sub>2</sub>O, 4Al<sub>2</sub>O<sub>3</sub>, 36WO<sub>3</sub>.

The dry salt is insol in pure H<sub>2</sub>O, but

readily sol. in H<sub>2</sub>O containing NH<sub>3</sub> or HNO<sub>3</sub> (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1231.)

Barium aluminicotungstate, 8BaO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+7H<sub>2</sub>O

Not sol in acids when dry. Somewhat decomposed by boiling with conc. HCl, HNO<sub>3</sub>, or aqua regia (Daniels, J. Am. Chem. Soc. 1908, 30. 1848.)

Copper aluminicotungstate, 2CuO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+16½H<sub>2</sub>O.

Sol in large quantities of H<sub>2</sub>O. (Daniels, J. Am. Chem. Soc. 1908, 30. 1847.)

Mercurous aluminicotungstate, 5Hg<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>.

Sl. sol. in H<sub>2</sub>O. Sol in HNO<sub>3</sub> (1.5) (Daniels, J. Am. Chem. Soc. 1908, 30. 1849)

Zinc aluminicotungstate, 1½ZnO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+8H<sub>2</sub>O.

Insol. in H<sub>2</sub>O. (Daniels, J. Am. Chem. Soc. 1908, 30. 1850.)

ZnO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+20H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Daniels.)

### Aluminum, Al

Less easily attacked than ordinary metals (iron, copper, lead, zinc, tin) by air, H<sub>2</sub>O, wine, beer, coffee, milk, oil, butter, fats, etc. Vinegar dissolves 0.349 g. from a sq. decimetre in 4 months, and 5 % NaCl+Ag, only 0.045 g. in the same time. (Ballaud, C. R. 114. 1536)

The action of various substances contained in foods and drinks on compact Al as it occurs in utensils is very slight. Hard or soft water, whether cold or hot, showed no action in 8 days; 1 % solutions of tartaric, tannic, and acetic acids had no action in same time, also 5 % boric, carbolic, and salicylic acids. 4 % and 10 % acetic acid dissolved only 0.4 mg. of Al, while 10 % acetic acid dissolved 2.1 mg. from a roughened piece of Al foil in 8 days. 1 % soda solution dissolved 15 mg. in 8 days. (Rupp, Dingl. 283. 119)

Similar results were obtained by Arche. (Dingl. 284. 255)

Liquids which are ordinarily contained in foods and drinks do not attack sheet Al except in a very small degree. The following losses in weight in mg. by the action of the given liquids on 100 sq. centimetres sheet aluminum for 6 days were obtained:

Liquids	Loss in mg
Claret	2.84
Hock	3.27
Brandy	1.08
5 % alcohol	0.61
5 % tartaric acid + Ag	1.69
1 % " " "	2.58
5 % acetic acid + Ag	3.58
1 % " " "	4.38

Liquids	Loss in mg.
5 % citric acid + Aq	2.15
1 % " " " " " "	1.90
5 % lactic acid + Aq	4.77
5 % butyric acid + Aq	1.31
Coffee	0.50
Tea	0
Beer	0
4 % boric acid + Aq	1.77
5 % carboic acid + Aq	0.23
1 % " " " " " "	0.49
1/2 % salicylic acid + Aq	6.35

(Lunge, C N. 65. 110.)

The apparent solubility of this metal in  $H_2O$  is due to the presence of minute quantities of Na. Absolutely pure Al does not lose any weight to  $H_2O$  and the  $H_2O$  remains perfectly clear. Also dil acids remain perfectly clear. (Moissan, C R. 1895, 121. 794-98; C C 1896, I 193.)

Sl. attacked by  $H_2O$  at  $80^\circ$  (W. Smith, J. Soc Chem Ind 1904, 23. 475.)

Easily sol. in dil or conc.  $HCl$  + Aq, whether hot or cold; also in  $HBr$ ,  $HI$ , or  $HF$  + Aq. Insol in dil.  $H_2SO_4$  + Aq (de la Rive); sl. attacked by cold, easily by hot conc.  $H_2SO_4$ . Not attacked by  $HNO_3$  + Aq even when conc. and boiling (Wöhler); easily sol. in dil.  $H_2SO_4$  or  $HNO_3$  + Aq in vacuo (Weeren, B. 24. 1798); slowly sol in 37 %  $HNO_3$  + Aq, 100 conc.  $HNO_3$  + Aq requiring 2 months to dissolve 2 g. Al (Montemartini, Gazz. ch. it. 22. 397); very sl. sol in most organic acids, but solubility is increased by presence of NaCl.

Not attacked by dil. or conc.  $HNO_3$  at ord. temp. but attacked by hot  $HNO_3$ . Attacked by  $H_3PO_4$  (Smith, J. Soc. Chem. Ind 1904, 23. 475.)

Completely sol. at  $100^\circ$  in two hours in  $HNO_3$ , sp. gr. 1.15-1.46. (Stulman, J Am. Chem Soc. 1897, 19. 714.)

Very easily sol. in  $HNO_3$  (contrary to the usual statement in text-books). (Woy, C C. 190, J. I. 94.)

Slowly attacked by  $HNO_3$  + Aq (20-25 %) at  $25-30^\circ$ . (Deventer, Chem Weekbl 1907, 4. 69.)

Dil  $HNO_3$  or  $H_2SO_4$  does not attack Al on account of formation of layer of gas. Action is increased by vacuum. Solutions of metallic chlorides, the metal of which is insol and attacks itself to the Al (Pt, Au, Cu, Hg) increase the solubility, but when metal is soluble in the acid (Fe, Zn, etc.), there is no increase of solubility (Ditte, C R. 1890, 110. 573.)

Violently attacked by dil. or conc.  $H_3PO_4$  + Aq. (Winteler.)

Not attacked by solution of  $HCl$  in liquid  $HCN$  (Kahlenberg, J. phys. Chem 1902, 6. 662.)

Very easily sol. in conc or dil  $KOH$ , or  $f NaOH$  + Aq. Slowly attacked by  $NH_4OH$  +

Aq (Wöhler); sol in  $BaO \cdot H_2O$  + Aq (Beckmann, J. pr. (2) 28. 385), slowly sol in  $CaO \cdot H_2O$  + Aq.

Sol in excess of 10 %  $KOH$  + Aq and in  $NaOH$  and  $LiOH$  + Aq; sol. in hot conc  $Ba(OH)_2$ ,  $Sr(OH)_2$  and  $Ca(OH)_2$  + Aq. (Allen, Am. Ch. J 1900, 24. 304-331.)

Attacked by hot conc  $NH_4OH$  + Aq (Smith, J. Soc Chem. Ind 1904, 23. 475.)

Sl attacked by sulphates, or nitrates + Aq, but all chlorides, bromides, and iodides, except those of the alkalis and alkaline earths, even  $AlCl_3$  + Aq, dissolve the metal. Insol. in alum., or in  $NaCl$  + Aq, but sol in alum +  $NaCl$  + Aq (Tissier, C. R. 41. 362), sol in  $NaCl$  + Aq (Deville, A ch (3) 43. 14), sol. in neutral  $FeCl_3$  + Aq in vacuo (Weeren, B. 24. 1798.) Violently attacked by  $CuCl_2$  + Aq (Tommasi, Bull Soc (2) 37. 443.)

Rapidly sol in  $K_2S_2O_8$  + Aq, more slowly sol. in  $(NH_4)_2S_2O_8$  + Aq (Levi, Gazz. ch. it. 1908, 38. (1) 583.)

Attacked by  $(NH_4)_3PO_4$  + Aq. Sl attacked by  $NaNO_3$  + Aq or  $KNO_3$  + Aq at  $100^\circ$ . (Smith, J. Soc Chem Ind. 1904, 23. 475.)

Not affected by  $NH_4NO_3$  + Aq (Hodgkinson, C N. 1904, 90. 142.)

Attacked by  $POCl_3$  at  $100^\circ$ . (Remtzer, B. 13. 845.)

Insol in liquid  $NH_3$  (Gore, Am. Ch. J. 1898, 20. 826.)

Insol in liquid  $CO_2$  (Büchner, Z. phys. Ch 1906, 54. 674.)

Attacked by  $NOCl$ . (Sudborough, Chem. Soc. 1891, 59. 659.)

92 % alcohol attacks Al less than  $H_2O$ . Pure Al is attacked less than commercial (Hugouenq, J Pharm. 1895, (6) 1. 537.)

Sol. in organic acids containing chlorides (Smith, J. Soc Chem. Ind 1904, 23. 475.)

Acetic, tartaric and citric acids attack Al only at first. Metal is covered by layer of hydroxide but on addition of haloid salts, gradual solution ensues. (Ditte, C R. 1898, 127. 919.)

Not attacked by sugar + Aq. (Klein, C R. 102. 1170.)

#### Aluminum arsenide.

Decomp by  $H_2O$  with evolution of  $AsH_3$ . (Wöhler, Pogg. 11. 160.)

Decomp. by  $H_2O$  (Fonzes-Diacon, C. R. 1900, 130. 1315.)

#### Aluminum boride, $Al_2B_3$ .

Very slowly sol. in hot conc  $HCl$  + Aq, and hot  $NaOH$  + Aq, but easily in moderately strong warm  $HNO_3$  + Aq (Hampe, A. 183. 75.)

$Al_2B_3$ . Not attacked by  $HCl$ , or  $KOH$  + Aq. Scarcely attacked by boiling  $H_2SO_4$ . Hot conc  $HNO_3$  + Aq dissolves gradually but completely (Hampe, I. c.)

#### Aluminum borocarbide, $Al_3C_2B_{14}$ .

Insol in  $H_2O$ ,  $HCl$  + Aq,  $H_2SO_4$  + Aq, or

KOH + Aq; slowly sol in hot conc  $\text{HNO}_3$  + Aq. (Hampe, l. c.)

### Aluminum bromide, $\text{AlBr}_3$

*Anhydrous* Dissolved by  $\text{H}_2\text{O}$  with great violence and evolution of much heat Very sol. in alcohol More sol. in  $\text{CS}_2$  than  $\text{AlI}_3$ . (Weber, Pogg. 103. 264)

Sol. in  $\text{SOCl}_2$  (Besson, C. R. 1896, 123. 884.)

Sol in  $\text{C}_2\text{H}_5\text{Br}$ . (Plotnikoff, C. C. 1902, II. 617)

Sol in acetone. (Naumann, B. 1904, 37. 4328); (Fidmann, C. C. 1899, II. 1014)

### Solubility of $\text{AlBr}_3$ in organic liquids

Solvent	t°	Mole per 100	t°	Mole per 100	t°	Mole per 100
Benzophenone	48°	0	130°	43.2	50°	66.0
	45	8.5	140	48.4	38	67.2
	42	13.8	142	50	50	70.7
	38	18.3	140	52.1	60	74.2
	50	21	130	54.5	70	78.3
	60	23.4	120	56.7	80	83.3
	70	25.7	110	58.6	85	86.7
	80	28.1	100	60.3	90	90.7
	90	30.6	90	61.7	93	94.8
	100	33.4	80	62.9	96	100
	110	36.3	70	64.1		
	120	39.6	60	65.1		
Ethylene bromide	10°	0	20°	33.9	70°	72.7
	6	8.4	30	40.1	80	82.3
	2	16.0	40	47.2	90	92.2
	-2	22.9	50	55.1	96	100
Benzoyl chloride	0	5°	0	85°	47	40°
	-2	5	6.5	90	50.8	60
	-5	13.0	80	52.8	70	83.9
	10	17.4	60	56	80	89.2
	30	24.6	40	59.5	90	95.8
	50	31.8	20	63.1	96	100
	70	40	7	65.5		
	80	44.3	20	67.9		

(Menschutkin, Ann. Inst. Pol. P.-le-Gr, 13. 1)

+6 $\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ .

+15 $\text{H}_2\text{O}$  (Panfiloff, J. B. 1895. 785)

**Aluminum antimony bromide,  $2\text{AlBr}_3, 5\text{SbBr}_3$**   
+24 $\text{H}_2\text{O}$ .

Hygroscopic. Decomp by  $\text{H}_2\text{O}$  (Weinland, B. 1903, 36. 258)

**Aluminum potassium bromide,  $\text{AlBr}_3, \text{KBr}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Weber, Pogg. 103. 267.)

**Aluminum bromide ammonia,  $\text{AlBr}_3, x\text{NH}_3$**

Decomp by  $\text{H}_2\text{O}$ . (Weber, Pogg. 103. 267)

**Aluminum perbromide carbon disulphide,  $\text{AlBr}_3, \text{Br}_4, \text{CS}_2$**

Sol in ether, ethyl bromide, ethylene bromide and benzene, decomp. by  $\text{H}_2\text{O}$  (Plotnikoff, J. Russ. phys. Chem. Soc. 1901, 33. 91, C. C. 1901, I. 1293)

2 $\text{AlBr}_3, \text{Br}_4, \text{CS}_2$ . Sol. in ether and benzene; insol in petroleum ether. (Plotnikoff, l. c.)

**Aluminum bromochloride,  $\text{AlCl}_2\text{Br}$ .**

Deliquescent. Somewhat less violently dissolved by  $\text{H}_2\text{O}$  than is  $\text{AlBr}_3$  (v. Bartsch, Z. anorg. 1907, 55. 154.)

+6 $\text{H}_2\text{O}$  Deliquescent. Sol. in  $\text{H}_2\text{O}$  without evolution of heat (v. Bartsch, Z. anorg. 1907, 55. 155)

**Aluminum carbide,  $\text{Al}_4\text{C}_3$ .**

Decomp. by fused KOH at 100°; insol. in fuming  $\text{HNO}_3$  in the cold, decomp. by  $\text{H}_2\text{O}$ , and dil. acids (Moissan, Bull. Soc. 1894, (3) 11. 1012; C. R. 1894, 119. 16-20.)

Insol in acetone (Naumann, B. 1904, 37. 4328.)

**Aluminum chloride, basic,  $\text{Al}_2\text{O}_3, \text{H}_2\text{O}, \text{HCl}$ .**

Easily sol in  $\text{H}_2\text{O}$ . (Schlumberger, Bull. Soc. 1895, (3) 13. 56)

**Aluminum chloride,  $\text{AlCl}_3$**

*Anhydrous.* Very deliquescent. Sol. in  $\text{H}_2\text{O}$  with a hissing noise and evolution of heat. Solution of  $\text{AlCl}_3$  in  $\text{H}_2\text{O}$  loses HCl on evaporation, and  $\text{AlCl}_3$  is finally wholly converted into  $\text{Al}_2\text{O}_3$ .

Sol in 1432 pts  $\text{H}_2\text{O}$  at 15°. (Gerlach.)

$\text{AlCl}_3$  + Aq containing 19.15 %  $\text{AlCl}_3$  boils at 103.4°,  $\text{AlCl}_3$  + Aq containing 38.3 %  $\text{AlCl}_3$  boils at 112.8° (Gerlach)

### Sp. gr. of $\text{AlCl}_3$ + Aq at 15°.

% $\text{AlCl}_3$	Sp. gr.	% $\text{AlCl}_3$	Sp. gr.
1	1.0072	22	1.1709
2	1.0144	23	1.1795
3	1.0216	24	1.1881
4	1.0289	25	1.1968
5	1.0361	26	1.2058
6	1.0435	27	1.2149
7	1.0510	28	1.2241
8	1.0585	29	1.2331
9	1.0659	30	1.2422
10	1.0734	31	1.2518
11	1.0812	32	1.2615
12	1.0890	33	1.2711
13	1.0968	34	1.2808
14	1.1047	35	1.2905
15	1.1125	36	1.3007
16	1.1207	37	1.3109
17	1.1290	38	1.3211
18	1.1372	39	1.3313
19	1.1455	40	1.3415
20	1.1537	41	1.3522
21	1.1632		

(Gerlach, Z. anal. 8. 281.)

Sp. gr. at 20° of  $\text{AlCl}_3 + \text{Aq}$  containing mg. mols.  $\text{AlCl}_3$  per liter.

M	Sp. gr.
0 01	1 00104
0 025	1 00282
0 05	1 00588
0 075	1 00870
0 10	1 01158
0 25	1 02911
0 55	1 05706
1 0	1 11054
1 5	1 16308
2 0	1 21378

(Jones & Pearce, Am. Ch. J. 1907, 38, 726.)

Sol. in 1 pt. strong alcohol at 12.5° (Wenzel); easily sol. in ether; sl. sol. in  $\text{CS}_2$ , insol. in ligroine or benzene.

Difficulty sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29, 374.)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84, 26.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 826.)

Insol. in  $\text{CS}_2$  at ord. temp (Arcetowski, Z. anorg. 1894, 6, 257.)

Sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37, 4328.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

Insol. in methylal. (Eidmann, C. C. 1899, II, 1014.)

#### Solubility of $\text{AlCl}_3$ in organic liquids.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzophenone	48°	0	130°	43 2	130°	66 0
	44	8 5	125	48 4	140	67 2
	39 5	13 8	120	50	150	70 7
	50	18.3	110	52 1	180	74 2
	60	21	100	54.5	170	78 3
	70	23 4	90	56.7	180	83 3
	80	25.7	80	58 6	185	86 7
	90	28 1	70	60 3	190	90.7
	100	30 6	60	61 7	192	94 8
	110	33 4	80	62 9	194	100
	120	36 3	100	64.1		
	125	39 6	120	65 1		
Benzoyl chloride	-0 5°	0	60°	33 0	80°	52.9
	-4	7 9	70	37 5	70	55 1
	-7.5	12 7	80	42 2	60	57 2
	0	14 1	90	47 1	40	61 0
	20	18 8	93	48 7		
	40	25 0	90	50 6		

(Mensehutkin, Ann. Inst. Pol. P.-le-Gr., 13, 1.)

+6H<sub>2</sub>O. Very deliquescent; very sol. in H<sub>2</sub>O. Sol. in 0.25 pt. H<sub>2</sub>O. (Thomson.)

Sol. in 2 pts abs alcohol at ordinary temp., and 1.5 pts at b-pt. (Thomson.)

Completely insol. in a solution of ether in H<sub>2</sub>O sat. with HCl (Havens, Am. J. Sci. 1898, (4) 6, 46)

Aluminum ammonium chloride,  $\text{AlCl}_3 \cdot \text{NH}_4\text{Cl}$  (Baud, A. ch. 1904, (8) 1, 46)

Aluminum antimony chloride.

See Chlorantimonate, aluminum.

Aluminum barium chloride,  $2\text{AlCl}_3 \cdot \text{BaCl}_2$  (Baud, C. R. 1901, 133, 869)

Aluminum calcium chloride, basic.

$3\text{CaO} \cdot \text{CaCl}_2 \cdot \text{Al}_2\text{O}_3 + 10\text{H}_2\text{O}$ . (Stenmetz, Z. phys. Ch. 1905, 52, 466.)

$10\text{CaO} \cdot \text{CaCl}_2 \cdot 6\text{Al}_2\text{O}_3$ . Slowly decomp. by boiling H<sub>2</sub>O. (Gorgeu, Bull. Soc. 1887, (2) 48, 51.)

Aluminum calcium chloride,  $4\text{AlCl}_3 \cdot 3\text{CaCl}_2$  (Baud, A. ch. 1904, (8) 1, 51.)

Aluminum nitrosyl chloride,  $\text{AlCl}_3 \cdot \text{NOCl}$ .

Deliquescent, and decomp. by H<sub>2</sub>O. (Weber Pogg. 118, 471.)

Aluminum palladium chloride,  $\text{AlCl}_3 \cdot \text{PdCl}_2 + 10\text{H}_2\text{O}$ .

See Chloropalladate, aluminum.

Aluminum phosphorus pentachloride,  $\text{AlCl}_3 \cdot \text{PCl}_5$ .

Decomp. violently by H<sub>2</sub>O. (Baudrinont.)

Aluminum phosphoryl chloride,  $\text{AlCl}_3 \cdot \text{POCl}_3$ .

Deliquescent. Sol. in H<sub>2</sub>O with decomp. Sol. in warm  $\text{POCl}_3$ , from which it separates on cooling. (Casselmann, A. 98, 220.)

Aluminum platinum chloride,  $\text{AlCl}_3 \cdot \text{PtCl}_2 + 15\text{H}_2\text{O}$

See Chloroplatinite, aluminum.

Aluminum potassium chloride,  $\text{AlCl}_3 \cdot \text{KCl}$ .

Slowly deliquescent. Sol. in H<sub>2</sub>O with evolution of heat and decomp. (Degen, A. 18, 332.)

Aluminum selenium chloride,  $2\text{AlCl}_3 \cdot \text{SeCl}_4$ .

Sol. in H<sub>2</sub>O with evolution of heat and separation of traces of selenium. (Weber, Pogg. 104, 427.)

Aluminum sodium chloride,  $\text{AlCl}_3 \cdot \text{NaCl}$ .

Much less deliquescent than  $\text{AlCl}_3$ . Sol. in H<sub>2</sub>O with evolution of heat. Upon evaporating, NaCl crystallises out (Wöhler.)

Aluminum strontium chloride,  $4\text{AlCl}_3 \cdot 3\text{SrCl}_2$ . (Baud, A. ch. 1909, (8) 1, 52.)

Aluminum sulphur chloride,  $2\text{AlCl}_3 \cdot \text{SCl}_4$ .

Decomp. by H<sub>2</sub>O with evolution of much

heat and separation of some sulphur. (Weber, Pogg, 104. 421.)

$\text{AlCl}_3, \text{SCl}_2$  Decomp. by  $\text{H}_2\text{O}$  (Ruff, B. 1901, 34. 1757.)

**Aluminum tellurium chloride**,  $2\text{AlCl}_3, \text{TeCl}_4$ .  
Very sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Weber, J pr. 76. 313.)

**Aluminum chloride ammonia**,  $\text{AlCl}_3, \text{NH}_3$ .  
Sol. in  $\text{H}_2\text{O}$  (Rose, Pogg, 24. 248.)

Completely sol in  $\text{H}_2\text{O}$  (Baud, C R 1901, 132. 135.)

$\text{AlCl}_3, 2\text{NH}_3$  Very hygroscopic. (Stillman, Am Ch J. 1895, 17. 750.)

$\text{AlCl}_3, 3\text{NH}_3$  Decomp. by  $\text{H}_2\text{O}$ .

$\text{AlCl}_3, 5\text{NH}_3$  M pt  $380^\circ$ . (Baud, C. R. 1901, 132. 135.)

$\text{AlCl}_3, 6\text{NH}_3$  Decomp. by  $\text{H}_2\text{O}$  (Stillman, Am Ch J. 1895, 17. 752.) Somewhat hygroscopic (Baud, C. R. 1901, 132. 135.)

**Aluminum chloride nitric oxide**,  $2\text{AlCl}_3, \text{NO}$

Very hygroscopic Decomp. rapidly in the air Sol in  $\text{KOH} + \text{Aq}$ . (Thomas, C. R. 1895, 121. 130.)

**Aluminum chloride phosphine**,  $3\text{AlCl}_3, \text{PH}_3$

Decomp. by  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Rose Pogg, 24. 295.)

**Aluminum chloride hydrogen sulphide**.

Deliquescent. Decomp. by  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Wöhler.)

**Aluminum chloride sulphur dioxide**,  $\text{AlCl}_3, \text{SO}_2$

Decomp. by  $\text{H}_2\text{O}$ , alcohol, or benzene (Adrianowski, B. 12. 688.)

$2\text{AlCl}_3, \text{SO}_2$ . (Baud, A. ch 1904, (S) 1. 32.)

**Aluminum cobalt**,  $\text{Co}_2\text{Al}_3$ .

Sol in strong acids (Brunck, B. 1901, 34. 2734.)

**Aluminum copper**,  $\text{Cu}_4\text{Al}_3$ .

Sol. in aqua regia; decomp. by  $\text{HCl}$  (Brunck, B. 1901, 34. 2733.)

**Aluminum fluoride**,  $\text{AlF}_3$ .

*Anhydrous* Not attacked by  $\text{H}_2\text{O}$  or acids, and only very slightly by boiling conc  $\text{H}_2\text{SO}_4$ . Insol. in boiling  $\text{KOH} + \text{Aq}$ . (Deville, C R 42. 49.)

Insol. in ethyl acetate. (Naumann, B 1910, 43. 314.)

Insol in acetone. (Naumann, B 1904, 37. 4328.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$  Sl. sol. in  $\text{HF}$ . (Baud, C. R. 1902, 135. 1104.)

$+ \text{H}_2\text{O}$ . Completely but only sparingly sol in  $\text{H}_2\text{O}$ . (Mazzuchelli, Real. Ac. Linc. 1907, (5) 16, I. 775; Chem Soc 1907, 92, (2). 549.)

$+ 3\frac{1}{2}\text{H}_2\text{O}$ . Two modifications: (1) Easily sol. in  $\text{H}_2\text{O}$ . Sol in  $\text{HF}$ . (2) Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HF}$ . (Baud, C R. 1902, 135. 1104.)

$+ 7\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ . (Deville, A. ch (3) 61. 329.)

*Min Fluelsite*.

$+ 8\frac{1}{2}\text{H}_2\text{O}$ . Very efflorescent Sat. solution contains 3.85 g.  $\text{AlF}_3$  per 100 g. at  $11^\circ$  and 1.2 g. at  $-0.2^\circ$  (Mazzuchelli, Real. Ac. Linc. 1907, (5) 16, I. 775, Chem Soc. 1907, (2), 92. 549.)

**Aluminum hydrogen fluoride**,  $3\text{AlF}_3, 2\text{HF} + 5\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ ; precipitated by alcohol. (Deville)

$2\text{AlF}_3, \text{HF} + 5\text{H}_2\text{O}$ . (Deville, A. ch. (6) 61. 329.)

**Aluminum ammonium fluoride**,  $\text{AlF}_3, \text{NH}_4\text{F}$ .

Somewhat sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  or  $\text{NH}_4\text{F}$  (Berzelius, Pogg 1. 45.)

$\text{AlF}_3, 2\text{NH}_4\text{F} + 1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in 100 pts.  $\text{H}_2\text{O}$  at  $16^\circ$  (Baud, C. R. 1902, 135. 1338.)

$\text{AlF}_3, 3\text{NH}_4\text{F}$ . Nearly insol in  $\text{H}_2\text{O}$ ; easily sol. in dil acids. (Petersen, J pr. (2) 40. 35.)

Quite easily sol in  $\text{H}_2\text{O}$ , but insol in  $\text{NH}_4\text{F} + \text{Aq}$ . (Helmholtz, Z. anorg 3. 129.)

**Aluminum barium fluoride**.

Apparently not obtained in pure state. (Röder)

**Aluminum calcium fluoride**,  $\text{AlF}_3, \text{CaF}_2 + \text{H}_2\text{O}$ .

*Min Evigtokite*.

**Aluminum calcium sodium fluoride**,  $\text{AlF}_3, \text{CaF}_2, \text{NaF} + \text{H}_2\text{O}$ .

*Min. Pachnolite*

**Aluminum cobaltous fluoride**,  $\text{AlF}_3, \text{CoF}_2 + 7\text{H}_2\text{O}$ .

Sol in dil  $\text{HF} + \text{Aq}$  (Weinland, Z. anorg. 1899, 22. 272.)

**Aluminum cupric fluoride**,  $2\text{AlF}_3, \text{CuF}_2$ .

Very slowly but completely sol in  $\text{H}_2\text{O}$ . (Berzelius)

$\text{AlF}_3, 2\text{CuF}_2 + 11\text{H}_2\text{O}$ . Sol in dil  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg 1899, 22. 272-76.)

$2\text{AlF}_3, 3\text{CuF}_2 + 18\text{H}_2\text{O}$ . Sol in dil  $\text{HF} + \text{Aq}$  (Weinland)

**Aluminum cupric hydrogen fluoride**,  $\text{AlF}_3, \text{CuF}_2, \text{HF} + 8\text{H}_2\text{O}$ .

Efflorescent in the air. Sol. in dil  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg 1899, 22. 272.)

**Aluminum iron (ferrous) fluoride**,  $\text{AlF}_3, \text{FeF}_2 + 7\text{H}_2\text{O}$ .

Sl. sol. in dil  $\text{HF} + \text{Aq}$  (Weinland, Z. anorg. 1899, 22. 270.)

**Aluminum lithium fluoride**.

Insol. in  $\text{H}_2\text{O}$  (Berzelius)

**Aluminum magnesium fluoride**.

$2\text{AlF}_3, \text{MgF}_2$  (?) (Röder.)

**Aluminum nickel fluoride,  $\text{AlF}_3, \text{NiF}_2 + 7\text{H}_2\text{O}$ .**

Sl. sol. in dl.  $\text{HF} + \text{Aq}$ . (Wernland, Z. anorg. 1899, 22, 271.)

**Aluminum potassium fluoride,  $\text{AlF}_3, 3\text{KF}$ .**

Very sl. sol. in acid solutions, and still less in  $\text{H}_2\text{O}$  (Gay-Lussac and Thénard)

$\text{AlF}_3, 2\text{KF}$ . As above

**Aluminum silicon fluoride.**

See Fluosilicate, aluminum.

**Aluminum sodium fluoride.**

$2\text{AlF}_3, 3\text{NaF}$  Min *Chiolite*

$\text{AlF}_3, 2\text{NaF}$  Min. *Chiodineffite*.

$\text{AlF}_3, 3\text{NaF}$  Min. *Cryolite*

Sl. sol. in  $\text{H}_2\text{O}$  Insol in  $\text{HCl} + \text{Aq}$ . Decomp by  $\text{H}_2\text{SO}_4$ , or by boiling with  $\text{NaOH} + \text{Aq}$

**Aluminum strontium fluoride.**

As the Ba salt. (Röder)

**Aluminum thallos fluoride,  $2\text{AlF}_3, 3\text{TlF}$ .**

Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 61, 243)

**Aluminum zinc fluoride,  $\text{AlF}_3, \text{ZnF}_2 + 7\text{H}_2\text{O}$**

Sol in dl.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22, 272)

$2\text{AlF}_3, \text{ZnF}_2$ . Slowly but completely sol in  $\text{H}_2\text{O}$  (Berzelius)

**Aluminum hydroxide,  $\text{Al}_2\text{O}_3, \text{H}_2\text{O}$   
= $\text{Al}_2\text{O}_3(\text{OH})_3$ .**

Dehydrated by conc. acids, without dissolving. (Becquerel, C. R., 67, 108)

Min. *Diaspore*. Insol in  $\text{HCl} + \text{Aq}$ , and not attacked by boiling conc.  $\text{H}_2\text{SO}_4$ , unless it has been ignited

$\text{Al}_2\text{O}_3, 2\text{H}_2\text{O} = \text{Al}_2\text{O}_3(\text{OH})_4$ . Pptd. Al hydroxide, when boiled twenty hours with  $\text{H}_2\text{O}$  is insol in acids and alkalis, and has the above composition. (St. Gilles, A. ch. (3) 48, 57)

Min *Bauxite*.

**Soluble modifications**—(a) *Meta-aluminum hydroxide* From basic Al acetate Sol. in  $\text{H}_2\text{O}$  and more readily in  $\text{HC}_2\text{H}_3\text{O}_2$ . The aqueous solution is coagulated by traces of alkalis, many acids, and salts, while other acids and salts have no effect. Thus, 1 pt.  $\text{H}_2\text{SO}_4$  in 1000 pts.  $\text{H}_2\text{O}$ , added to 7000 pts. of above solution containing 20 pts.  $\text{Al}_2\text{O}_3$ , converts the liquid into a nearly solid mass. Citric, tartaric, oxalic, chromic, molybdic, racemic, suberic, salicylic, benzoic, gallic, lactic, cinnamic, butyric, valeric, camphoric, picric, uric, meconic, cemenic, and hemipinic acids act in the same way.  $\text{HCl}$  and  $\text{HNO}_3$  have far less action, 600 mols being necessary to produce the same effect as 1 mol  $\text{H}_2\text{SO}_4$ , while acetic, formic, boric, arsenous, pyro-

meconic, and opianic acids do not coagulate the solution, except when moderately conc. 1 pt.  $\text{KOH}$  in 1000 pts.  $\text{H}_2\text{O}$  coagulates 6000 pts. of the solution.  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ , and  $\text{Ca}(\text{OH})_2$  have the same effect.

The solution is not coagulated by acetates, unless added in large quantity, and even then the ppt. is redissolved when treated with  $\text{H}_2\text{O}$ . Nitrates and chlorides coagulate with difficulty;  $\text{Na}_2\text{SO}_4$ ,  $\text{MgSO}_4$ , and  $\text{CaSO}_4 + \text{Aq}$ , however, have as strong an action as a liquid containing the same amount of  $\text{H}_2\text{SO}_4$ . A teaspoonful of the solution introduced into the mouth solidifies at once from the action of the saliva. The ppt. formed by acids is not sol in an excess of the acid, but by the long continued action of conc.  $\text{H}_2\text{SO}_4$ , especially if hot, the ppt. is dissolved; boiling conc.  $\text{HCl} + \text{Aq}$  also dissolves it, but less readily than  $\text{H}_2\text{SO}_4$ . The ppt. is sol. in boiling conc.  $\text{KOH} + \text{Aq}$ . The residue, when the solution is evaporated at  $100^\circ$ , has composition  $\text{Al}_2\text{O}_3, 2\text{H}_2\text{O}$ , and is insol in acids. (Crum, Chem. Soc. 6, 225)

(b) *By Dialysis*. Sol. in  $\text{H}_2\text{O}$ , from which it is separated by extremely small amounts of various substances, as acids, ammonia, salts (especially  $\text{K}_2\text{SO}_4$ ), caramel, etc. An excess of acid dissolves the coagulum. If the solution contains 0.5%  $\text{Al}_2\text{O}_3$  or less, it may be boiled without change, but the hydroxide separates out suddenly when it is reduced to  $\frac{1}{2}$  its vol., and even very dil. solutions gelatinize spontaneously in a few days. The solution is not coagulated by alcohol or sugar (Graham, A. 121, 41.)

$\text{Al}_2\text{O}_3, 3\text{H}_2\text{O} = \text{Al}(\text{OH})_3$ . *Crystallized* Difficultly sol. in acids and alkalis. (Cossa, N. Cim. (2) 3, 228) Insol in boiling  $\text{HCl} + \text{Aq}$ . (Wöhler, A. 113, 249) Sl. sol in  $\text{KOH} + \text{Aq}$ ; nearly insol in cold  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3 + \text{Aq}$ ; very slowly sol in hot  $\text{HCl} + \text{Aq}$ , more readily in hot  $\text{H}_2\text{SO}_4$ . (v. Bonsdorff, Pogg. 27, 275.)

$\alpha$ -modification. Unstable. Changes into  $\beta$ -modification. Sol. in  $\text{N-H}_2\text{SO}_4$  at ord. temp. Sol in  $\text{N-NaOH}$  and in hot  $\text{NaOH}$  of concentration  $5\text{Na}_2\text{O}, 100\text{H}_2\text{O}$ . (Russ, Z. anorg. 1904, 41, 226)

$\beta$ -modification. Insol in  $\text{N-H}_2\text{SO}_4$  at ord. temp. Difficultly sol in warm  $\text{N-NaOH}$ , but easily sol. in hot  $\text{NaOH}$  of concentration  $5\text{Na}_2\text{O}, 100\text{H}_2\text{O}$ . Its solubility in  $\text{NaOH}$  increases with increase in concentration of the hydroxyl ions (Russ)

$\delta$ -modification. Easily sol. in conc.  $\text{H}_2\text{SO}_4$ , only sl. sol in  $\text{HCl}$ ,  $\text{HNO}_3$ , or acetic acids, or in alkali +  $\text{Aq}$  (Tommasi, C. C. 1905, II, 605.)

Min *Gibbsite*. Sol. in  $\text{HCl} + \text{Aq}$ , and dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Readily sol in conc.  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq}$ .

*Precipitated*. Completely insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{CO}_3 + \text{Aq}$ . Easily sol. in acids when freshly pptd., but solubility diminishes on standing.

Easily sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ . (Sonnenschein)

Herz (Z. anorg. 25, 155) found that aluminum hydroxide which has been dried in a vacuum desiccator requires for solution in  $\text{NaOH} + \text{Aq.}$  3 atoms  $\text{Na}$  to 1 atom  $\text{Al}$ . Slade (Z. Elektrochem. 1911, 17, 261) was unable to obtain this result. Herz says Slade's error is due to insufficient shaking of the solution. (Herz, Z. Elektrochem. 1911, 17, 403.)

New solubility determinations verify the statement of Herz (Z. anorg. 25, 155) that the solubility of  $\text{Al}(\text{OH})_3$  in  $\text{NaOH} + \text{Aq.}$  is proportional to the concentration of  $\text{NaOH}$ . They do not, however, verify his statement that the ratio  $\text{Na} : \text{Al}$  in the solutions is always 3 : 1, for the author finds that the ratio  $\text{Na} : \text{Al}$  varies from 2 : 1 to 10 : 1 depending on the conditions of precipitation and the method and duration of drying of the  $\text{Al}(\text{OH})_3$ . (Slade, Z. Elektrochem. 1912, 18, 1.)

$\text{Al}$  sol in  $\text{NH}_4\text{OH} + \text{Aq.}$  when freshly pptd., but presence of  $\text{NH}_4$  salts diminish its solubility, and it separates out completely after long standing. (Fresenius.)

Somewhat sol in  $\text{NH}_4\text{OH} + \text{Aq.}$  the more readily the larger the vol. of  $\text{H}_2\text{O}$ . Somewhat sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  but less than in  $\text{NH}_4\text{OH} + \text{Aq.}$   $\text{Al}$  sol. in dil.  $\text{NH}_4\text{Cl} + \text{Aq.}$  unless that salt be in large excess. It is finally wholly pptd. if allowed to stand several days.

1875 pts.  $\text{NH}_4\text{OH} + \text{Aq.}$  (4 %  $\text{NH}_4\text{OH}$ ) dissolve an amt. of  $\text{Al}(\text{OH})_3$  corresponding to one pt.  $\text{Al}_2\text{O}_3$ ;  $\text{NH}_4\text{Cl}$  prevents this solubility almost completely. (Hanamann, Pharm. Viertelj. 12, 527.)

$\text{Al}(\text{OH})_3$  prepared by ppt. of a solution of  $\text{Al}(\text{NO}_3)_3$  with  $\text{NH}_4\text{OH}$ , filtered and washed, is insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$

$\text{Al}(\text{OH})_3$  prepared by pptn. of a solution of potassium aluminate with  $\text{NH}_4\text{Cl}$ , is sol. in a large excess of  $\text{NH}_4\text{OH}$  if this is added to the ppt. at once. This modification which is sol. in  $\text{NH}_4\text{OH}$  is unstable and easily goes over into the modification which is insol. in  $\text{NH}_4\text{OH}$ . (Renz, B. 1903, 36, 2751.)

Conc.  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  does not dissolve  $\text{Al}(\text{OH})_3$ , and not a trace is dissolved by boiling conc.  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Weeren, Pogg. 92, 97.)

With  $\text{NH}_4\text{F} + \text{Aq.}$  it forms a double salt,  $\text{AlF}_3 \cdot 3\text{NH}_4\text{F}$ , which is sol. in  $\text{H}_2\text{O}$ , but not in  $\text{NH}_4\text{F} + \text{Aq.}$  (Helmholtz, Z. anorg. 3, 127.)

Insol. in  $(\text{NH}_4)_2\text{S} + \text{Aq.}$  (Malaguti and Durocher, A. ch. (3) 17, 421.) Fuchs found, on the contrary, that it is not wholly insol. in  $(\text{NH}_4)_2\text{S} + \text{Aq.}$  (Fresenius, Quant.)

Insol. in  $\text{FeCl}_3 + \text{Aq.}$  (Béchamp.)

Determinations of the solubility of aluminum hydroxide in  $\text{AlCl}_3 + \text{Aq.}$  show that part goes into solution to form a compound, while the greater part is in the colloidal form. (Fischer, Z. anorg. 1904, 40, 46.)

Only sl. sol. in conc.  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq.}$  but solubility increases with decrease in concentration of  $\text{Al}_2(\text{SO}_4)_3$ , until it reaches a maximum at a concentration of 32 %  $\text{Al}_2(\text{SO}_4)_3$  at 20°, 28 % at 40°, and 38 % at 60°. With further decrease in concentration of  $\text{Al}_2(\text{SO}_4)_3$ ,

the solubility of  $\text{Al}(\text{OH})_3$  in  $\text{Al}_2(\text{SO}_4)_3$  diminishes. (Kreman, C. A. 1909, 2422.)

Sol in  $\text{Ba}(\text{OH})_2 + \text{Aq.}$  (Rose.)

Sol in boiling  $\text{Fe}(\text{NO}_3)_3$ ,  $\text{Cr}(\text{NO}_3)_3$ ,  $\text{Bi}(\text{NO}_3)_3$ ,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{HgNO}_3$ ,  $\text{SnCl}_2$ , and  $\text{SbCl}_3 + \text{Aq.}$  (Persoz.)

Insol. in  $\text{HCN}$  or cold  $\text{KCN} + \text{Aq.}$  but sl. sol. in hot  $\text{KCN} + \text{Aq.}$  (Rose.)

Insol. in  $\text{K}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq.}$  (Osann, 1821.)

When moist, sol. in  $\text{H}_2\text{SO}_4 + \text{Aq.}$  from which it is reprecipitated on boiling. (Berthier, A. ch. (3) 7, 76.)

Somewhat sol. in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq.}$  (Mercier.)

Not pptd. by  $\text{NH}_4\text{OH} + \text{Aq.}$  in presence of  $\text{Na}$  citrate. (Spiller.)

Sol. in ethyl amine, amyl amine, alkaline, ethyl picoline hydroxide, stubethylum hydroxide, triethyltoluene ammonium hydroxide +  $\text{Aq.}$  (Friedlander.)

Sol. in alkyl amines. (Renz, B. 1903, 36, 2751.)

Insol. in acetone. (Naumann, B. 1904, 37, 4328.)

Sol to a considerable extent in  $\text{K}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq.}$

Very sl. sol. in cane sugar +  $\text{Aq.}$  (Ramsey.)

Solubility in glycerine +  $\text{Aq.}$  containing about 60 % by vol. of glycerine 100 cc. of the solution contain 0.25 g.  $\text{Al}_2\text{O}_3$ . (Müller, Z. anorg. 1905, 43, 322.)

$\text{Al}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq.}$  and alcohol. Sol. in  $\text{HCl}$  and  $\text{HNO}_3 + \text{Aq.}$  (Zunino, Gazz. ch. it 1900, 30 (1), 194.)

$\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ , "Trialuminum hydroxide."

Not sol. in conc. acids in the cold; not sol. in  $\text{KOH}$  (cold) and only sl. sol. in hot  $\text{KOH}$ . Characterized by its solubility in exactly one mol. dil.  $\text{HCl}$ . Dil. solutions do not gelatinize even on long standing. Conc. solution of  $\text{NH}_4\text{Cl}$  and other salts cause ppt. which redissolves on addition of  $\text{H}_2\text{O}$ .

Alkalies and alkali carbonates decompose the salt with  $\text{HCl}$  and ppt. trialuminum hydroxide.  $\text{H}_2\text{SO}_4$  and sol. sulphates give insol. compds. with the hydrate.  $\text{HNO}_3$ , like  $\text{HCl}$  gives soluble compds. with the hydrate. (Structural formula given.) (Sehlumberger, Bull. Soc. 1895, (5) 13, 41-65; C. C. 1895, I, 421.)

Aluminum iodide,  $\text{AlI}_3$ .

Anhydrous. Fumes on air and deliquesces. Sol. in  $\text{H}_2\text{O}$  with evolution of much heat. Sol. in  $\text{CS}_2$  and crystallizes from the hot sat. solution on cooling. (Weber.) Sol. in alcohol (Weber), ether and tetraachloromethane. (Gustavson.)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84, 26.)

+  $6\text{H}_2\text{O}$  Very sol. in  $\text{H}_2\text{O}$ .

Aluminum mercuric iodide,  $\text{AlI}_3 \cdot \text{HgI}_2 + 8\text{H}_2\text{O}$ .

Very deliquescent; sol. in  $\text{H}_2\text{O}$  without decomposition. (Dubois, C. R. 1908, 146, 1028.)

- Aluminum potassium iodide,  $\text{AlI}_3$ , KI**  
Sol in  $\text{H}_2\text{O}$  with evolution of much heat. (Weber, Pogg. 101. 469)
- Aluminum iodide ammonia,  $\text{AlI}_3$ ,  $3\text{NH}_3$**   
Decomp by  $\text{H}_2\text{O}$  (Weber, Pogg. 103. 263.)
- Aluminum iodide mercuric oxydide,  $2\text{AlI}_3$ ,  $\text{HgO}$ ,  $3\text{HgI}_2 + 15\text{H}_2\text{O}$**   
(Duboin, C. R. 1907, 146. 714.)
- Aluminum iron,  $\text{FeAl}_3$**   
Readily sol. in strong  $\text{HNO}_3$ . (Brunck, B. 1901, 34. 2734)
- Aluminum manganese,  $\text{Mn}_2\text{Al}_7$**   
Sol in strong  $\text{HCl}$ . (Brunck, B. 1901, 34. 2735)
- Aluminum molybdenum,  $\text{Al}_3\text{Mo}$**   
Easily sol. in hot  $\text{HNO}_3$  or  $\text{HCl}$  (Wohler, A. 1860, 115. 103)  
 $\text{Al}_3\text{Mo}$ . (Guillet, C. R. 1901, 133. 293)  
 $\text{AlMo}$ . (Guillet.)  
 $\text{AlMo}_2$ . Not attacked by  $\text{dil. HCl} + \text{Aq.}$  (Guillet.)  
 $\text{AlMo}_3$ . Not attacked by  $\text{HCl} + \text{Aq}$  (Guillet)
- Aluminum nickel,  $\text{Al}_3\text{Ni}$**   
Sol. in strong acids (Brunck, B. 1901, 34. 2734.)
- Aluminum nitride,  $\text{Al}_3\text{N}_3$**   
Slowly attacked by hot or cold  $\text{H}_2\text{O}$ . Decomp by acids and aqueous solutions of the alkalis, especially when they are concentrated. (Mallet, A. 186. 155)  
Easily decomp.  $\text{H}_2\text{O}$  when finely powdered. (Rossi, C. R. 1895, 121. 942)  
Decomp by moist air and by boiling  $\text{H}_2\text{O}$  and by alkalis +  $\text{Aq.}$  (Franck, Ch. Z. 1897, 21. 263.)
- Aluminum oxide,  $\text{Al}_2\text{O}_3$**   
*Crystalline.* Min. *Corundum, sapphire, ruby, emery.* Insol in acids.  
*Amorphous.* Ignited  $\text{Al}_2\text{O}_3$  is insol. in acids except that it dissolves slowly when heated with a mixture of 1 pt  $\text{H}_2\text{SO}_4$  and 1 pt  $\text{H}_2\text{O}$ . (Berzelius.) Slowly sol. in boiling  $\text{HCl} + \text{Aq.}$  (Rose, Pogg. 52. 595)  
Sol. in 22 pts. of a mixture of 8 pts.  $\text{H}_2\text{SO}_4$  and 1 pt.  $\text{H}_2\text{O}$ . (Mitscherlich.) The lower the temperature at which  $\text{Al}_2\text{O}_3$  has been heated, the more sol. it is in acids and alkalis.  
Solubility in (calcium succate + sugar) +  $\text{Aq.}$   
1 l. solution containing 418.6 g sugar and 34.3 g.  $\text{CaO}$  dissolves 1.35 g.  $\text{Al}_2\text{O}_3$ ; 1 l. solution containing 296.5 g. sugar and 24.2 g.  $\text{CaO}$  dissolves 0.32 g.  $\text{Al}_2\text{O}_3$ ; 1 l. solution containing 174.4 g sugar and 14.1 g  $\text{CaO}$  dis-
- solves 0.19 g  $\text{Al}_2\text{O}_3$ . (Bodenbender, J. B. 1865. 600.)  
Insol. in acetone (Naumann, B. 1904, 37. 4328)  
See also Aluminum hydroxide.
- Aluminum peroxide,  $\text{Al}_2\text{O}_3$ ,  $\text{Al}_2\text{O}_3 + 10\text{H}_2\text{O}$**   
Ppt; sol in acids with decomp. (Terni, C. A. 1912. 3038)
- Aluminum oxybromide.**  
Basic aluminum bromides containing three equivalents or less of  $\text{Al}_2\text{O}_3$  to one of  $\text{AlBr}_3$  are sol in  $\text{H}_2\text{O}$ . Those containing more than three equivalents are insol (Ordway, Am. J. Sci. (2) 28. 203.)
- Aluminum oxychloride.**  
Sol. in  $\text{dil. acids}$  or  $\text{alkalis}$ . Decomp. by  $\text{H}_2\text{O}$  (Hautefeuille and Perrey, C. R. 100. 1220.)  
Basic aluminum chlorides containing two equivalents or less of  $\text{Al}_2\text{O}_3$  to one of  $\text{AlCl}_3$  are sol in  $\text{H}_2\text{O}$ . Those containing more than two equivalents are insol. (Ordway)  
 $\text{Al}_2\text{O}_3$ ,  $3\text{AlCl}_3 + 3\text{H}_2\text{O}$  (Tommasi, Bull. Soc. (2) 37. 443.)  
 $\text{Al}_2\text{O}_3$ ,  $8\text{AlCl}_3 + 3\text{H}_2\text{O}$  (Tommasi)  
 $3\text{Al}_2\text{O}_3$ ,  $\text{AlCl}_3 + 15\text{H}_2\text{O}$ . (Tommasi)
- Aluminum phosphide,  $\text{Al}_3\text{P}$**   
Unstable (Franck, Ch. Z. 1898, 22. 240.)  
 $\text{Al}_3\text{P}$ . Decomp. by  $\text{H}_2\text{O}$ . (Fonzes-Diacon, C. R. 1900, 130. 1315.)  
Unstable. (Franck, Ch. Z. 1898, 22. 240.)  
 $\text{Al}_3\text{P}$ . Decomp by  $\text{H}_2\text{O}$  and acids. (Franck.)  
 $\text{Al}_3\text{P}$ . Decomp. by  $\text{H}_2\text{O}$  and acids (Franck, Ch. Z. 1898, 22. 238)  
 $\text{Al}_3\text{P}$ . Unstable (Franck, Ch. Z. 1898, 22. 240)
- Aluminum platinum,  $\text{Pt}_3\text{Al}_{16}$**   
The Al is dissolved out by  $\text{HCl}$ . (Brunck, B. 1901, 34. 2735.)
- Aluminum selenide,  $\text{Al}_2\text{Se}_3$**   
Decomp. by  $\text{H}_2\text{O}$ . (Fonzes-Diacon, C. R. 1900, 130. 1315)
- Aluminum silicide,  $\text{Al}_3\text{Si}_4$**   
More easily sol. in acids than Al. (Winkler, J. pt. 91. 193)
- Aluminum chromium silicide,  $\text{Al}_2\text{Cr}_2\text{Si}_5$**   
Insol in hot conc.  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and aqua regia. Sol. in cold  $\text{HF}$  or in  $\text{HF} + \text{HNO}_3$ . Sol in molten alkali. Insol. in  $\text{NaOH} + \text{Aq.}$ ,  $\text{KOH} + \text{Aq}$  or fused  $\text{KClO}_3$  or  $\text{KHSO}_4$ . (Manchot and Kieser, A. 1904, 337. 356.)  
 $\text{Al}_2\text{Cr}_2\text{Si}_5$ . Insol. in hot conc.  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and aqua regia. Sol. in  $\text{HF}$  and in molten alkali. (Manchot and Kieser, A. 1904, 337. 358)

**Aluminum tungsten silicide.**

Insol in most acids and aqua regia. Easily sol in HF, HNO<sub>3</sub> and in molten alkali. Not attacked by dil NaOH + Aq. (Manchot and Kieser, A. 1904, 337. 360.)

**Aluminum vanadium silicide, Al<sub>2</sub>V<sub>2</sub>Si<sub>11</sub>.**

Sol. in HF. Not attacked by hot conc HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub> or aqua regia. Decomp. by fusing with NaOH. Stable toward fused KClO<sub>3</sub>. (Manchot, A. 1907, 357. 134.)

**Aluminum sulphide, Al<sub>2</sub>S<sub>3</sub>.**

Decomp. by H<sub>2</sub>O. Sol in acids and alkalis. (Regelsberger, Z. Elektrochem, 1898, 4. 548.) Al<sub>2</sub>S<sub>3</sub>. Decomp in moist air and by H<sub>2</sub>O. (Wohler.) Insol in acetone. (Naumann, B. 1904, 37. 4328.)

**Aluminum chromium sulphide, Al<sub>2</sub>S<sub>3</sub>.CrS.**

Sl. attacked by HCl + Aq. Gradually decomp by HNO<sub>3</sub>. (Houdard, C. R. 1907, 144. 1115.)

**Aluminum magnesium sulphide, Al<sub>2</sub>S<sub>3</sub>, MgS.**

Decomp. by H<sub>2</sub>O, alcohol and acids. (Houdard, C. R. 1907, 144. 1116.)

**Aluminum potassium sulphide.**

Violently decomposed by H<sub>2</sub>O. (St. Claire Deville, J. pr. 71. 293.) Does not exist. (Giatama, R. t. c. 3. 4.)

**Aluminum silver sulphide, 5Al<sub>2</sub>S<sub>3</sub>, 4Ag<sub>2</sub>S.**

(Cambé, Real. Ac. Line (5) 21, II. 838.)

**Aluminum telluride.**

Decomp by H<sub>2</sub>O. (Wohler, Pogg 11. 160.)

**Aluminum titanide, Al<sub>2</sub>Ti.**

Not attacked by H<sub>2</sub>O or by cold HNO<sub>3</sub>. Sl. sol. in warm HNO<sub>3</sub>. Sol. in cold conc. H<sub>2</sub>SO<sub>4</sub> or HCl. Sol. in warm KOH + Aq. (Levy, A. ch. 1902, (6) 25. 449.)

Sol. in HCl and in aqua regia. (Guillet.) Al<sub>2</sub>Ti. Sol. in hot dil. H<sub>2</sub>SO<sub>4</sub> and in hot KOH + aq. Sol. in hot conc acids (Manchot, A. 1907, 357. 142.)

Al<sub>2</sub>Ti<sub>3</sub>. Aluminothermic product is sol. in HCl and aqua regia. (Guillet.)

**Aluminosulphuric acid, Al<sub>2</sub>(SO<sub>4</sub>H)<sub>3</sub> + 7 H<sub>2</sub>O**

Sol. in H<sub>2</sub>O with decomp. into Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>. (Silberberger, M. 1904, 25. 222.)

**Diamidé, N<sub>2</sub>H<sub>4</sub>.**

See Hydrazine.

**Amidochromic acid.****Amidochromates.**

Do not exist. Those described by Darm-

städter and Löwenthal are impure bichromates. (Wyrouboff, Bull. Soc. 1894, (3) 11. 845-53; C. C. 1894, II. 610.)

**Ammonium amidochromate, (NH<sub>4</sub>)NH<sub>2</sub>CrO<sub>3</sub>.**

Very sol in H<sub>2</sub>O. (Löwenthal, Z. anorg. 1894, 6. 363.)

Is ammonium dichromate. (Wyrouboff, Bull. Soc. (3) 11. 845.)

**Lithium amidochromate, LiNH<sub>2</sub>CrO<sub>3</sub>.**

Very sol in H<sub>2</sub>O and acids. (Löwenthal, Z. anorg. 1894, 6. 364.)

**Potassium amidochromate, KCrO<sub>3</sub>NH<sub>2</sub>.**

Sol only in H<sub>2</sub>O. Sat. solution in H<sub>2</sub>O contains 13 % of the salt. (Heintze, J. pr. (2) 4. 214.)

**Amidophosphoric acid, HPO<sub>3</sub>(NH<sub>2</sub>) = PO(NH<sub>2</sub>)(OH)<sub>2</sub>.**

Sol in H<sub>2</sub>O, but decomp. on standing or by heat. (Stokes, Am. Ch. J. 15. 198.)

**Aluminum amidophosphate.**

Ppt. Sol in NH<sub>4</sub>OH + Aq. (Stokes.)

**Ammonium amidophosphate, NH<sub>4</sub>HPO<sub>3</sub>(NH<sub>2</sub>)**

Very sol. in H<sub>2</sub>O. (Stokes.)

**Barium amidophosphate, BaPO<sub>3</sub>(NH<sub>2</sub>) + H<sub>2</sub>O.**

Very sl. sol in H<sub>2</sub>O. (Stokes.) BaH<sub>2</sub>(PO<sub>3</sub>NH<sub>2</sub>)<sub>2</sub> + 2½ H<sub>2</sub>O. Quite difficultly sol. in H<sub>2</sub>O. (Stokes.)

**Calcium amidophosphate, CaPO<sub>3</sub>(NH<sub>2</sub>).**

Much less sol in H<sub>2</sub>O than Ba salt. (Stokes.) CaH<sub>2</sub>(PO<sub>3</sub>NH<sub>2</sub>)<sub>2</sub>. Much less sol. in H<sub>2</sub>O than the Ba salt. (Stokes.)

**Chromic amidophosphate.**

Ppt. Sol. in warm NH<sub>4</sub>OH + Aq. (Stokes.)

**Cobalt amidophosphate.**

Neutral. Ppt.

Acid. Sl. sol. in H<sub>2</sub>O; sol. in NH<sub>4</sub>OH + Aq.

**Cupric amidophosphate.**

Neutral. Sl. sol. in H<sub>2</sub>O.

Acid. Nearly insol. in H<sub>2</sub>O.

**Ferrous amidophosphate.**

Neutral. Sol. in much H<sub>2</sub>O, and in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> or NH<sub>4</sub>OH + Aq.

Acid. Nearly insol. in H<sub>2</sub>O or NH<sub>4</sub>Cl + Aq. Sol. in NH<sub>4</sub>OH + Aq.

**Ferric amidophosphate.**

Neutral. Ppt. Sol. in excess of alkali.

amidophosphate and in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol.  
in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$   
Acid. As the neutral salt.

Hydroxylamine amidophosphate,  
 $(\text{NH}_2\text{O})\text{HPO}_2(\text{NH}_2)$   
Sl. sol. in  $\text{H}_2\text{O}$ . (Stokes)

Lithium amidophosphate,  $\text{LiHPO}_2(\text{NH}_2)$ .  
Sl. sol. in  $\text{H}_2\text{O}$  (Stokes.)

Magnesium amidophosphate,  $\text{MgPO}_2(\text{NH}_2)$   
 $+ 7\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ ; quite easily sol. in dil.  
 $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Stokes)  
 $\text{MgH}_2(\text{PO}_2\text{NH}_2)_2 + 3\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  
 $\text{NH}_4\text{Cl} + \text{Aq}$  (Stokes)

Manganese amidophosphate.  
Neutral Ppt.  
Acid Sl. sol. in  $\text{H}_2\text{O}$ .

Nickel amidophosphate.  
Neutral Ppt. Sol. in  $\text{HC}_2\text{H}_3\text{O}_2$  or  
 $\text{NH}_4\text{OH} + \text{Aq}$   
Acid Sl. sol. in  $\text{H}_2\text{O}$

Potassium amidophosphate,  $\text{K}_2\text{PO}_2(\text{NH}_2)$ .  
Very sol. in  $\text{H}_2\text{O}$  and not decomp. by boiling.  
(Stokes)  
 $\text{KHPO}_2(\text{NH}_2)$ . Easily sol. in cold  $\text{H}_2\text{O}$ ,  
insol. in alcohol. (Stokes)

Silver amidophosphate,  $\text{Ag}_2\text{PO}_2(\text{NH}_2)$ .  
Almost insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  or  
 $\text{NH}_4\text{OH} + \text{Aq}$   
 $\text{AgHPO}_2(\text{NH}_2)$ . Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol.  
in dil.  $\text{HNO}_3$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , also in  
 $\text{NH}_4\text{OH} + \text{Aq}$ .

Sodium amidophosphate,  $\text{Na}_2\text{PO}_2(\text{NH}_2)$   
Not deliquescent, very sol. in  $\text{H}_2\text{O}$ , pptd.  
from aqueous solution by alcohol. (Stokes.)  
 $\text{NaHPO}_2(\text{NH}_2) + \frac{1}{2}(\text{?})\text{H}_2\text{O}$  Nearly insol.  
in cold, and decomp. by hot  $\text{H}_2\text{O}$  Insol. in  
alcohol.

Zinc amidophosphate.  
Neutral. Perceptibly sol. in  $\text{H}_2\text{O}$ .  
Acid. Sl. sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH}$  or  
 $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ .

Diamidophosphoric acid,  $\text{PO}(\text{NH}_2)_2\text{OH}$   
Sol. in cold  $\text{H}_2\text{O}$ ; almost insol. in alcohol,  
stable in the air but decomp. when heated and  
by boiling in aq. solution. (Stokes, Am. Ch.  
J. 1894, 16. 130.)

Barium diamidophosphate,  $[\text{PO}(\text{NH}_2)_2\text{O}]_2\text{Ba}$   
Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol; aq.  
solution decomp. slowly. (Stokes, Am. Ch.  
J. 1894, 16. 134)

Magnesium diamidophosphate,  $[\text{PO}(\text{NH}_2)_2\text{O}]_2\text{Mg}$ .  
Sol. in  $\text{H}_2\text{O}$ , insol. in alcohol. (Stokes.)

Potassium diamidophosphate,  $\text{PO}(\text{NH}_2)_2\text{OK}$ .  
Sol. in  $\text{H}_2\text{O}$ ; not deliquescent; insol. in  
alcohol. (Stokes.)

Silver diamidophosphate,  $\text{PO}(\text{NH}_2)_2\text{OAg}$ .  
Very stable, insol. in  $\text{H}_2\text{O}$ . Very sol. in  
 $\text{NH}_4\text{OH} + \text{Aq}$ . (Stokes.)

Sodium diamidophosphate,  $\text{PO}(\text{NH}_2)_2\text{ONa}$ .  
Sol. in  $\text{H}_2\text{O}$ ; not deliquescent; insol. in  
alcohol (Stokes)

Diamidotrihydroxylphosphoric acid.

Silver diamidotrihydroxylphosphate,  
 $(\text{AgO})_2\text{P}(\text{NHAg})_2$   
(Stokes, Am. Ch. J. 1894, 16. 147)  
 $(\text{AgO})_2\text{P}(\text{NH}_2)(\text{NHAg})$ . Insol. in cold  
 $\text{H}_2\text{O}$  (Stokes)  
 $(\text{AgO})_2\text{P}(\text{NH}_2)_2$  Decomp. by cold  $\text{H}_2\text{O}$   
(Stokes.)  
 $+ 2\text{H}_2\text{O}$  Decomp. by boiling  $\text{H}_2\text{O}$ .  
(Stokes.)

Amidoimidophosphoric acid.

Amidohezimidoheptaphosphoric acid,  $\text{OH}$ .  
 $\text{PO}(\text{NH}_2)[\text{NH PO}(\text{OH})]_6\text{NH PO}(\text{OH})_2$   
 $= \text{P}_7\text{N}_7\text{O}_{15}\text{H}_{18}$   
Known only in solution in  $\text{H}_2\text{O}$ . (Stokes,  
Am. Ch. J. 1898, 20. 758)

Silver diamidopyrimidophosphate,  
 $\text{NH}(\text{PO.NH}_2\text{OAg})_2$ .  
Almost insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
(Stokes, Am. Ch. J. 1894, 16. 136.)

Silver amidotetrimido pentaphosphate,  
 $\text{P}_5\text{N}_4\text{O}_{14}\text{H}_5\text{Ag}_5$   
Ppt. (Stokes, Am. Ch. J. 1898, 20. 752.)

Silver amidohezimidoheptaphosphate,  
 $\text{P}_7\text{N}_7\text{O}_{15}\text{H}_5\text{Ag}_7$   
Ppt., decomp. by acetic acid. (Stokes,  
Am. Ch. J. 1898, 20. 759.)

Sodium amidodiamidotriphosphate,  
 $\text{NH PO}(\text{ONa})_2$   
 $\text{PO ONa} < \text{NHPO}(\text{ONa})\text{NH}_2$ .  
 $= \text{P}_3\text{N}_3\text{O}_4\text{H}_4\text{Na}_4 + \text{H}_2\text{O}$   
Unstable; sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol.  
(Stokes, Am. Ch. J. 1896, 18. 643.)

Sodium amidohezimidoheptaphosphate,  
 $\text{P}_7\text{N}_7\text{O}_{15}\text{H}_5\text{Na}_7$ .  
Sol. in  $\text{H}_2\text{O}$ ; pptd. by alcohol. (Stokes,  
Am. Ch. J. 1898, 20. 758.)

**Amidophosphimic acid.**Silver amidophosphumate,  $P(NH)NH_4(OAg)_3$ .Decomp. by heat; decomp. in contact with  $H_2O$ . (Stokes, Am. Ch. J. 1894, 16. 139.) $(AgO)_3P(NAg)(NHAg)$ . (?) Sl. sol. in  $NH_4OH + Aq$ . (Stokes, Am. Ch. J. 1894, 16. 149.)**Amidosulphonic acid,  $HOSO_2NH_2$ .**Easily sol. in  $H_2O$ , less easily in alcohol. (Berglund, B. 9. 252 and 1896.)Very stable, less easily sol. in  $H_2O$  than its K salt. (Raschig, A. 241. 177.)Stable in air. Non-deliquescent when cold. Sol. in 5 pts  $H_2O$  at  $0^\circ$  and in  $2\frac{1}{2}$  pts.  $H_2O$  at  $70^\circ$ . Solution in  $H_2O$  can be boiled several minutes without decomp. Solubility is decreased by addition of  $H_2SO_4$ , so that if  $1\frac{1}{5}$ – $1\frac{1}{4}$  pt  $H_2SO_4$  is added to  $H_2O$ , 100 pts. of the liquid dissolve only 3 pts  $HOSO_2NH_2$  in the cold. Pptd. from solution by  $HNO_3$  or glacial acetic acid, but not by  $HCl$ . Solubility is decreased by presence of  $NaHSO_4$ . (Divers and Haga, Chem. Soc. 1896, 69. 1641.)**Amidosulphonates.**Easily sol. in  $H_2O$ ; sl. sol. in alcohol**Aluminum amidosulphonate.**Very sol. in  $H_2O$  (Berglund, Bull. Soc. (2) 29. 422.)**Ammonium amidosulphonate,  $(NH_4)NH_2SO_3$ .**Deliquescent. Sol. in  $H_2O$ ; insol. in alcohol.**Ammonium silver amidosulphonate,** $NH_4SO_3(NH_2)$ ,  $AgSO_3(NH_2)$ .

(Ephraim &amp; Gurewitsch, B. 1910, 43. 148.)

**Barium amidosulphonate,  $Ba(NH_2SO_3)_2$ .**Sol. in 3 pts.  $H_2O$ . (Berglund, l.c.)**Cadmium amidosulphonate,  $Cd(NH_2SO_3)_2 + 5H_2O$ .**Very sol. in  $H_2O$  (B.)**Calcium amidosulphonate,  $Ca(NH_2SO_3)_2 + 4H_2O$ .**Very sol. in  $H_2O$  (B.)**Cobalt amidosulphonate,  $Co(NH_2SO_3)_2 + 3H_2O$ .**Sol. in  $H_2O$ . (B.)**Copper amidosulphonate,  $Cu(NH_2SO_3)_2 + 2H_2O$ .**Sol. in  $H_2O$ . (B.)**Gold (auric) potassium amidosulphonate,  $K_3Au_2(NSO_3)_2$ .**

Very sl. sol. in aq., more easily sol. in hot

 $H_2O$  Sol. in dl.  $HCl + Aq$  (Hofmann, B. 1912, 45. 1735.)**Lead amidosulphonate,  $Pb(NH_2SO_3)_2 + H_2O$ .**

The most sol. of all amidosulphonates. (B.)

**Lithium amidosulphonate,  $LiNH_2SO_3$ .**

Deliquescent. (B.)

**Magnesium amidosulphonate.**Very sol. in  $H_2O$ **Manganese amidosulphonate,  $Mn(NH_2SO_3)_2 + 3H_2O$ .**Very sol. in  $H_2O$ . (B.)**Mercuric amidosulphonate, basic,** $Hg(HgOSO_2NH_2)_2$ .Insol. in 3.5 %  $HNO_3 + Aq$ . Very sol. in 3 %  $HCl + Aq$ . (Hofmann, B. 1912, 45. 1733.) $+ 2H_2O$ . Insol. in hot  $H_2O$ . Sol. in  $KOH + Aq$ . (Divers and Haga, Chem. Soc. 1896, 69. 1649.)**Mercuric potassium amidosulphonate,** $KHgNSO_3$ .Very sl. sol. in cold  $H_2O$  and cold dil.  $KOH + Aq$ . Sol. in 3 %  $HCl + Aq$ . (Hofmann, B. 1912, 45. 1732.)**Mercuric sodium amidosulphonate,** $NaHgNSO_3$ .Nearly completely sol. in hot  $H_2O$  (Hofmann, B. 1912, 45. 1734.)**Nickel amidosulphonate,  $Ni(NH_2SO_3)_2 + 3H_2O$ .**Sol. in  $H_2O$ . (B.)**Potassium amidosulphonate,  $KNH_2SO_3$ .**Sol. in  $H_2O$ . (Berglund.)**Potassium silver amidosulphonate,** $NHAgSO_3K + H_2O$ Decomp. by  $H_2O$ , sol. in  $NH_4OH + Aq$ . (Hofmann, B. 1912, 45. 1734.)**Silver amidosulphonate,  $AgNH_2SO_3$ .**Sol. in 15 pts  $H_2O$  at  $19^\circ$  (B.)**Sodium amidosulphonate,  $NaNH_2SO_3$ .**Sol. in  $H_2O$ .**Strontium amidosulphonate,  $Sr(NH_2SO_3)_2 + 4H_2O$ .**Sol. in  $H_2O$ .**Thallium amidosulphonate,  $TlNH_2SO_3$ .**Sol. in  $H_2O$ .**Uranyl amidosulphonate.**Sol. in  $H_2O$ .**Zinc amidosulphonate,  $Zn(NH_2SO_3)_2 + 4H_2O$ .**Sol. in  $H_2O$ .



Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  at various pressures and temperatures: P=partial pressure, i. e. total pressure minus the tension of aqueous vapour at the given temperature; G=grams  $\text{NH}_3$  dissolved in 1 g.  $\text{H}_2\text{O}$  at the given pressure; G at 760=grams  $\text{NH}_3$  that would be contained in 1 g.  $\text{H}_2\text{O}$  if the solubility was proportional to the pressure.

P	0°		20°		40°		100°	
	G at P	G at 760	G at P	G at 760	G at P	G at 760	G at P	G at 760
20	0 082	3 113		....				....
30	0 117	2 960						....
40	0 148	2 820						....
60	0 169	2 522	0 119	1 513				....
80	0 240	2 280	0 141	1 337	0 052	0 497		....
100	0 280	2 127	0 158	1 200	0 064	0 490		....
120	0 316	2 000	0 173	1 095	0 076	0 483		....
140	0 346	1 880	0 187	1 017	0 088	0 476		....
160	0 375	1 780	0 202	0 962	0 099	0 470		....
180	0 398	1 684	0 207	0 918	0 109	0 462		....
200	0 421	1 598	0 232	0 881	0 120	0 454		....
250	0 472	1 434	0 266	0 810	0 145	0 440		....
300	0 519	1 315	0 296	0 750	0 168	0 426		....
350	0 563	1 223	0 325	0 705	0 191	0 414		....
400	0 606	1 152	0 353	0 670	0 211	0 402		....
450	0 650	1 100	0 378	0 638	0 232	0 399		....
500	0 692	1 052	0 403	0 612	0 251	0 382		....
550	0 732	1 012	0 425	0 587	0 269	0 372		....
600	0 770	0 975	0 447	0 566	0 287	0 363		....
650	0 809	0 946	0 470	0 550	0 304	0 355		....
700	0 850	0 923	0 493	0 534	0 320	0 347	0 068	0 074
750	0 891	0 903	0 514	0 521	0 335	0 339	0 073	0 074
760	0 899	0 899	0 518	0 518	0 338	0 338	0 074	0 074
800	0 937	0 888	0 535	0 504	0 349	0 332	0 078	0 074
850	0 980	0 876	0 556	0 497	0 363	0 325	0 083	0 074
900	1 029	0 869	0 574	0 485	0 378	0 319	0 088	0 074
950	1 077	0 862	0 594	0 475	0 391	0 313	0 092	0 073
1000	1 126	0 855	0 613	0 466	0 404	0 307	0 096	0 073
1050	1 177	0 852	0 632	0 457	0 414	0 300	0 101	0 073
1100	1 230	0 850	0 651	0 450	0 425	0 294	0 106	0 073
1150	1 283	0 848	0 669	0 442	0 434	0 287	0 110	0 073
1200	1 336	0 846	0 685	0 433	0 445	0 282	0 115	0 073
1250	1 388	0 844	0 704	0 428	0 454	0 276	0 120	0 073
1300	1 442	0 843	0 722	0 422	0 463	0 271	0 125	0 073
1350	1 496	0 842	0 741	0 417	0 472	0 266	0 130	0 073
1400	1 549	0 841	0 761	0 413	0 479	0 260	0 135	0 073
1450	1 603	0 840	0 780	0 409	0 486	0 255		....
1500	1 658	0 839	0 801	0 406	0 493	0 250		....
1600	1 758	0 835	0 842	0 400	0 511	0 242		....
1700	1 861	0 832	0 881	0 394	0 530	0 237		....
1800	1 966	0 830	0 919	0 388	0 547	0 231		....
1900	2 070	0 828	0 955	0 382	0 565	0 226		....
2000			0 993	0 377	0 579	0 220		....
2100					0 594	0 215		....

(Sims, A. 118. 346.)

Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  at temps. below  
 1°. One gram  $\text{H}_2\text{O}$  dissolves

grams $\text{NH}_3$	Temp.
0.947	-3.9°
1.115	-10°
1.768	-20°
2.781	-30°
2.946	-40°

(Mallet, Ann. Ch. J. 1897, 19. 807)

The solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  does not follow Dalton's law at ord. temp., but does at temp. near 100°. (Konowaloff, J. Russ. Phys. Chem. Soc. 1894, 26. 48; Chem. Soc. 1896, 70 (2). 351.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
32.3*	0.8750	14.53	0.9435
29.25	0.8857	13.46	0.9476
26	0.9000	12.40	0.9513
25.37*	0.9054	11.56	0.9545
22.07	0.9166	10.82	0.9573
19.54	0.9255	10.17	0.9597
17.52	0.9326	9.6	0.9616
15.88	0.9385	9.5*	0.9632

(H. Davy, Elements, 1. 241)

\* By direct experiment. The other numbers were obtained by calculation, making no allowance for compensation.

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at 16°, according to Otto in his Lehrbuch.

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
12.000	0.9517	8.500	0.9650
11.875	0.9521	8.375	0.9654
11.750	0.9526	8.250	0.9659
11.625	0.9531	8.125	0.9664
11.500	0.9536	8.000	0.9669
11.375	0.9540	7.875	0.9673
11.250	0.9545	7.750	0.9678
11.125	0.9550	7.625	0.9683
11.000	0.9555	7.500	0.9688
10.950	0.9556	7.375	0.9692
10.875	0.9559	7.250	0.9697
10.750	0.9564	7.125	0.9702
10.625	0.9569	7.000	0.9707
10.500	0.9574	6.875	0.9711
10.375	0.9578	6.750	0.9716
10.250	0.9583	6.625	0.9721
10.125	0.9588	6.500	0.9726
10.000	0.9593	6.375	0.9730
9.875	0.9597	6.250	0.9735
9.750	0.9602	6.125	0.9740
9.625	0.9607	6.000	0.9745
9.500	0.9612	5.875	0.9749
9.375	0.9616	5.750	0.9754
9.250	0.9621	5.625	0.9759
9.125	0.9626	5.500	0.9764
9.000	0.9631	5.375	0.9768
8.875	0.9636	5.250	0.9773
8.750	0.9641	5.125	0.9778
8.625	0.9645	5.000	0.9783

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$ , according to Ure in Dict. of Arts

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
27.940	0.8914	15.900	0.9363
27.633	0.8937	14.575	0.9410
27.038	0.8967	13.250	0.9455
26.751	0.8983	11.925	0.9510
26.500	0.9000	10.600	0.9564
25.175	0.9045	9.275	0.9614
23.850	0.9090	7.950	0.9662
22.525	0.9133	6.625	0.9716
21.200	0.9177	5.300	0.9768
19.875	0.9227	3.975	0.9828
18.550	0.9275	2.650	0.9887
17.225	0.9320	1.325	0.9945

Sp. gr. b.-pt., and vols. gas in  $\text{NH}_4\text{OH} + \text{Aq}$ .

% $\text{NH}_3$	Sp. gr.	B.-pt.	Vols. gas in 1 vol. liquid
35.3	0.85	-3.3°	494
32.6	0.86	+3.3°	456
29.9	0.87	10°	419
27.3	0.88	16.6°	382
24.7	0.89	23.3°	346
22.2	0.90	30°	311
19.8	0.91	36.6°	277
17.4	0.92	43.3°	244
15.1	0.93	50°	211
12.8	0.94	56.6°	180
10.5	0.95	63.3°	147
8.3	0.96	70°	116
6.2	0.97	78.3°	87
4.1	0.98	86.1°	57
2.0	0.99	91.1°	28

(Dalton, in New System, 2. 422.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  sat. at t°

t°	Sp. gr.	t°	Sp. gr.	t°	Sp. gr.
0	0.8535	9	0.8740	18	0.8903
1	0.8561	10	0.8766	19	0.8916
2	0.8587	11	0.8785	20	0.8923
3	0.8611	12	0.8804	21	0.8940
4	0.8635	13	0.8823	22	0.8952
5	0.8658	14	0.8841	23	0.8963
6	0.8681	15	0.8858	24	0.8974
7	0.8703	16	0.8874	25	0.8984
8	0.8725	17	0.8889		

(Carius, A. 99. 141.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at 14°, according to Carius (A. 99. 148).

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
36.0	0.8844	35.2	0.8860
35.8	0.8848	35.0	0.8864
35.6	0.8852	34.8	0.8868
35.4	0.8856	34.6	0.8872

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $14^\circ$ , etc.—Cont.

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
34.4	0.8877	22.2	0.9185
34.2	0.8881	22.0	0.9191
34.0	0.8885	21.8	0.9197
33.8	0.8889	21.6	0.9203
33.6	0.8894	21.4	0.9209
33.4	0.8898	21.2	0.9215
33.2	0.8903	21.0	0.9221
33.0	0.8907	20.8	0.9227
32.8	0.8911	20.6	0.9233
32.6	0.8916	20.4	0.9239
32.4	0.8920	20.2	0.9245
32.2	0.8925	20.0	0.9251
32.0	0.8929	19.8	0.9257
31.8	0.8934	19.6	0.9264
31.6	0.8938	19.4	0.9271
31.4	0.8944	19.2	0.9277
31.2	0.8948	19.0	0.9283
31.0	0.8953	18.8	0.9289
30.8	0.8957	18.6	0.9296
30.6	0.8962	18.4	0.9302
30.4	0.8967	18.2	0.9308
30.2	0.8971	18.0	0.9314
30.0	0.8976	17.8	0.9321
29.8	0.8981	17.6	0.9327
29.6	0.8986	17.4	0.9333
29.4	0.8991	17.2	0.9340
29.2	0.8996	17.0	0.9347
29.0	0.9001	16.8	0.9353
28.8	0.9006	16.6	0.9360
28.6	0.9011	16.4	0.9366
28.4	0.9016	16.2	0.9373
28.2	0.9021	16.0	0.9380
28.0	0.9026	15.8	0.9386
27.8	0.9031	15.6	0.9393
27.6	0.9036	15.4	0.9400
27.4	0.9041	15.2	0.9407
27.2	0.9047	15.0	0.9414
27.0	0.9051	14.8	0.9420
26.8	0.9057	14.6	0.9427
26.6	0.9063	14.4	0.9434
26.4	0.9068	14.2	0.9441
26.2	0.9073	14.0	0.9449
26.0	0.9078	13.8	0.9456
25.8	0.9083	13.6	0.9463
25.6	0.9089	13.4	0.9470
25.4	0.9094	13.2	0.9477
25.2	0.9100	13.0	0.9484
25.0	0.9106	12.8	0.9491
24.8	0.9111	12.6	0.9498
24.6	0.9116	12.4	0.9505
24.4	0.9122	12.2	0.9512
24.2	0.9127	12.0	0.9520
24.0	0.9133	11.8	0.9527
23.8	0.9139	11.6	0.9534
23.6	0.9145	11.4	0.9542
23.4	0.9150	11.2	0.9549
23.2	0.9156	11.0	0.9556
23.0	0.9162	10.8	0.9563
22.8	0.9168	10.6	0.9571
22.6	0.9174	10.4	0.9578
22.4	0.9180	10.2	0.9586

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $14^\circ$ , etc.—Cont.

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
10.0	0.9593	5.0	0.9790
9.8	0.9601	4.8	0.9799
9.6	0.9608	4.6	0.9807
9.4	0.9616	4.4	0.9815
9.2	0.9623	4.2	0.9823
9.0	0.9631	4.0	0.9831
8.8	0.9639	3.8	0.9839
8.6	0.9647	3.6	0.9847
8.4	0.9654	3.4	0.9855
8.2	0.9662	3.2	0.9863
8.0	0.9670	3.0	0.9873
7.8	0.9677	2.8	0.9882
7.6	0.9685	2.6	0.9890
7.4	0.9693	2.4	0.9899
7.2	0.9701	2.2	0.9907
7.0	0.9709	2.0	0.9915
6.8	0.9717	1.8	0.9924
6.6	0.9725	1.6	0.9932
6.4	0.9733	1.4	0.9941
6.2	0.9741	1.2	0.9950
6.0	0.9749	1.0	0.9959
5.8	0.9757	0.8	0.9967
5.6	0.9765	0.6	0.9975
5.4	0.9773	0.4	0.9983
5.2	0.9781	0.2	0.9991

Hager also gives a table in his *Commentar zur Pharmacopoea*, which is practically identical with those here given.

Strength of  $\text{NH}_4\text{OH} + \text{Aq}$  of certain sp. gr. at  $12^\circ$ .

Sp. gr.	1 kg solution contains g $\text{NH}_3$	1 l solution contains g $\text{NH}_3$	1 litre consists of	
			$\text{H}_2\text{O}$ in cc	liquid $\text{NH}_3$ in cc
0.870	384.4	334.5	535.5	464.5
0.880	347.2	305.5	574.5	425.5
0.890	311.6	277.3	612.7	387.3
0.900	277.3	249.5	650.5	349.5
0.910	244.9	222.8	687.2	312.8
0.920	213.4	196.3	723.7	276.3
0.930	182.9	170.1	759.9	240.1
0.940	152.9	143.7	796.3	203.7
0.950	124.2	118.0	832.0	168.0
0.960	97.0	93.1	866.9	133.1
0.970	70.2	68.0	902.0	98.0
0.980	45.3	44.3	935.7	64.3
0.990	21.0	20.7	969.3	30.7

(Wachsmuth, *Arch. Pharm.* (3) 8. 510.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$   
(Most careful experiments)

Sp. gr.	% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$
0.990	2.15	0.926	19.50
0.974	6.10	0.916	22.50
0.950	12.54	0.910	24.40

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ —Continued

Sp. gr.	% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$
0 900	27 70	0 882	34 8
0 890	31 40	0 880	35 5
0 885	33.5		

(Grüneberg, Chem. Ind 12, 97)

The following table is calculated from the above by interpolation:—

Sp. gr.	% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$
0 995	1 05	0 935	16 90
0 990	2 15	0 930	18 35
0 985	3 30	0 925	19 80
0 980	4 50	0 920	21 30
0 975	5 75	0 915	22 85
0 970	7 05	0 910	24 40
0 965	8 40	0 905	26 00
0 960	9 80	0 900	27 70
0 955	11 20	0 895	29 50
0 950	12 60	0 890	31 40
0 945	14 00	0 885	33 40
0 940	15 45	0 880	35 50

(Grüneberg.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $14^\circ$ 

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
31	0 8933	15 6	0 9400
23.8	0 9116	11 7	0 9536
20 4	0 9246	5 1	0 9780

(Lunge and Smith, B. 17, 777.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ , according to Lunge and Wiernik (Zeit. f. angew. Ch. 1889, 183).

(Most carefully worked out and calculated)

Sp. gr.	% $\text{NH}_3$	1 l contains g. $\text{NH}_3$	Correction for $\pm 1^\circ$
1.000	0.00	0 0	0 00018
0.998	0 45	4 5	0 00018
0 996	0 91	9 1	0 00019
0 994	1 37	13 6	0 00019
0 992	1 84	18 2	0 00020
0 990	2 31	22 9	0 00020
0 988	2 80	27 7	0 00021
0 986	3 30	32 5	0 00021
0 984	3 80	37 4	0 00022
0 982	4 30	42 2	0 00022
0 980	4 80	47 0	0 00023
0 978	5 30	51 8	0 00023
0 976	5 80	56 6	0 00024
0 974	6 30	61 4	0 00024
0 972	6 80	66 1	0 00025
0 970	7 31	70 9	0 00025
0 968	7 82	75 7	0 00026

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ , etc.—Continued

Sp. gr.	% $\text{NH}_3$	1 l contains g. $\text{NH}_3$	Correction for $\pm 1^\circ$
0 966	8 33	80 5	0 00026
0 964	8 84	85 2	0 00027
0 962	9 35	89 9	0 00028
0 960	9 81	95.1	0 00029
0 958	10 47	100 3	0 00030
0 956	11 03	105 4	0 00031
0 954	11 60	110.7	0 00032
0 952	12 17	115 9	0 00033
0 950	12 74	121 0	0 00034
0 948	13 31	126.2	0 00035
0 946	13 88	131 3	0 00036
0 944	14 46	136 5	0 00037
0 942	15 04	141 7	0 00038
0 940	15 63	146 9	0 00039
0 938	16 22	152 1	0 00040
0 936	16 82	157 4	0 00041
0 934	17 42	162 7	0 00041
0 932	18 03	168 1	0 00042
0 930	18 64	173 4	0 00042
0 928	19 25	178 6	0 00043
0 926	19 87	184 2	0 00044
0 924	20 49	189 3	0 00045
0 922	21 12	194.7	0 00046
0 920	21 75	200 1	0 00047
0 918	22 39	205 6	0 00048
0 916	23 03	210.9	0 00049
0 914	23 68	216 3	0 00050
0 912	24 33	221 9	0 00051
0 910	24 99	227.4	0 00052
0 908	25 65	232 9	0 00053
0 906	26 31	238 3	0 00054
0 904	26 98	243.9	0 00055
0 902	27 65	249 4	0 00056
0 900	28 33	255 0	0 00057
0 898	29 01	260 5	0 00058
0 896	29 69	266 0	0 00059
0 894	30 37	271 5	0 00060
0 892	31 05	277 0	0 00060
0 890	31 75	282.6	0 00061
0 888	32 50	288 6	0 00062
0 886	33 25	294.6	0 00063
0 884	34 10	301.4	0 00064
0 882	34 95	308 3	0 00065

 $\text{NH}_3$  is much less sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ .Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$ , and  $\text{KOH} + \text{Aq}$  of various strengths; 100 pts. solvent absorbs g.  $\text{NH}_3$  at  $t^\circ$ .

$t^\circ$	$\text{H}_2\text{O}$	$\text{KOH} + \text{Aq}$ 11.25% $\text{K}_2\text{O}$	$\text{KOH} + \text{Aq}$ 26.25% $\text{K}_2\text{O}$
0	90 00	72 00	49.50
8	72 75	57 00	37 50
16	59 75	46 00	28.50
24	49.50	37.25	21.75

(Result A ch. (5) 1 989)

100 pts. sat. KOH + Aq dissolve only 1 pt.  $\text{NH}_3$ .

Solubility in NaOH + Aq is the same as in KOH + Aq of the same strength.

$\text{NH}_4\text{Cl}$  + Aq absorbs slightly less  $\text{NH}_3$  than the same vol.  $\text{H}_2\text{O}$ .  $\text{NaNO}_3$  and  $\text{NH}_4\text{NO}_3$  + Aq absorb almost the same amount  $\text{NH}_3$  as the same vol.  $\text{H}_2\text{O}$ . (Raoult, *l.c.*)

Solubility of  $\text{NH}_3$  in 100 pts.  $\text{Ca}(\text{NO}_3)_2$  + Aq

t°	$\text{H}_2\text{O}$	$\text{Ca}(\text{NO}_3)_2$ + Aq 28.33% $\text{Ca}(\text{NO}_3)_2$	$\text{Ca}(\text{NO}_3)_2$ + Aq 59.03% $\text{Ca}(\text{NO}_3)_2$
0	90.00	96.25	104.50
8	72.75	78.50	84.75
16	59.75	65.00	70.50

(Raoult, *l.c.*)

Solubility in salt solutions at 25°C.

Salt	Mols $\text{NH}_3$ soluble in 1 liter of		
	5-normal solution	1-normal solution	1 5-normal solution
KCl	0.930	0.866	0.809
KBr	0.950	0.904	0.857
KI	0.970	0.942	0.900
KOH	0.852	0.716	0.607
NaCl	0.938	0.889	0.843
NaBr	0.965	0.916	0.890
NaI	0.995	0.992	0.985
NaOH	0.876	0.789	0.716
LiCl	0.980	1.008	1.045
LiBr	1.001	1.040	1.090
LiI	1.030	1.094	1.190
LiOH	0.865	0.808	0.768
KF	0.839	0.722	0.626
$\text{KNO}_3$	0.923	0.852	0.804
$\text{KNO}_2$	0.920	0.855	0.798
KCN	0.926	0.858	0.802
KCNS	0.932	0.868	0.814
$\frac{1}{2}\text{K}_2\text{SO}_4$	0.875	0.772	0.678
$\frac{1}{2}\text{K}_2\text{S}_2\text{O}_8$	0.865	0.768	0.675
$\frac{1}{2}\text{K}_2\text{CO}_3$	0.788	0.650	0.554
$\frac{1}{2}\text{K}_2\text{C}_2\text{O}_4$	0.866	0.771	0.675
$\frac{1}{2}\text{K}_2\text{Cr}_2\text{O}_7$	0.866	0.771	0.675
$\text{CH}_3\text{COOK}$	0.866	0.765	0.685
HCOOK	0.868	0.760	0.678
$\text{KBO}_2$	0.814	0.677	0.560
$\frac{1}{2}\text{K}_2\text{HPO}_4$	0.860	0.749	0.664
$\frac{1}{2}\text{Na}_2\text{S}$	0.887	0.795	0.726
$\text{KClO}_4$ 0.25-norm.	0.927	...	...
$\text{KBrO}_3$ 0.25-norm.	0.940	...	...
$\text{KIO}_3$ 0.25-norm.	0.951	...	...

(Abegg & Riesenfeld, Z. phys. Ch. 1902, 40. 100)

Solubility in salts + Aq at 35°C.

Salt	Concentration of the aq. solution	Mols $\text{NH}_3$ soluble in 1 liter of solution
KCl	0.5 normal	0.923
NaCl	"	0.966
$\text{CH}_3\text{COOK}$	"	0.902
$\frac{1}{2}(\text{COOK})_2$	"	0.902
KOH	"	0.870
NaOH	"	0.896
$\frac{1}{2}\text{K}_2\text{CO}_3$	0.426 normal	0.914
$\frac{1}{2}\text{Na}_2\text{CO}_3$	"	0.932

(Riesenfeld, Z. phys. Ch. 1903, 45. 462)

The solubility of  $\text{NH}_3$  in  $\text{NaNO}_3$ ,  $\text{NH}_4\text{NO}_3$  and in  $\text{AgNO}_3 \cdot 2\text{NH}_3$  + Aq is nearly the same as in pure  $\text{H}_2\text{O}$  (Konowaloff, C. C. 1898, II. 659)

Distribution-coefficient of  $\text{NH}_3$  between water and  $\text{CHCl}_3$  = 26.3 at 20°; 24.9 at 25°; 23.2 at 30°.

The distribution-coefficient of  $\text{NH}_3$  between  $\text{CHCl}_3$  and a number of salt solutions has been determined for the purpose of studying the nature of metal-ammonia compounds in aqueous solution. (Dawson, Chem. Soc. 1900, 77. 1242.)

Distribution of  $\text{NH}_3$  between  $\text{H}_2\text{O}$  and  $\text{CHCl}_3$  at 18°.

$\text{NH}_3$ concentration in aqueous solution, mols./litre	$\text{NH}_3$ concentration in $\text{CHCl}_3$ solution, mols./litre
0.9280	0.03506
1.921	0.07703
2.064	0.08350
2.274	0.09317
2.590	0.1083
3.700	0.1639
4.333	0.1996

(Dawson, Z. phys. Ch. 1909, 69. 120)

Distribution of  $\text{NH}_3$  between hydroxides + Aq and  $\text{CHCl}_3$  at 18°

Aqueous solution	$\text{NH}_3$ concentration in the aqueous solution, mols./litre	$\text{NH}_3$ concentration in the $\text{CHCl}_3$ solution, mols./litre
0.2-N. KOH	1.949	0.0841
0.5-N. KOH	1.978	0.0951
0.2-N. NaOH	2.016	0.0869
0.5-N. NaOH	1.944	0.0907
0.2-N. $\frac{1}{2}\text{Ba}(\text{OH})_2$	2.076	0.08905
0.5-N. $\frac{1}{2}\text{Ba}(\text{OH})_2$	3.397	0.1560

(Dawson, *l.c.*)

Distribution of  $\text{NH}_3$  between  $\text{Cu}(\text{OH})_2 + \text{Aq}$  and  $\text{CHCl}_3$  at  $18^\circ$ 

Cone. of $\text{Cu}(\text{OH})_2$ , equivalents/litre	$\text{NH}_3$ concentration in aqueous solution, mols./litre	$\text{NH}_3$ concentration in $\text{CHCl}_3$ solution, mols./litre
0.041	2.014	0.07968
0.0705	2.653	0.1087
0.081	3.011	0.1247

(Dawson, *l.c.*)

## Sol. in alcohol and ether.

Sol. in 3 pts. alcohol of  $38^\circ$  (Boulay)1 vol. alcohol of 0.829 sp. gr. absorbs about 50 vols.  $\text{NH}_3$ . (Davy)Much less sol. in ethyl, propyl, or amyl alcohol than in  $\text{H}_2\text{O}$ . (Pagliano and Emo, Gazz. ch. it 13. 278)Solubility of  $\text{NH}_3$  in alcohol at  $t^\circ$ : weight  $\text{NH}_3$  = weight  $\text{NH}_3$  contained in a litre of solution sat. at 760 mm. and  $t^\circ$ , sp. gr. = sp. gr. of solution; C = coefficient of solubility.

Temp	Degree of Alcohol	$100^\circ$	$90^\circ$	$80^\circ$	$70^\circ$	$60^\circ$	$50^\circ$
$0^\circ$	Weight $\text{NH}_3$	130.5	146.0	206.5		246.0	304.5
	Sp. gr.	0.782	0.783	0.808		0.830	0.835
	C	209.5	245.0	390.0		504.5	697.7
$10^\circ$	Weight $\text{NH}_3$	108.5	120.0	167.0		198.25	227.0
	Sp. gr.	0.787	0.803	0.800	....	0.831	0.850
	C	164.3	186.0	288.0		373.0	438.6
$20^\circ$	Weight $\text{NH}_3$	75.0	97.5	119.75	137.5	152.5	182.7
	Sp. gr.	0.791	0.788	0.821	0.829	0.842	0.869
	C	106.6	147.8	190.5	223.0	260.8	338.2
$30^\circ$	Weight $\text{NH}_3$	51.5	74.0	81.75	100.3	129.5	152.0
	Sp. gr.	0.798	0.791	0.826		0.846	0.883
	C	97.0	186.7	121.6		211.6	252.0

(Delépine, J. Pharm. (5) 25. 496.)

Solubility of  $\text{NH}_3$  in methyl alcohol (absolute) at  $t^\circ$ .

$t^\circ$	% $\text{NH}_3$	Pts. $\text{NH}_3$ per 100 pts. alcohol
0	29.3	41.5
6	26.0	35.2
11.7	23.5	30.7
14.7	21.8	27.9
17	20.8	26.3
22	18.3	22.4
28.4	14.8	17.4

(de Bruyn, *l.c.*)

Readily sol. in ether.

Sol. in 0.4 vol. petroleum from Amiano. (Sausure)

1 vol. oil of turpentine absorbs 7.5 vols.  $\text{NH}_3$  at  $16^\circ$ 1 vol. oil of lemon absorbs 8.5 vols.  $\text{NH}_3$  at  $16^\circ$ .Solubility of  $\text{NH}_3$  in ethyl alcohol (absolute) at  $t^\circ$ .

$t^\circ$	% $\text{NH}_3$	Pts. $\text{NH}_3$ per 100 pts. alcohol
0	19.7	24.5
6	17.1	20.6
11.7	14.1	16.4
14.7	13.2	15.2
17	12.6	14.7
23	10.9	12.2
28.4	9.2	10.1

(de Bruyn, R. t. c. 11. 112)

1 vol. abs. alcohol at  $20^\circ$  and 760 mm. pressure absorbs 340 vols.  $\text{NH}_3$  gas. (Müller, W. Ann. 1891, 43. 567.)1 l methyl alcohol sat. with  $\text{NH}_3$  contains 218 g.  $\text{NH}_3$  at  $0^\circ$ ; sp. gr. of solution = 0.770; coefficient of solubility = 425.0 (Delépine)1 vol. oil of rosemary absorbs 9.75 vols.  $\text{NH}_3$  at  $29^\circ$ .1 vol. oil of lavender absorbs 47 vols.  $\text{NH}_3$  at  $20^\circ$ . (Sausure.)1 vol. caoutchouc absorbs 3 vols.  $\text{NH}_3$ . (Himly.)Valerol absorbs much  $\text{NH}_3$ . (Gerhardt, A. ch (3) 7. 278.)1 vol. ether at 760 mm. pressure absorbs 17.13 vols.  $\text{NH}_3$  at  $0^\circ$ ; 12.35 vols. at  $10^\circ$  and 10.27 vols. at  $15^\circ$ . (Christoff, Z. phys. Ch. 1912, 79. 459.)+  $\text{H}_2\text{O}$ . Colorless crystals.+  $\frac{1}{2}\text{H}_2\text{O}$ . Large transparent crystals. (Rupert, J. Am. Chem. Soc. 1909, 31. 868.)

Ammonia, with metal salts.

For the ammonia addition-products of metal salts, see under the respective metal salts, except in the case of Co, Cr, Hg, and the Pt metals, for which see cobalt ammonium, chromium ammonium, etc.

further reference. New data on Co and Cr ammonium compounds and those of the Pt metals, published since the first edition, has not been included in the present edition

Ammonium amalgam,  $\text{NH}_4 \cdot \text{xHg}$ .

Decomp. by  $\text{H}_2\text{O}$ , but more easily in presence of naphtha, alcohol, or ether.

Ammonium azoimide,  $\text{N}_4\text{H}_4 = \text{NH}_4\text{N}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ , sl. sol. in absolute alcohol, easily in 80% alcohol. Insol. in ether or benzene. (Curtius, B. 24. 3344)

Ammonium cobalt azoimide,  $\text{NH}_4\text{N}_3 \cdot \text{CoN}_3$ .

Rather sol. in  $\text{H}_2\text{O}$ . (Curtius and Rissom, J. pr. 1898, (2) 68. 302.)

Ammonium bromide,  $\text{NH}_4\text{Br}$ .

Easily sol. in  $\text{H}_2\text{O}$  with absorption of much heat.

1 pt.  $\text{NH}_4\text{Br}$  dissolves in pts.  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$
10	1 51	30	1 23	100	0 78
16	1 39	50	1 06		

(Eder, W. A. B. 82. (2) 1284.)

$\text{NH}_4\text{Br} + \text{Aq}$  containing 41.09%  $\text{NH}_4\text{Br}$  is sat. at  $15^\circ$ . (Gerlach.)

Sp. gr. of  $\text{NH}_4\text{Br} + \text{Aq}$  at  $15^\circ$ .

% $\text{NH}_4\text{Br}$	Sp. gr.	% $\text{NH}_4\text{Br}$	Sp. gr.
5	1 0326	20	1 1285
10	1 0652	30	1 1921
15	1 0960	41 09	1 2920

(Eder.)

Sp. gr. of  $\text{NH}_4\text{Br} + \text{Aq}$  at  $16^\circ$ .

% $\text{NH}_4\text{Br}$	Sp. gr.	% $\text{NH}_4\text{Br}$	Sp. gr.
2	1 0119	22	1 1375
3	1.0181	23	1 1440
4	1 0242	24	1 1506
5	1 0303	25	1 1573
6	1 0364	26	1 1642
7	1 0425	27	1.1713
8	1.0486	28	1.1787
9	1 0547	29	1 1862
10	1 0609	30	1.1938
11	1 0672	31	1 2018
12	1 0735	32	1 2098
13	1 0798	33	1 2180
14	1 0862	34	1 2260
15	1.0926	35	1 2342
16	1 0988	36	1 2425
17	1 1051	37	1.2509
18	1 1115	38	1 2594
19	1 1181	39	1.2679
20	1 1246	40	1 2765
21	1 1310	41	1 2850

(Hager, Comm. 1883.)

25 g.  $\text{NH}_4\text{Br} + 50$  g.  $\text{H}_2\text{O}$  lower the temp. from  $15.1^\circ$  to  $-1.1^\circ$ . (Rüdorff.)

Sol. in liquid  $\text{NH}_3$  at  $-50^\circ$ . (Moissan C R. 1901, 133. 713.)

Very sol. in liquid  $\text{NH}_3$ . (Frankhn, Am. Ch. J. 1898, 20. 828.)

Sl. sol. in alcohol.

1 pt.  $\text{NH}_4\text{Br}$  dissolves in 32.3 pts. alcohol (0.806 sp. gr.) at  $15^\circ$ ; 9.5 pts. at  $78^\circ$ . (Eder, l.c.)

100 pts. absolute methyl alcohol dissolve 12.5 pts. at  $19^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 3.22 pts. at  $19^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

Solubility in mixtures of methyl and ethyl alcohol at  $25^\circ$ .

P = % methyl alcohol in the solvent.

G = g.  $\text{NH}_4\text{Br}$  in 10 cc. of the solution.

S = sp. gr. of the sat. solution at  $25^\circ/4^\circ$ .

P	G	S
0 00	0 255	0 8065
4 37	0.299	0 8083
10 40	0.321	0.8117
41 02	0.506	0 8252
80 69	0.813	0.8501
84 77	0.847	0.8508
91 25	0 934	0 8551
100 00	0 983	0 8605

(Heiz, Z. anorg. 1908, 60. 156.)

Solubility in mixtures of methyl and propyl alcohol at  $25^\circ$

P = % propyl alcohol in the solvent.

G = g.  $\text{NH}_4\text{Br}$  in 10 cc. of the solution.

S = Sp. gr. of the sat. solution at  $25^\circ/4^\circ$ .

P	G	S
0	0 983	0 8605
11 11	0 851	0 8524
23 8	0 690	0.8426
65 2	0 308	0 8184
91.8	0 128	0.8097
93 75	0 125	0.8089
100	0.095	0 8059

(Herz, l.c.)

Solubility in mixtures of propyl and ethyl alcohol at  $25^\circ$ .

P = % propyl alcohol in the solvent.

G = g.  $\text{NH}_4\text{Br}$  in 10 cc. of the solution.

S = Sp. gr. of the sat. solution at  $25^\circ/4^\circ$ .

P	G	S
0	0 255	0 8065
8.1	0 251	0.8062
17 85	0 237	0 8052
56.6	0 163	0 8048
88.6	0.111	0 8042
91 2	0.105	0 8049
95 2	0 104	0.8059
100	0 095	0 8059

(Herz, l.c.)

Sol. in 809 pts. ether (0.729 sp. gr.). (Eder, l.c.)

Sol. in acetone. (Eidmann, C. C. 1899. II, 1014); (Naumann, B. 1904, 37. 4328.)

Insol. in benzonitrile (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethylacetate. (Naumann, B. 1910, 43. 314.)

#### Ammonium tribromide, $\text{NH}_4\text{Br}_3$ .

Gives off Br in air. Sol. in  $\text{H}_2\text{O}$ . (Roozeboom, B. 14. 2398.)

Decomp. in the air. Very sol. in  $\text{H}_2\text{O}$ . (Chattaway, Chem. Soc. 1915, 107. 106.)

#### Ammonium antimony bromide, $3\text{NH}_4\text{Br}$ , $2\text{SbBr}_3$

Easily sol. in abs. alcohol. (Caven, C. C. 1905. II, 293.)

$7\text{NH}_4\text{Br}$ ,  $3\text{SbBr}_3$ . Easily sol. in abs. alcohol. (Caven, C. C. 1905. II, 293.)

See also Bromantimonate, ammonium.

#### Ammonium bismuth bromide, $\text{NH}_4\text{Br}$ , $\text{BiBr}_3$ , $+\text{H}_2\text{O}$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol. (Nicklès, C. R. 51. 1097.)

#### Ammonium cadmium bromide, $\text{NH}_4\text{Br}$ , $\text{CdBr}_2$ , $+\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in 0.73 pt.  $\text{H}_2\text{O}$ , 5.3 pts. abs. alcohol, 280 pts. ether (sp. gr. 0.729), and 24 pts. alcohol ether (1:1). (Eder, Dingl. 221. 89.)

Sol. in  $\text{H}_2\text{O}$  without decomp. between  $1^\circ$  and  $110.1^\circ$ .

100 pts. of the solution contain at:

$1^\circ$  14.8° 52.2° 110.1°  
53.82 58.01 65.32 75.83 pts. of the salt.  
(Rimbach, B. 1905, 38. 1555.)

$4\text{NH}_4\text{Br}$ ,  $\text{CdBr}_2$ . Sol. in 0.96 pt.  $\text{H}_2\text{O}$ , from which it is pptd. by alcohol or ether. (Eder.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

Below  $180^\circ$  the salt is decomp. by  $\text{H}_2\text{O}$ ; at  $180^\circ$  it is sol. in  $\text{H}_2\text{O}$  without decomp

$t^\circ$	100 pts. of the solution contain			Solid phase
	Pts. Cd	Pts. Br	Pts. $\text{NH}_4$	
0.8	14.72	50.46	6.67	Double salt $+\text{NH}_4\text{Br}$
13.0	14.94	51.48	6.85	
44.5	15.01	53.85	7.35	
76.4	14.60	55.28	7.80	"
123.5	15.50	59.50	8.45	
160.0	14.70	62.67	9.43	
				Double salt

(Rimbach, B. 1905, 38. 1558.)

Not sol. in  $\text{HBr}+\text{Aq}$  without decomp. (Rimbach.)

Not sol without decomp. in  $\text{LiBr}+\text{Aq}$ ,  $\text{CaBr}_2+\text{Aq}$ ,  $\text{MgBr}_2+\text{Aq}$ ,  $\text{NiBr}_2+\text{Aq}$ , or

$\text{CoBr}_2+\text{Aq}$ , even though very conc. solutions are used. Sol. without decomp. in  $\text{ZnBr}_2+\text{Aq}$ . (Rimbach, B. 1905, 38. 1571.)

#### Ammonium chloromolybdenum bromide, $2\text{NH}_4\text{Br}$ , $\text{Cl}_2\text{Mo}_2\text{Br}_2$

Decomp. by pure  $\text{H}_2\text{O}$ . Can be crystallized from  $\text{HBr}+\text{Aq}$ . Apparently sol. without decomp. in alcohol. (Blomstrand.)

#### Ammonium cuprous bromide.

$4\text{NH}_4\text{Br}$ ,  $\text{Cu}_2\text{Br}_2$ . Fairly stable in air.  $2\text{NH}_4\text{Br}$ ,  $\text{Cu}_2\text{Br}_2+\text{H}_2\text{O}$ . Fairly stable in air. (Wells, Z. anorg. 1895, 10. 159.)

#### Ammonium cuprous bromide ammonia, $\text{NH}_4\text{Br}$ , $\text{Cu}_2\text{Br}_2$ , $3\text{NH}_3$

(Pleurent, C. R. 1891, 113. 1047.)

#### Ammonium cupric bromide, $2\text{NH}_4\text{Br}$ , $\text{CuBr}_2$ , $+\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (de Koninck, B. 21. 777 R.)

#### Ammonium iridium bromide.

See Bromiridate, ammonium.

#### Ammonium iron (ferrie) bromide,

$(\text{NH}_4)_3\text{FeBr}_6+\text{H}_2\text{O}$ .

Very deliquescent, sol. in  $\text{H}_2\text{O}$ . (Walden, Z. anorg. 1894, 7. 332.)

#### Ammonium lead bromide, $12\text{NH}_4\text{Br}$ , $7\text{PbBr}_2$ , $+\text{H}_2\text{O}$ .

Decomp. on air, or with cold  $\text{H}_2\text{O}$  (André, C. R. 96. 1502.)

$6\text{NH}_4\text{Br}$ ,  $\text{PbBr}_2+\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . (A.)

$7\text{NH}_4\text{Br}$ ,  $\text{PbBr}_2+1\frac{1}{2}\text{H}_2\text{O}$ . Stable on air; decomp. by cold  $\text{H}_2\text{O}$ . (A.)

None of the above compounds exist. (Wells, Sil. Am. J. 146. 25.)

$2\text{NH}_4\text{Br}$ ,  $\text{PbBr}_2$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{KOH}+\text{Aq}$  and in strong acids.

(Fonze-Diacon, Bull. Soc. 1897, (3) 17.351.)  $\text{NH}_4\text{Br}$ ,  $3\text{PbBr}_2$ . (Wells)

#### Ammonium magnesium bromide, $\text{NH}_4\text{Br}$ , $\text{MgBr}_2$ , $+\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Lerch, J. pr. (2) 28. 338.)

#### Ammonium mercuric bromide,

$2\text{HgBr}_2$ ,  $\text{NH}_4\text{Br}$ .

Decomp. by  $\text{H}_2\text{O}$  into its constituent salts. (Ray, Chem. Soc. 1902, 81. 648.)

#### Ammonium molybdenum bromide, $2\text{NH}_4\text{Br}$ , $\text{MoBr}_3$ , $+\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  (Rosenham, Z. anorg. 1905, 48. 322.)

#### Ammonium molybdenum bromide chloride.

See Ammonium chloromolybdenum bromide.

Ammonium osmium bromide.

See Bromosmate, ammonium.

Ammonium osmyl bromide,  $(\text{NH}_4)_2\text{OsO}_2\text{Br}_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Wintrebert, A. ch. 1903, (7) 28. 95.)

Ammonium osmyl oxybromide,  
 $(\text{NH}_4)_2\text{OsO}_2\text{Br}_2$ .

(Wintrebert, A. ch. 1903 (7) 28. 117.)

Ammonium palladium bromide.

See Bromopalladate, ammonium, and  
Bromopalladite, ammonium.

Ammonium platinum bromide.

See Bromoplatinate, ammonium.

Ammonium rhodium bromide.

See Bromorhodite, ammonium.

Ammonium selenium bromide.

See Bromoselenate, ammonium.

Ammonium tellurium bromide.

See Bromotellurate, ammonium.

Ammonium thallic bromide,  $\text{NH}_4\text{Br}$ ,  $\text{TiBr}_3$  +  $2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Willm.)

+  $4\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Nicklès.)

+  $5\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Nicklès.)

Ammonium stannous bromide (ammonium bromostannite),  $\text{NH}_4\text{Br}$ ,  $\text{SnBr}_2$  +  $\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Benas, C. C. 1884. 958.)

$2\text{NH}_4\text{Br}$ ,  $\text{SnBr}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Raymann and Preis, A. 223. 323.)

+  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Benas, l.c.)

+  $2\text{H}_2\text{O}$ . (Richardson, Am. Ch. J. 14. 96.)

$\text{NH}_4\text{Br}$ ,  $2\text{SnBr}_2$  (?). (Benas.)

Ammonium stannic bromide,  $2\text{NH}_4\text{Br}$ ,  $\text{SnBr}_4$ .

See Bromostannate, ammonium.

Ammonium uranyl bromide,  $2\text{NH}_4\text{Br}$ ,  $\text{UO}_2\text{Br}_2$  +  $2\text{H}_2\text{O}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Sendtner.)

Ammonium zinc bromide,  $2\text{NH}_4\text{Br}$ ,  $\text{ZnBr}_2$ .

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Bödeker, J. B. 1860. 17.)

+  $\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (André, A. ch. (6) 3. 104.)

+  $x\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1908, 59. 66.)

$3\text{NH}_4\text{Br}$ ,  $\text{ZnBr}_2$ . Sol. in  $\text{H}_2\text{O}$ . Decomp. only by great dilution (Jones & Knight, Am. Ch. J. 1899, 22. 136.)

+  $\text{H}_2\text{O}$ . Not hygroscopic. (Ephraim, Z. anorg. 1908, 59. 66.)

Ammonium bromide arsenic trioxide.

See Arsenite bromide, ammonium.

Ammonium bromide mercuric chloride,

$\text{NH}_4\text{Br}$ ,  $2\text{HgCl}_2$ .

Ppt. (Ray, Chem. Soc. 1902, 81. 649.)

Ammonium bromide mercuric iodide,

$2\text{NH}_4\text{Br}$ ,  $\text{HgI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol without decomp. (Grossmann, B. 1903, 36. 1602.)

$3\text{NH}_4\text{Br}$ ,  $2\text{HgI}_2$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol without decomp. (Grossmann, B. 1903, 36. 1602.)

Ammonium lead bromochloride,

$\text{NH}_4\text{Pb}_2\text{Br}_4\text{Cl}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Fonze-Diacon, Bull. Soc. 1897, (3) 17. 350.)

$\text{NH}_4\text{Pb}_2\text{Br}_4\text{Cl}$ . Decomp. by  $\text{H}_2\text{O}$ . (Fonze-Diacon, Bull. Soc. 1897, (3) 17. 349.)

Ammonium bromochloroiodide,  $\text{NH}_4\text{ClBrI}$

Very stable; sol. in  $\text{H}_2\text{O}$ . (Chattaway, Chem. Soc. 1915, 107. 108.)

Ammonium lead bromiodide,  $\text{NH}_4\text{PbBrI}_2$  +  $2\text{H}_2\text{O}$  and  $\text{NH}_4\text{Pb}_2\text{BrI}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{KOH}$  +  $\text{Ag}$  and in strong acids. (Fonze-Diacon, Bull. Soc. 1897, (3) 17. 352.)

Ammonium bromiodobromide,  $\text{NH}_4\text{BrIBr}$ .

Decomp. in the air. Sol. in ether. (Jackson, Am. Ch. J. 1900, 24. 28.)

Ammonium chloride,  $\text{NH}_4\text{Cl}$

(Sal-ammoniac.) Not deliquescent. Sol. in  $\text{H}_2\text{O}$  with reduction of temp

Sol. in 2.4 pts.  $\text{H}_2\text{O}$ . (Wenzel)

$\text{NH}_4\text{Cl}$  +  $\text{Aq}$  sat. at  $10^\circ$  has sp. gr. = 1.072. (T.)

Sol. in 2.72 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . (M. R. and P.)

Sol. in 3 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Abl.)

Sol. in 6 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . (Fourcroy)

100 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$  dissolve 36.76 pts.  $\text{NH}_4\text{Cl}$

$\text{NH}_4\text{Cl}$  +  $\text{Aq}$  sat. at 15° b.-pt. (114.2°) contains 83.9

pts.  $\text{NH}_4\text{Cl}$  in 100 pts. of the solution. (Benzolus.)

100 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  dissolve 33-36 pts.; and at  $100^\circ$ ,

100 pts.  $\text{NH}_4\text{Cl}$ . (Ure's Dict.)

$\text{NH}_4\text{Cl}$  +  $\text{Aq}$  sat. at  $15^\circ$  has sp. gr. = 1.076209, and

contains at least 31.88 pts.  $\text{NH}_4\text{Cl}$  dissolved in every

100 pts.  $\text{H}_2\text{O}$ . (Michel and Kraft, A. ch. (3) 41. 478.)

$\text{NH}_4\text{Cl}$  +  $\text{Aq}$  sat. at  $10^\circ$  contains 23.8%  $\text{NH}_4\text{Cl}$ .

(Eller.)

$\text{NH}_4\text{Cl}$  +  $\text{Aq}$  sat. in the cold contains 14.3%  $\text{NH}_4\text{Cl}$ .

(Fourcroy)

Sol. in 1 pt.  $\text{H}_2\text{O}$  at  $113.6^\circ$ , b.-pt. of sat. solution.

(Griffiths.)

Sol. in 2.7 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$ , forming a liquid of 1.08

sp. gr. (Karsten, 1840.)

Sol. in 2.727 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ . (Gren's Handbuch.)

100 pts.  $\text{H}_2\text{O}$  at 718 mm. pressure and  $1^\circ$  dissolve pts

$\text{NH}_4\text{Cl}$ .

$t^\circ$	Pts. $\text{NH}_4\text{Cl}$	$t^\circ$	Pts. $\text{NH}_4\text{Cl}$	$t^\circ$	Pts. $\text{NH}_4\text{Cl}$	$t^\circ$	Pts. $\text{NH}_4\text{Cl}$
0	28.40	30	41.72	60	55.04	90	68.36
10	32.84	40	46.16	70	59.48	100	72.80
20	37.28	50	50.60	80	63.92	110	77.24

(Allward, C. R. 59. 500.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts NH <sub>4</sub> Cl	t°	Pts NH <sub>4</sub> Cl	t°	Pts NH <sub>4</sub> Cl
0	29.7	30	41.4	60	55.2
1	30.0	31	41.8	61	55.7
2	30.3	32	42.2	62	56.2
3	30.6	33	42.7	63	56.7
4	31.0	34	43.1	64	57.2
5	31.4	35	43.6	65	57.7
6	31.8	36	44.0	66	58.2
7	32.2	37	44.4	67	58.7
8	32.6	38	44.9	68	59.2
9	33.0	39	45.3	69	59.7
10	33.3	40	45.8	70	60.2
11	33.7	41	46.2	71	60.7
12	34.1	42	46.7	72	61.2
13	34.5	43	47.1	73	61.7
14	34.8	44	47.6	74	62.3
15	35.2	45	48.0	75	62.8
16	35.6	46	48.5	76	63.4
17	36.0	47	49.0	77	63.9
18	36.4	48	49.5	78	64.5
19	36.8	49	49.9	79	65.1
20	37.2	50	50.4	80	65.6
21	37.6	51	50.9	81	66.2
22	38.0	52	51.3	82	66.7
23	38.4	53	51.8	83	67.3
24	38.8	54	52.3	84	67.8
25	39.3	55	52.8	85	68.4
26	39.7	56	53.2	86	69.0
27	40.1	57	53.7	87	69.6
28	40.5	58	54.2	88	70.2
29	40.9	59	54.7	89	70.7

(Muldner, calculated from his own and other observations. Schenk. Verhandel 1864. 57.)

Solubility in 100 pts. H<sub>2</sub>O at t°

t°	Pts NH <sub>4</sub> Cl	t°	Pts NH <sub>4</sub> Cl	t°	Pts NH <sub>4</sub> Cl
0	29.7	10.8	33.9	64.9	57.9
6.2	32.2	31.6	42.2	90.6	67.2

(Landström, Pogg 136. 315.)

NH<sub>4</sub>Cl + Aq sat. at 13-16° contains 26.16% NH<sub>4</sub>Cl. (v. Hauer, J. pr. 103. 114.)

Sol. in 2.72 pts H<sub>2</sub>O at 19°. (Schiff, A. 109. 326.)

Sol. in 2.803 pts. H<sub>2</sub>O at 15°. (Gerlach.)

Sat. NH<sub>4</sub>Cl + Aq at 75° contains 38.23% NH<sub>4</sub>Cl. (Fischugseff, Z. anorg. 1914. 86. 161.)

NH<sub>4</sub>Cl + Aq sat. at 30° contains 29.5% NH<sub>4</sub>Cl. (Meerburg, C. C. 1904. II, 1362.)

Solubility in H<sub>2</sub>O at t°.

t°	1000 mols. H <sub>2</sub> O dissolve mols. NH <sub>4</sub> Cl	100 g. H <sub>2</sub> O dissolve g. NH <sub>4</sub> Cl
3.5	105.2	31.25
25.0	129.7	38.5
50.0	167.0	49.6

(Biltz and Marcus, Z. anorg. 1911. 71. 169.)

Solubility of NH<sub>4</sub>Cl in H<sub>2</sub>O at t°.

t°	g NH <sub>4</sub> Cl in 100 g. of the solution	Solid phase
-0.45	0.7 <sup>a</sup>	Ice
-1.25	1.9 <sup>a</sup>	"
-1.70	2.7 <sup>a</sup>	"
-3.05	4.6	"
-4.45	6.6 <sup>b</sup>	"
-6.4	9.2 <sup>b</sup>	"
-8.25	11.4	"
-9.7	13.1	"
-11.9	15.3	"
-13.25	16.7	"
-14.70	18.1 <sup>b</sup>	"
-15.4	18.9	"
±-16.0	±19.5	Ice + NH <sub>4</sub> Cl
-15.0	19.7	NH <sub>4</sub> Cl
-12.2	20.0	"
-10.9	20.3	"
-7.4	21.1	"
-5.7	21.7	"
-2.3	22.3	"
±-1.1	22.6	"
0	22.7	"

(Meerburg, Z. anorg. 1903. 37. 203.)

100 g. H<sub>2</sub>O dissolve 29.5 g. NH<sub>4</sub>Cl at 30°. (Sohrenemakers, Arch. neer. Sc. (2) 15. 17.)

Spec. gravity of NH<sub>4</sub>Cl + Aq. G = according to Gerlach at 15° (Z. anal. 8. 281); S = according to Schiff at 19° (A. 110. 74).

% NH <sub>4</sub> Cl	Sp. gr. °		% NH <sub>4</sub> Cl	Sp. gr.	
	G	S		G	S
1	1.00316	1.0029	17	1.05088	1.0495
2	1.00632	1.0058	18	1.05387	1.0523
3	1.00946	1.0087	19	1.05648	1.0551
4	1.01264	1.0116	20	1.05929	1.0579
5	1.01580	1.0145	21	1.06204	1.0606
6	1.01880	1.0174	22	1.06479	1.0633
7	1.02180	1.0203	23	1.06754	1.0660
8	1.02481	1.0233	24	1.07029	1.0687
9	1.02781	1.0263	25	1.07304	1.0714
10	1.03081	1.0293	26	1.07579	1.0741
11	1.03370	1.0322	26.297	1.07658	
12	1.03658	1.0351	27		1.0768
13	1.03947	1.0380	28		1.0794
14	1.04325	1.0409	29		1.0802
15	1.04524	1.0438	30		1.0846
16	1.04805	1.0467			

For older determinations, see Storer's Dict.

Sp. gr. of NH<sub>4</sub>Cl + Aq at 18°.

% NH <sub>4</sub> Cl	Sp. gr.	% NH <sub>4</sub> Cl	Sp. gr.
5	1.0142	20	1.0571
10	1.0289	25	1.0710
15	1.0430		...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr at 20°/4° of a normal solution of  $\text{NH}_4\text{Cl}$  = 1.01454 (Haugh, J. Am. Chem. Soc. 1912, 34, 1151.)

$\text{NH}_4\text{Cl}$  + Aq containing 6.52%  $\text{NH}_4\text{Cl}$  has sp. gr. 20°/20° = 1.0195. (Le Blanc & Rohland, Z. phys. Ch. 1896, 19, 272.)

Temp of maximum density of $\text{NH}_4\text{Cl}$ + Aq	g mol. $\text{NH}_4\text{Cl}$ in 1000 g. $\text{H}_2\text{O}$
2.640°	0.1899
0.055°	0.5407

(de Coppet, C. R. 1900, 131, 178.)

Sp. gr. of dil  $\text{NH}_4\text{Cl}$  + Aq at 20.004° and 731 mm. (corr.)

Conc = g. equiv  $\text{NH}_4\text{Cl}$  per l. at 20.004°.

Conc	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,001,8
0.0002	1.000,003,7
0.0005	1.000,009,3
0.0010	1.000,018,5
0.0020	1.000,036,9
0.0050	1.000,091,3
0.0100	1.000,180,3

(Lamb and Lee, J. Am. Chem. Soc. 1913, 35, 1688.)

Sp. gr of dil  $\text{NH}_4\text{Cl}$  + Aq.

$\text{NH}_4\text{Cl}$ g in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
0.4431	1.000150
0.9061	1.000304
1.8085	1.000606
3.5947	1.001196
7.7845	1.002562
15.3425	1.004994
31.2364	1.010018

(Dyken, Z. phys. Ch. 1897, 24, 107.)

B-pt. of  $\text{NH}_4\text{Cl}$  + Aq, containing pts.  $\text{NH}_4\text{Cl}$  to 100 pts.  $\text{H}_2\text{O}$ . G = according to Gerlach (Z. anal. 26, 439); L = according to Legrand (A. ch. (2) 69, 436)

B-pt.	G	L	B-pt.	G	L
101°	6.5	7.8	109°	50.6	53.5
102	12.8	13.9	110	56.2	59.9
103	19.0	19.7	111	61.9	66.4
104	24.7	25.2	112	67.8	73.3
105	29.7	30.5	113	74.2	80.5
106	34.6	35.7	114	81.3	88.1
107	39.6	41.3	114.2		88.9
108	45.0	47.3	114.8	87.1	

Sat  $\text{NH}_4\text{Cl}$  + Aq boils at 115.8° at 718 mm. pressure (Alluard, C. R. 59, 500.)

$\text{NH}_4\text{Cl}$  + Aq containing 74.2 pts.  $\text{NH}_4\text{Cl}$  to 100 pts.  $\text{H}_2\text{O}$  forms a crust at 113°; highest temperature observed, 114.8° (Gerlach, Z. anal. 26, 426.)

$\text{NH}_4\text{Cl}$  + Aq containing 10%  $\text{NH}_4\text{Cl}$  boils at 101.7°; 20%  $\text{NH}_4\text{Cl}$ , at 104.4°. (Gerlach.)

$\text{NH}_4\text{Cl}$  + Aq containing 10.6%  $\text{NH}_4\text{Cl}$  gives off  $\text{NH}_3$  at 37° (Leeds, Am. J. Sci. (3) 7, 197.)

When  $\text{NH}_4\text{Cl}$  + Aq is boiled, or even evap. on water bath, a little  $\text{NH}_3$  is expelled. (Fresenius.)

30 pts.  $\text{NH}_4\text{Cl}$  mixed with 100 pts.  $\text{H}_2\text{O}$  lower the temp from 13.3° to -5.1°, that is 18.4°. (Rudorff, B. 2, 68.)

Freezing-point of sat. solution is -15.4°, the same temp which is caused by mixing 25 pts.  $\text{NH}_4\text{Cl}$  with 100 pts. snow. (Rudorff, Pogg. 122, 337.)

Conc.  $\text{HCl}$  + Aq precipitates part of  $\text{NH}_4\text{Cl}$  from sat.  $\text{NH}_4\text{Cl}$  + Aq. (Vogel, J. pr. 2, 199.)

Solubility of  $\text{NH}_4\text{Cl}$  in  $\text{HCl}$  + Aq at 0°  $\text{NH}_4\text{Cl}$  = mols.  $\text{NH}_4\text{Cl}$  (in milligrammes) dissolved in 10 cc of the liquid;  $\text{HCl}$  = mols.  $\text{HCl}$  (in milligrammes) dissolved in 10 cc. of the liquid.

$\text{NH}_4\text{Cl}$	$\text{HCl}$	Sum of mols	Sp. gr
46.125	0.0	46.125.	1.076
43.6	2.9	46.5	1.0695
41.0	5.5	46.5	1.0705
39.15	7.85	47.0	1.0715
36.45	10.85	47.30	1.073
27.37	21.4	48.77	1.078
10.875	53.0	63.875	1.106
8.8	61.0	69.8	1.114

(Engel, Bull. Soc. (2) 45, 655.)

Solubility of  $\text{NH}_4\text{Cl}$  in  $\text{HCl}$  + Aq.

t°	$\text{HCl}$ concentration g mol per 100 g $\text{H}_2\text{O}$	Weight $\text{NH}_4\text{Cl}$ dissolved in 1000 g. $\text{H}_2\text{O}$	Molecular solubility
0°	0	298.40	5.59
"	$\frac{1}{4}$	286.43	5.36
"	$\frac{1}{2}$	271.23	5.08
"	1	245.35	4.60
25°	0	395.10	7.40
"	$\frac{1}{4}$	380.85	7.13
"	$\frac{1}{2}$	366.00	6.85
"	1	339.05	6.35

(Armstrong & Eyre, Proc R. Soc. (A.) 84, 127.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq.}$   $\text{NH}_4\text{Cl} = \text{mols.}$   
 $\text{NH}_4\text{Cl}$  (in mgs.) in 10 cc. solution;  
 $\text{NH}_3 = \text{mols.}$   $\text{NH}_3$  (in mgs.) in 10 cc.  
 solution

$\text{NH}_4\text{Cl}$	$\text{NH}_3$	Sp. gr.
46.125	0	1.076
45.8	5.37	1.067
45.5	12.025	1.054
45.125	23.4	1.044
44.5	38.0	1.031
44.0	47	1.025
43.625	54.5	1.017
43.125	80.0	0.993
44.0	90.0	0.992
44.375	95.5	0.983
49.75	130	0.953
60.0	169.75	0.931

(Engel, Bull. Soc. (3) 6. 17.)

$\text{NH}_4\text{Cl} + \text{BaCl}_2$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 33.8  
 pts.  $\text{NH}_4\text{Cl} + 11.6$  pts.  $\text{BaCl}_2$  at  $20^\circ$ . (Rudorff,  
 Pogg. 148. 487.)

Solubility of  $\text{NH}_4\text{Cl}$  and  $\text{BaCl}_2$  in  $\text{H}_2\text{O}$

$t^\circ$	Wt. per 100		Solid phase
	$\text{NH}_4\text{Cl}$	$\text{BaCl}_2$	
-15 $2^\circ$	16.10	8.07	$\text{NH}_4\text{Cl} +$ $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
0	19.26	8.22	
30	24.89	8.19	
40	26.93	8.40	
50	29.53	8.55	

(Schreinemakers, Chem. Weekbl. 1910, 7. 333.)  
 See also  $\text{BaCl}_2 + \text{NH}_4\text{Cl}$  under  $\text{BaCl}_2$ .

$\text{NH}_4\text{Cl} + \text{CdCl}_2$ . Solubility of  $\text{NH}_4\text{Cl}$  and  
 $\text{CdCl}_2$ .

See Ammonium cadmium chloride.

$\text{NH}_4\text{Cl} + \text{CuCl}_2$ . Solubility of  $\text{NH}_4\text{Cl}$  in  
 $\text{H}_2\text{O}$  at  $30^\circ$  in presence of varying amounts of  
 $\text{CuCl}_2$ .

% by wt. $\text{CuCl}_2$	% by wt. $\text{NH}_4\text{Cl}$	Solid phase
0	29.5	$\text{NH}_4\text{Cl}$
1.9	28.6	$\text{NH}_4\text{Cl} + \text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
3.6	25.9	$\text{CuCl}_2 \cdot 2\text{NH}_4\text{Cl} \cdot 2\text{H}_2\text{O}$
7.7	19.8	"
10.5	16.5	"
12.3	14.9	"
15.6	12.1	"
19.9	9.4	"
24.0	7.1	"
29.4	4.9	"
35.1	3.4	"
41.4	2.1	"
43.2	2.0	$\text{CuCl}_2 \cdot 2\text{NH}_4\text{Cl} \cdot 2\text{H}_2\text{O} + \text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
43.9	0	$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$

(Meerburg, Z. anorg. 1905, 45. 3)

$\text{NH}_4\text{Cl} + \text{PbCl}_2$ . Solubility of  $\text{NH}_4\text{Cl}$  and  
 $\text{PbCl}_2$  in  $\text{H}_2\text{O}$  at  $22^\circ$ .

g. equivalent in 1000 g. $\text{H}_2\text{O}$		Solid phase
$\text{NH}_4\text{Cl}$	$\text{PbCl}_2$	
0.0	0.0749	$\text{PbCl}_2$
0.1	0.0325	"
0.2	0.0194	"
0.3	0.0153	"
0.4	0.0158	"
0.5	0.0130	"
0.52	0.0127	$\text{PbCl}_2 + \text{NH}_4\text{Cl} \cdot 2\text{PbCl}_2$
0.55	0.0123	$\text{NH}_4\text{Cl} \cdot 2\text{PbCl}_2$
0.6	0.0113	"
0.65	0.0105	"
0.7	0.0099	"
0.8	0.0087	"
0.9	0.0083	"
1.0	0.0080	"
1.2	0.0075	"
1.5	0.0073	"
2.0	0.0077	"
2.5	0.0092	"
3.0	0.0112	"
4.0	0.0182	"
5.0	0.0296	"
6.0	0.0473	"
7.0	0.0774	"
7.29	0.0898	$\text{NH}_4\text{Cl} + \text{NH}_4\text{Cl} \cdot 2\text{PbCl}_2$
7.29	0.0000	$\text{NH}_4\text{Cl}$

(Bronstedt, Z. phys. Ch. 1911, 77. 132.)

Solubility of  $\text{NH}_4\text{Cl}$  and  $2\text{PbCl}_2$ ,  $\text{NH}_4\text{Cl}$  in  
 $\text{H}_2\text{O}$  at  $100^\circ$ .

$\text{NH}_4\text{Cl}$ g. equivalent		$\text{PbCl}_2$ g. equivalent		Solid phase
in 1000 g. solution	in 1000 g. $\text{H}_2\text{O}$	in 1000 g. solution	in 1000 g. $\text{H}_2\text{O}$	
1.277	1.404	0.160	0.176	$\text{NH}_4\text{Cl}$ $+ 2\text{PbCl}_2 \cdot \text{H}_2\text{O}$

(Bronstedt, l. c.)

$\text{NH}_4\text{Cl} + \text{MgCl}_2$ . Solubility of  $\text{NH}_4\text{Cl}$  and  
 $\text{NH}_4\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ .

$t^\circ$	In 1000 g. mols. $\text{H}_2\text{O}$		Solid phase
	$\text{NH}_4\text{Cl}$	$\text{MgCl}_2$	
3.5 $^\circ$	27.5	55.7	$\text{NH}_4\text{Cl} + \text{NH}_4\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
25	42.1	56.4	"
50	62.9	59.1	"

(Riltz and Marcus, Z. anorg. 1911, 71. 170.)

Solubility of  $\text{NH}_4\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$  and  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ .

$t^\circ$	In 1000 g. mol $\text{H}_2\text{O}$		Solid phase
	g. mol $\text{NH}_4\text{Cl}$	g. mol $\text{MgCl}_2$	
3 $5^\circ$	0.5	99.5	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O} + \text{NH}_4\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
25°	0.5	103.8	
50°	0.8	111.2	

(Biltz and Marcus, Z. anorg. 1911, 71. 170.)

 $\text{NH}_4\text{Cl} + \text{NH}_4\text{NO}_3$  100 pts  $\text{H}_2\text{O}$  dissolve 29.1 pts.  $\text{NH}_4\text{Cl} + 173.8$  pts.  $\text{NH}_4\text{NO}_3$  at 19  $5^\circ$ . (Rüdorff, B. 6. 482.) $\text{NH}_4\text{Cl} + \text{Ba}(\text{NO}_3)_2$  100 pts  $\text{H}_2\text{O}$  dissolve at 18  $5^\circ$ —

	1	2	3	4	5
$\text{NH}_4\text{Cl}$	36.7	38.6	38.06	39.18	
$\text{Ba}(\text{NO}_3)_2$		8.6	16.73	17.02	8.9

2, sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  treated with  $\text{NH}_4\text{Cl}$ ; 3, sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  treated with  $\text{Ba}(\text{NO}_3)_2$ ; 4, simultaneous treatment of both salts with  $\text{H}_2\text{O}$  (Karsten.) $\text{NH}_4\text{Cl} + \text{KNO}_3$  100 pts.  $\text{H}_2\text{O}$  dissolve at 18  $5^\circ$ —

	1	2	3	4	5	6
$\text{KNO}_3$	29.9	30.56	37.68	38.62		34.2
$\text{NH}_4\text{Cl}$		44.33	37.98	39.84	36.7	38.8
		74.89	75.66	78.46		73.0

1 and 5, according to Mulder; 2, sat.  $\text{KNO}_3 + \text{Aq}$  treated with  $\text{NH}_4\text{Cl}$ ; 3, sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  treated with  $\text{KNO}_3$ ; 4, simultaneous treatment of  $\text{NH}_4\text{Cl}$  and  $\text{KNO}_3$  (Karsten); 6, by warming solution with excess of both salts, and cooling to 14  $8^\circ$ . The amount of excess of one or the other salt has no influence. (Rüdorff.) $\text{NH}_4\text{Cl} + \text{NaNO}_3$ . Slowly sol. in sat.  $\text{NaNO}_3 + \text{Aq}$ , at first to a clear solution, but afterwards  $\text{NaCl}$  separates out. (Karsten.) $\text{NH}_4\text{Cl} + \text{KCl}$  100 pts.  $\text{H}_2\text{O}$  dissolve—

	(Rüdorff) 15°	(Karsten) 18 $75^\circ$
$\text{KCl}$	16.97	34.4
$\text{NH}_4\text{Cl}$	28.90	16.27
		29.83
		37.02

	(Rüdorff) 22°	(Mulder) At b-pt.
$\text{KCl}$	19.1	58.5
$\text{NH}_4\text{Cl}$	30.4	21.9
		67.7
		87.3

100 pts. sat. solution of  $\text{NH}_4\text{Cl} + \text{KCl}$  contain 30.61 pts of the two salts at 13–16° (v. Hauer, J. pr 103. 114.) $\text{NH}_4\text{Cl} + \text{NaCl}$  100 pts  $\text{H}_2\text{O}$  dissolve—

	10–20°	(Mulder) 10°	10°	(v. Hauer) 13–16°
$\text{NH}_4\text{Cl}$		19.50	33.3	18.8–20.3
$\text{NaCl}$	35.8	30.00	..	24.6–26.1
		49.50		43.4–46.4

	(Karsten) 18 $75^\circ$	(Rüdorff) 18 $7^\circ$	(Mulder) At b-pt.
$\text{NH}_4\text{Cl}$	23.06	37.02	22.9
$\text{NaCl}$	26.38	23.9	87.3
	48.44	46.8	78.5
			22.3
			100.8

Sp. gr. of sat. solution of  $\text{NH}_4\text{Cl} + \text{NaCl}$  is 1.179. (Karsten.) $\text{NH}_4\text{Cl} + (\text{NH}_4)_2\text{SO}_4$  100 pts  $\text{H}_2\text{O}$  dissolve 26.8 pts.  $\text{NH}_4\text{Cl} + 46.5$  pts.  $(\text{NH}_4)_2\text{SO}_4$  at 21  $5^\circ$ . (Rüdorff, B. 6. 484.)Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at 30°.

Composition of the solution		Solid phase
% by wt. $\text{NH}_4\text{Cl}$	% by wt. $(\text{NH}_4)_2\text{SO}_4$	
0	44	$(\text{NH}_4)_2\text{SO}_4$
6.86	36.15	"
14.62	28.6	"
17.60	25.69	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{Cl}$
17.93	25.81	"
19.07	23.22	$\text{NH}_4\text{Cl}$
19.97	21.3	"
22.3	16.33	"
24.06	12.72	"
29.5	0	"

(Schrenemakers, Z. phys. Ch. 1909, 69. 562.)

 $\text{NH}_4\text{Cl} + \text{CuSO}_4$ . Sol in sat.  $\text{CuSO}_4 + \text{Aq}$ , at first to a clear solution, but a double sulphate of  $\text{NH}_4$  and  $\text{Cu}$  soon separates. (Karsten.) $\text{NH}_4\text{Cl} + \text{MgSO}_4$ . Slowly and difficultly sol in sat.  $\text{MgSO}_4 + \text{Aq}$  with subsequent separation of double sulphate. (Karsten.) $\text{NH}_4\text{Cl} + \text{K}_2\text{SO}_4$  100 pts.  $\text{H}_2\text{O}$  dissolve, at 18  $75^\circ$ —

		a	b	c
$\text{K}_2\text{SO}_4$	10.8	11.1	13.26	13.28
$\text{NH}_4\text{Cl}$		38.2	37.94	37.92
		49.3	51.20	51.20

In (a)  $\text{NH}_4\text{Cl}$  was added to sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ . In (b)  $\text{K}_2\text{SO}_4$  was added to sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ . In (c)  $\text{NH}_4\text{Cl}$  and  $\text{K}_2\text{SO}_4$  were treated together with  $\text{H}_2\text{O}$ . (Karsten.)

100 pts.  $\text{H}_2\text{O}$  at  $14^\circ$  dissolve 14.1 pts  $\text{K}_2\text{SO}_4 + 36.8$  pts.  $\text{NH}_4\text{Cl} = 50.9$  pts.  $\text{K}_2\text{SO}_4 + \text{NH}_4\text{Cl}$ , under all conditions. (Rüdorff, Pogg. 148. 565.)

100 pts  $\text{H}_2\text{O}$  dissolve at b.-pt.—

K <sub>2</sub> SO <sub>4</sub>	26 75	33 3- 33 9	87 3
NH <sub>4</sub> Cl		90 4-111 8	
		123.7-145 7	

(Mulder)

$\text{NH}_4\text{Cl} + \text{Na}_2\text{SO}_4$  100 pts.  $\text{H}_2\text{O}$  dissolve 28.9 pts  $\text{NH}_4\text{Cl} + 24.7$  pts  $\text{Na}_2\text{SO}_4$ , if  $\text{NH}_4\text{Cl} + \text{Aq}$  sat. at  $10^\circ$  is sat with  $\text{Na}_2\text{SO}_4$  at  $11^\circ$

100 pts  $\text{H}_2\text{O}$  dissolve 31.8 pts  $\text{NH}_4\text{Cl} + 9.0$  pts.  $\text{Na}_2\text{SO}_4$ , if  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat. at  $10^\circ$  is sat. with  $\text{NH}_4\text{Cl}$  at  $11^\circ$ . (Mulder, J. B. 1866. 68)

Sol. in sat  $\text{Na}_2\text{SO}_4 + \text{Aq}$ . (Karsten.)

Sol. in sat  $\text{ZnSO}_4 + \text{Aq}$  (Karsten.)

Sl. sol. in liquid  $\text{NH}_3$  at  $-50^\circ$ . (Moissan, C. R. 1901, 133. 713)

Very sol in liquid  $\text{NH}_3$  (Frankhn, Am. Ch. J. 1898, 20. 826.)

Very al sol. in absolute alcohol.

100 pts. alcohol of 0.939 sp. gr dissolve—

at  $4^\circ$   $8^\circ$   $27^\circ$   $38^\circ$   $56^\circ$   
11.2 12.6 19.4 23.6 30.1 pts.  $\text{NH}_4\text{Cl}$

(Geiardin, A. ch. (4) 5. 129)

14 pts. boiling highest rectified spirit dissolve 1 pt  $\text{NH}_4\text{Cl}$ . (Wenzel)

100 pts. alcohol of—

0.900 sp. gr. dissolve 6.5 pts  $\text{NH}_4\text{Cl}$ .

0.872 " " " 4.75 " "

0.834 " " " 1.5 " "

(Kurwan)

Though somewhat sol in pure absolute alcohol,  $\text{NH}_4\text{Cl}$  is absolutely insol. in alcohol in presence of methyl amine chlorides (Winkles, A. 93. 324)

100 pts absolute methyl alcohol dissolve 3.35 pts at  $19^\circ$ .

100 pts. absolute ethyl alcohol dissolve 0.62 pt. at  $19^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783)

Solubility of  $\text{NH}_4\text{Cl}$  in methyl alcohol

$t^\circ$	Alcohol concentration, mol g alcohol for 1000 g. $\text{H}_2\text{O}$	Solubility in 1000 g. $\text{H}_2\text{O}$	Molecular solubility
$0^\circ$	0	298.40	5.59
"	$\frac{1}{4}$	297.35	5.57
"	$\frac{1}{2}$	296.55	5.55
"	1	292.65	5.47
"	3	283.15	5.30
$25^\circ$	0	395.10	7.40
"	$\frac{1}{4}$	394.75	7.39
"	$\frac{1}{2}$	393.85	7.37
"	1	392.90	7.36
"	3	386.20	7.23

(Armstrong and Eyre, Proc. R. Soc. Lond. (A) 84. 127.)

Solubility of  $\text{NH}_4\text{Cl}$  in ethyl alcohol at  $0^\circ$ .

Alcohol concentration, mol g alcohol for 1000 g. $\text{H}_2\text{O}$	Solubility in 1000 g. $\text{H}_2\text{O}$	Molecular solubility
0	298.40	5.59
$\frac{1}{4}$	295.50	5.53
$\frac{1}{2}$	291.95	5.47
1	286.40	5.37
3	266.25	4.99

(Armstrong and Eyre, l c)

See also ammonium cupric chloride.

Solubility of  $\text{NH}_4\text{Cl}$  in propyl alcohol.

$t^\circ$	Alcohol concentration, mol g alcohol for 1000 g. $\text{H}_2\text{O}$	Solubility in 1000 g. $\text{H}_2\text{O}$	Molecular solubility
$0^\circ$	0	298.46	5.59
"	$\frac{1}{4}$	295.40	5.53
"	$\frac{1}{2}$	291.30	5.45
"	1	284.00	5.32
$25^\circ$	0	395.10	7.40
"	$\frac{1}{4}$	393.50	7.37
"	$\frac{1}{2}$	390.80	7.32
"	1	384.80	7.21

(Armstrong and Eyre, l c)

Solubility in mixtures of methyl and ethyl alcohol at  $25^\circ$

P = % methyl alcohol in the solvent

G = g.  $\text{NH}_4\text{Cl}$  in 10 cc. of the solution

S = sp. gr. of the sat. solution at  $25^\circ/4^\circ$ .

P	G	S
0.00	0.0533	0.7908
4.37	0.0583	0.7909
10.40	0.0658	0.7910
41.02	0.118	0.7957
80.69	0.217	0.8020
84.77	0.227	0.8026
91.25	0.247	0.8040
100.00	0.276	0.8062

(Heiz, Z. anorg. 1908, 60. 155.)

Solubility in mixtures of methyl and propyl alcohol at  $25^\circ$ .

P = % propyl alcohol in the solvent.

G = g.  $\text{NH}_4\text{Cl}$  in 10 cc. of the solution.

S = Sp. gr. of the sat. solution at  $25^\circ/4^\circ$ .

P	G	S
0	0.276	0.8062
11.11	0.231	0.8035
23.8	0.182	0.8008
65.2	0.071	0.8005
91.8	0.026	0.8002
93.75	0.023	0.8000
100.00	0.018	0.8009(?)

(Heiz, Z. anorg. 1908, 60. 157.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent

G = g.  $\text{NH}_4\text{Cl}$  in 10 cc of the solution

S = Sp gr of the sat solution at 25°/4°

P	G	S
0	0 0533	0 7908
8 1	0 0505	0 7910
17 85	0 0455	0 7916
56 6	0 0312	0 7963
88 6	0 0210	0 7996
91 2	0 0203	0 8001
95.2	0 0190	0 8003
100	0.0177	0 8009

(Herz, Z. anorg. 1908, 60, 160.)

Insol. in ether and  $\text{CS}_2$  (Fordos and Gélys, A. ch. (3) 32, 393)

Very sl. sol. in acetone. (Krug and M'Elroy, J. anal. appl. Ch. 6, 184.)

Solubility of  $\text{NH}_4\text{Cl}$  in acetone + Aq at 25°

A = cc. acetone in 100 cc acetone + Aq.

$\text{NH}_4\text{Cl}$  = millimols.  $\text{NH}_4\text{Cl}$  in 100 cc of the solution

A	$\text{NH}_4\text{Cl}$	Sp. gr
0	585 1	1 0793
10	534 1	1 0618
20	464 6	1 0451
30	396 7	1 0263
40	328 5	0 99984
46 5	283 7	0 97998
to 2 phases		
85 7	18 9	0 8390
90	9 4	0 8274

(Herz, Z. anorg. 1905, 45, 263.)

Solubility of  $\text{NH}_4\text{Cl}$  in glycerine + Aq at 25°.

G = g. glycerine in 100 g. glycerine + Aq

$\text{NH}_4\text{Cl}$  = millimols.  $\text{NH}_4\text{Cl}$  in 100 cc. of the solution

G	$\text{NH}_4\text{Cl}$	Sp. gr
0	585 1	1 0793
13 28	544 6	1.0947
25 98	502 9	1 1127
45.36	434 4	1 1452
54 23	403 5	1 1606
83 84	291 4	1 2235
100	228 4	1.2617

(Herz, l. c.)

Insol in acetone (Naumann, B. 1904, 37, 4328.); (Eidmann, C. C. 1899, II, 1014.)

Insol in anhydrous pyridine Sol in 97% pyridine + Aq, 95% pyridine + Aq and in 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30, 1107)

Insol. in  $\text{CS}_2$  (Arcetowski, Z. anorg. 1894, 6, 257.)

Very sol. in ethyl amine (Shinn, J. phys. Chem. 1907, 11, 538)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43, 314)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370)

Sol in formic acid. (Zanninovich-Tessarin, Z. phys. Ch. 1896, 19, 251)

Ammonium antimony chloride,  $\text{SbCl}_3(\text{NH}_4)_2$ ,  $\text{SbCl}_4(\text{NH}_4)_2$ .

Ppt Decomp. by  $\text{H}_2\text{O}$  (Weinland, B. 1905, 38, 1085.)

$\text{SbCl}_3(\text{NH}_4)$ ,  $\text{SbCl}_4$ ,  $\text{NH}_4\text{OH}$ . Very deliquescent; sl sol in  $\text{H}_2\text{O}$  with decomp. (Weinland, B. 1901, 34, 2635)

Ammonium antimonous chloride,  $\text{NH}_4\text{Cl}$ ,  $\text{SbCl}_3$ .

Deliquescent (Dehéraïn, C. R. 52, 734.)

$2\text{NH}_4\text{Cl}$ ,  $\text{SbCl}_3 + 2\text{H}_2\text{O}$  Permanent in dry air; decomp. by much  $\text{H}_2\text{O}$  (Poggiale)

$3\text{NH}_4\text{Cl}$ ,  $\text{SbCl}_3 + 3\text{H}_2\text{O}$ . As above

Ammonium antimonic chloride,  $3\text{NH}_4\text{Cl}$ ,  $\text{SbCl}_5$ .

Decomp by  $\text{H}_2\text{O}$ . (Dehéraïn, C. R. 52, 734.)

$4\text{NH}_4\text{Cl}$ ,  $\text{SbCl}_5$  Decomp by  $\text{H}_2\text{O}$ . (D)

See also Chlorantimonate, ammonium.

Ammonium antimony platinum chloride,  $(\text{Sb}, \text{Pt})\text{Cl}_6(\text{NH}_4)_2$

Ppt (Weinland, B. 1905, 38, 1084)

Ammonium antimony tin chloride,  $(\text{Sb}, \text{Sn})\text{Cl}_6(\text{NH}_4)_2$ .

Ppt. (Weinland, B. 1905, 38, 1085.)

Ammonium arsenyl chloride,  $2\text{NH}_4\text{Cl}$ ,  $\text{AsOCl}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

(Wallace, Phil. Mag. (4) 16, 358)

Ammonium bismuth chloride,  $\text{NH}_4\text{Cl}$ ,  $2\text{BiCl}_3$ .

Deliquescent. (Dehéraïn, C. R. 54, 724.)

$2\text{NH}_4\text{Cl}$ ,  $\text{BiCl}_3$  Decomp. by  $\text{H}_2\text{O}$ . (Arppe.)

Pogg. 64, 237)

$+2\frac{1}{2}\text{H}_2\text{O}$ . (Rammelsberg)

$3\text{NH}_4\text{Cl}$ ,  $\text{BiCl}_3$  Decomp. by  $\text{H}_2\text{O}$  (Arppe.)

$5\text{NH}_4\text{Cl}$ ,  $2\text{BiCl}_3$ . (Rammelsberg)

Ammonium bismuth potassium chloride,  $2\text{NH}_4\text{Cl}$ ,  $\text{BiCl}_3$ ,  $\text{KCl}$ .

(Dehéraïn, C. R. 54, 724.)

Ammonium cadmium chloride,  $\text{NH}_4\text{Cl}$ ,  $\text{CdCl}_2$

Solubility of  $\text{NH}_4\text{Cl}$ ,  $\text{CdCl}_2$  in  $\text{H}_2\text{O}$  at t°

t°	Pts. by weight in 100 pts of solution			g in 100 g solution	Grams in 100 $\text{H}_2\text{O}$	Mols $\text{H}_2\text{O}$ free salt dissolved by 100 mols. $\text{H}_2\text{O}$
	Cl	Cd	$\text{NH}_4$			
2 4°	13 44	14 26	2.24	29 94	42 74	3.25
16 0	15 07	15 82	2 56	33.45	50 26	3.83
41 2	17 46	18 61	2 89	38 96	63 83	4 86
63 8	19 73	20 92	3 34	43 99	78.54	5 98
105 9	23 52	24 70	4 01	52 58	109 33	8 30

(Rumbach, B. 1897, 30, 3076.)

+ $\frac{1}{2}$ H<sub>2</sub>O. Sl sol. in H<sub>2</sub>O, alcohol, and wood spirit. (v. Hauer, W. A. B. 13. 449)

4NH<sub>4</sub>Cl, CdCl<sub>2</sub> Sol. in H<sub>2</sub>O. (v. Hauer)  
Decomp by H<sub>2</sub>O to NH<sub>4</sub>Cl, CdCl<sub>2</sub>. Decomp. increases with decrease of temp. At 3° approximately wholly decomp to NH<sub>4</sub>Cl, CdCl<sub>2</sub>. At 113.9° very nearly all is 4NH<sub>4</sub>Cl, CdCl<sub>2</sub> (Rimbach, B. 1897, 30. 3077)

Solubility of 4NH<sub>4</sub>Cl, CdCl<sub>2</sub> in H<sub>2</sub>O at t°.

t°	Pts dissolved in 100 pts by weight of solution.		
	Cd	Cl	NH <sub>4</sub>
3 0	5 75	18 17	7 37
16 1	6 93	20 26	7 97
40 2	9 91	23 84	8 92
58 5	12 50	26 53	9 35
112 9	16 66	31 79	10 78
113 9	16 51	32 71	11 30

(Rimbach, B. 1897, 30. 3071)

Sol. without decomp in 37.3% HCl(d=1.19) and 24.8% HCl(d=1.125) (Rimbach, B. 1905, 38. 1569)

Solubility of 4NH<sub>4</sub>Cl, CdCl<sub>2</sub>+NH<sub>4</sub>Cl in H<sub>2</sub>O at t°.

t°	In 100 pts. by wt of the solution			Composition of the solid phase	
	Pts by wt. Cd	Pts by wt. Cl	Pts. by wt. NH <sub>4</sub>	Mol. % NH <sub>4</sub> Cl	Mol. % Tetra-salt
1 0	2 82	17 11	7 82	59 0	41 0
13 2	2 76	18 84	8 71	74 0	26 0
40.1	3 16	22 56	10 49	71 0	29 0
58 2	3 51	25 21	11 72	69 0	31 0

(Rimbach, B. 1902, 35. 1300)

Solubility of 4NH<sub>4</sub>Cl, CdCl<sub>2</sub>+NH<sub>4</sub>Cl, CdCl<sub>2</sub> in H<sub>2</sub>O at t°.

t°	In 100 pts. by wt of the solution			Composition of the solid phase	
	Pts. by wt. Cd	Pts. by wt. Cl	Pts. by wt. NH <sub>4</sub>	Mol. % Mono-salt	Mol. % Tetra-salt
1 1	5 34	17 62	7 27	49 6	50 4
14.0	7 12	19 86	7 84	47 0	53 0
40.7	10 24	23 82	8.85	77.0	23 0
58 5	12 50	26.53	9 35		

(Rimbach, B. 1902, 35. 1300.)

Sol. without decomp. in 50% LiCl+Aq. 33.3% CaCl<sub>2</sub>+Aq and 50% MgCl<sub>2</sub>+Aq. (Rimbach, B. 1905, 38. 1569.)

Ammonium chloromolybdenum chloride, 2NH<sub>4</sub>Cl, Cl<sub>2</sub>Mo<sub>2</sub>Cl<sub>2</sub>+2H<sub>2</sub>O

Decomp by pure H<sub>2</sub>O; can be crystallised from HCl+Aq. (Blomstrand.)

Ammonium chromium chloride, 2NH<sub>4</sub>Cl, CrCl<sub>3</sub>+H<sub>2</sub>O.

Sol. in H<sub>2</sub>O with decomp. (Neumann, A. 244. 229.)

+6H<sub>2</sub>O=2NH<sub>4</sub>Cl, [CrCl<sub>2</sub> 4H<sub>2</sub>O]Cl+2H<sub>2</sub>O.

Hygroscopic. Decomp by H<sub>2</sub>O and by alcohol. (Weinland, B. 1907, 40. 3770)

Ammonium cobaltous chloride, NH<sub>4</sub>Cl, CoCl<sub>2</sub>+6H<sub>2</sub>O

Deliquescent in moist air. Very easily sol. in H<sub>2</sub>O (Hantz, A. 66. 284)

Ammonium cobaltous chloride ammonia, NH<sub>4</sub>Cl, CoCl<sub>2</sub>, NH<sub>3</sub>. (F. Rose)

Ammonium cuprous chloride, 4NH<sub>4</sub>Cl Cu<sub>2</sub>Cl<sub>2</sub>.

Decomp. in the air.

4NH<sub>4</sub>Cl, 3Cu<sub>2</sub>Cl<sub>2</sub> Decomp by H<sub>2</sub>O, not by alcohol. (Ritthausen, J. pr. 59. 369.)

Fairly stable in air (Wells, Z. anorg. 1895, 10. 158.)

Ammonium cupric chloride,

NH<sub>4</sub>Cl, CuCl<sub>2</sub>

Solubility of NH<sub>4</sub>Cl, CuCl<sub>2</sub> in absolute alcohol at 25°.

CuCl <sub>2</sub> %	Solid phase	CuCl <sub>2</sub> %	Solid phase
4 65	NH <sub>4</sub> Cl+NH <sub>4</sub> Cl, CuCl <sub>2</sub>	12 90	NH <sub>4</sub> Cl, CuCl <sub>2</sub>
4.74	NH <sub>4</sub> Cl+NH <sub>4</sub> Cl, CuCl <sub>2</sub>	34 92	NH <sub>4</sub> Cl, CuCl <sub>2</sub> +CuCl <sub>2</sub> , C <sub>2</sub> H <sub>5</sub> OH
6.45	NH <sub>4</sub> Cl, CuCl <sub>2</sub>	34 50	

(Foote and Walden, J. Am. Ch. Soc. 1911, 33. 1032)

+2H<sub>2</sub>O Sol in 2 pts. H<sub>2</sub>O (Hantz, A. 66. 280.)

Does not exist t. (Meerburg, C. C. 1904. II. 1362.)

2NH<sub>4</sub>Cl, CdCl<sub>2</sub>+2H<sub>2</sub>O Easily sol. in H<sub>2</sub>O, also in alcohol, even when absolute. (Cap and Henry, J. pr. 13. 184.)

Solubility of 2NH<sub>4</sub>Cl, CuCl<sub>2</sub> in H<sub>2</sub>O at t°.

g. 2NH <sub>4</sub> Cl, CuCl <sub>2</sub> in 100 g. of the solution	t°	Solid phase
3 87	-1.5°	100
5.88	-2 48	"
8 78	-3 95	"
9 97	-4.60	"
13.12	-6.40	"
15.84	-8 04	"
17.64	-9 24	"
20 12	-10 80	"
20 3	-11 0	100+2NH <sub>4</sub> Cl, CuCl <sub>2</sub> .2H <sub>2</sub> O
20 46	-10	2NH <sub>4</sub> Cl, CuCl <sub>2</sub> .2H <sub>2</sub> O
21.16	-5	"
22 02	0	"
24 26	+12	"
25 95	20	"
27 70	30	"
30.47	40	"
33 24	50	"
36 13	60	"
39 25	70	"
43.36	80	"

(Meerburg, Z. anorg. 1905, 45. 8.)

Somewhat sol. in liquid  $\text{NH}_3$  (Franklin and Kraus, *Am. Ch. J.* 1898, 20, 827.)  
Is the only hydrate of  $2\text{NH}_4\text{Cl}$ ,  $\text{CuCl}_2$  existing between  $-11^\circ$  and  $+80^\circ$ . (Meeburg, *C. C.* 1904, II, 1362.)  
+  $3\text{H}_2\text{O}$ . (Bourgeois, *Bull. Soc.* 1898, (3) 19, 786.)

**Ammonium cupric chloride ammonia,**  
 $2\text{NH}_4\text{Cl}$ ,  $\text{CuCl}_2$ ,  $2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ , less easily by alcohol.  
Decomp. by acids (Litthausen)

**Ammonium indium chloride,**  $2\text{NH}_4\text{Cl}$ ,  $\text{InCl}_3$ ,  
+  $\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$ . (Meyer)

**Ammonium iodine chloride,**  $\text{NH}_4\text{Cl}$ ,  $\text{ICl}_3$ .

More sol. in  $\text{H}_2\text{O}$  than  $\text{KCl}$ ,  $\text{ICl}_3$ . (Fihol, *J. Pharm.* 26, 441; Berz J. B. 20, (2) 110)

**Ammonium iridium trichloride.**

*See Chloriridite, ammonium.*

**Ammonium iridium tetrachloride.**

*See Chloriridate, ammonium.*

**Ammonium iron (ferrous) chloride,**  $\text{NH}_4\text{Cl}$ ,  
 $\text{FeCl}_2$ .

Easily sol in  $\text{H}_2\text{O}$ ; insol in alcohol (Winkler.)

**Ammonium iron (ferric) chloride,**  $2\text{NH}_4\text{Cl}$ ,  
 $\text{FeCl}_3 + \text{H}_2\text{O}$

Deliquescent. Sol. in  $\text{H}_2\text{O}$  without decomp. (Fritzsche); sol. in 3 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl.)  
Sol. in  $\text{H}_2\text{O}$  (Walden, *Z. anorg.* 1894, 1, 332.)

**Ammonium iron (ferric) potassium chloride,**  
 $\text{NH}_4\text{Cl}$ ,  $\text{FeCl}_3$ ,  $\text{KCl} + 1\frac{1}{2}\text{H}_2\text{O}$ .

Min. *Kremersite*. Deliquescent.

**Ammonium lead chloride,**  $\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (?) (André, *C. R.* 96, 1502.)

$6\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2 + \text{H}_2\text{O}$ .  
 $9\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2 + 1\frac{1}{2}\text{H}_2\text{O}$   
 $9\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$   
 $10\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2 + \text{H}_2\text{O}$ .  
 $11\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2 + 3\frac{1}{2}\text{H}_2\text{O}$ .  
 $18\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2 + 4\text{H}_2\text{O}$

All these salts are decomp. by  $\text{H}_2\text{O}$ . (André *A. ch.* (6) 3, 104.)

Of the salts prepared by André, only one  $\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2$  exists. (Wells, *Sill Am. J.* 146, 25.)

Solubility determinations show that  $\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2$  is the only double salt formed at  $25^\circ$ . (Foote, *Am. Ch. J.* 1907, 37, 121.)

$\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2 + \frac{1}{2}\text{H}_2\text{O}$ . (Wells, *l.c.*)

**Ammonium lead tetrachloride.**

*See Chloroplumbate, ammonium.*

**Ammonium magnesium chloride,**  $\text{NH}_4\text{MgCl}_2$ ,  
+  $6\text{H}_2\text{O} = \text{NH}_4\text{Cl}$ ,  $\text{MgCl}_2 + 6\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .  
Sol. in 6 pts. cold  $\text{H}_2\text{O}$ . (Fourcroy.)

Solubility in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $1^\circ$ .

$t^\circ$	Per 1000 Mol. $\text{H}_2\text{O}$	
	Mol. $\text{NH}_4\text{Cl}$	Mol. $\text{MgCl}_2$
3 3°	27 5	55 7
25 0	42 1	56.4
50 0	62 9	59 1

(Biltz, *Z. anorg.* 1911, 71, 170.)

$4\text{NH}_4\text{Cl}$ ,  $5\text{MgCl}_2 + 33\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Berthelot and André, *A. ch.* (6) 11, 294.)

**Ammonium manganous chloride,**  $\text{NH}_4\text{Cl}$ ,  
 $\text{MnCl}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $1\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at ordinary temp. (Hantz, *A. ch.* 66, 280), does not exist. (Saunders, *Am. Ch. J.* 14, 134)

$2\text{NH}_4\text{Cl}$ ,  $\text{MnCl}_2 + \text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  (Ram-melsberg), does not exist. (Saunders)

+  $2\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ , but with decomp. into  $\text{NH}_4\text{Cl}$  and  $\text{MnCl}_2$ . (Saunders.)

**Ammonium manganic chloride,**  $2\text{NH}_4\text{Cl}$ ,  
 $\text{MnCl}_3$ .

Sol. in  $\text{H}_2\text{O}$ ; less sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  Un-stable (Neuman, *M* 1894, 15, 490.)

+  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  Sol. in  $\text{HCl}$  apparently without decomp. (Rice, *Chem. Soc.* 1898, 73, 260)

**Ammonium mercuric chloride,**  $2\text{NH}_4\text{Cl}$ ,  
 $\text{HgCl}_2 + \text{H}_2\text{O}$  (sal alembroth).

Sol. in 0.66 pt.  $\text{H}_2\text{O}$  at  $10^\circ$ , and in nearly every proportion of hot  $\text{H}_2\text{O}$ .

$\text{NH}_4\text{Cl}$ ,  $\text{HgCl}_2$ . Easily sol. in  $\text{H}_2\text{O}$ .  
+  $\frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Kane.)

$2\text{NH}_4\text{Cl}$ ,  $3\text{HgCl}_2 + 4\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Holmes, *C. N.* 5, 351.)

$\text{NH}_4\text{Cl}$ ,  $2\text{HgCl}_2$  Very sol. in  $\text{H}_2\text{O}$ . (Ray, *Chem. Soc.* 1902, 81, 648.)

$\text{NH}_4\text{Cl}$ ,  $5\text{HgCl}_2$ . (Strömholm, *J. pr.* 1902, (2) 66, 441.)

**Ammonium mercuric sodium chloride,**  $\text{NH}_4\text{Cl}$ ,  
 $\text{HgCl}_2$ ,  $4\text{NaCl}$  (?)

Sol. in  $\text{H}_2\text{O}$ . (Kossmann, *A. ch.* (3) 27, 243.)

**Ammonium molybdenum chloride,**  $2\text{NH}_4\text{Cl}$ ,  
 $\text{MoCl}_5 + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Nearly insol. in alcohol and ether. (Chilesotti, *C. C.* 1903, II, 652.)

*See also Ammonium chloromolybdenum chloride.*

**Ammonium molybdenum chloride iodide.**

*See Ammonium chloromolybdenum iodide.*

**Ammonium molybdenyl chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{MoO}_2\text{Cl}_2 + 2\text{H}_2\text{O}$ .

(Weinland, Z. anorg. 1905, 44. 98.)

$2\text{NH}_4\text{Cl}$ ,  $\text{MoOCl}_3$  Sol. in  $\text{H}_2\text{O}$ , insol. in  $\text{H}_2\text{O}$  sat with  $\text{HCl}$ . (Klasen, B 1901, 34. 149.)

**Ammonium nickel chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{NiCl}_2 + 6\text{H}_2\text{O}$ .

Deliquescent in moist air. Easily sol in  $\text{H}_2\text{O}$ . (Hautz.)

$4\text{NH}_4\text{Cl}$ ,  $\text{NiCl}_2 + 7\text{H}_2\text{O}$  (?).

**Ammonium osmium tetrachloride.**

See Chlorosmate, ammonium.

**Ammonium osmium sesquichloride.**

See Chlorosmite, ammonium.

**Ammonium osmyl chloride**,  $(\text{NH}_4)_2\text{OsO}_2\text{Cl}_4$ .

Sol. in  $\text{H}_2\text{O}$  Decomp. by  $\text{HCl}$  (Wintrebert, A. ch. 1903, (7) 28. 92)

**Ammonium osmyl oxychloride**,

$(\text{NH}_4)_2\text{OsO}_2\text{Cl}_2$ .

Very sl sol. in  $\text{H}_2\text{O}$  Sol in  $\text{KOH} + \text{Ag}$  with decomp. (Wintrebert, A. ch. 1903, (7) 28. 116.)

**Ammonium palladium chlorides.**

See Chloropalladate, ammonium and chloropalladate, ammonium.

**Ammonium rhodium dichloride**,  $4\text{NH}_4\text{Cl}$ ,  $\text{RhCl}_3 + 3\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , but decomp slowly (Willm B. 16. 3033.)

Does not exist. (Ladité, A. ch. (6) 17. 277.)

**Ammonium rhodium trichloride.**

See Chlororhodite, ammonium.

**Ammonium rhodium chloride ammonium nitrate**,  $\text{Rh}_2\text{Cl}_6$ ,  $6\text{NH}_4\text{Cl}$ ,  $2\text{NH}_4\text{NO}_3$ .

See Chlororhodite nitrate, ammonium.

**Ammonium ruthenium trichloride.**

See Chlororuthenite, ammonium.

**Ammonium ruthenium tetrachloride.**

See Chlororuthenate, ammonium.

**Ammonium tellurium chloride.**

See Chlorotellurate, ammonium.

**Ammonium thallic chloride**,  $3\text{NH}_4\text{Cl}$ ,  $\text{TlCl}_3$

Easily sol. in  $\text{H}_2\text{O}$ . (Willm)  $+ 2\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Nickles, J. Pharm. (4) 1. 28.)

**Ammonium thorium chloride**,  $8\text{NH}_4\text{Cl}$ ,  $\text{ThCl}_4 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Chydenius.)

**Ammonium tin (stannous) chloride** (ammonium chlorostannite),  $\text{NH}_4\text{Cl}$ ,  $\text{SnCl}_2 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Resembles K salt. (Richardson, Am. Ch. J. 14. 93.)

$2\text{NH}_4\text{Cl}$ ,  $\text{SnCl}_2 + \text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ , but decomp by boiling. (Rammelsberg)

Contains  $2\text{H}_2\text{O}$ . (Richardson)

$4\text{NH}_4\text{Cl}$ ,  $\text{SnCl}_2 + 3\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ . (Poggiale, C R 20. 1182)

Does not exist (Richardson)

**Ammonium tin (stannic) chloride.**

See Chlorostannate, ammonium.

**Ammonium titanium chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{TiCl}_3 + 2\text{H}_2\text{O}$

Ppt, decomp in moist air, sol in fuming  $\text{HCl}$ , insol in ether (Rosenheim, Z. anorg. 1901, 26. 242.)

**Ammonium titanium chloride**,  $3\text{NH}_4\text{Cl}$ ,  $\text{TiCl}_3$

Sol in  $\text{H}_2\text{O}$ .

$6\text{NH}_4\text{Cl}$ ,  $\text{TiCl}_3$  Sol in  $\text{H}_2\text{O}$ . (Rose)

**Ammonium tungsten chloride**,  $(\text{NH}_4)_3\text{W}_2\text{Cl}_9 = 3\text{NH}_4\text{Cl}$ ,  $2\text{WCl}_6$ .

Easily sol in  $\text{H}_2\text{O}$ . Nearly insol in most organic solvents. (Olsson, B 1913, 46. 577)

**Ammonium uranyl chloride.**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  (Pelletot)

$2\text{NH}_4\text{Cl}$ ,  $(\text{UO}_2)_2\text{Cl}_2 + 2\text{H}_2\text{O}$  Solution at  $15^\circ$  contains in 100 g. 3.51 g.  $\text{NH}_4$ , 40.67 g  $\text{UO}_2$  and 19.15 g.  $\text{Cl}$ , hence there is considerable decomp. (Rumbach, B 1904, 37. 466)

**Ammonium vanadium chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{VCl}_3 + \text{H}_2\text{O}$

Difficulty sol. in  $\text{H}_2\text{O}$  and alcohol (Stahler, B 1904, 37. 432)

**Ammonium zinc chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2 + 2\text{H}_2\text{O}$

Deliquescent. Very sol. in  $\text{H}_2\text{O}$  (Hautz, A 66. 287)

$2\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2$  Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg 504. 507)

$+ \text{H}_2\text{O}$  Deliquescent in moist air Sol. in  $\frac{1}{2}$  pt cold  $\text{H}_2\text{O}$  with absorption of heat. Sol. in 0.28 pt hot  $\text{H}_2\text{O}$  (Golfier-Bassayre, A. ch 70. 344), sol. in  $\frac{1}{2}$  pt. cold  $\text{H}_2\text{O}$ . (Hautz, A. 66. 287)

$3\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2$  Sol in  $\text{H}_2\text{O}$ . (Marignac.)  $+ \text{H}_2\text{O}$ . (Berthelot, A. ch. (6) 11. 294.)

$4\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2$  (Dehérain.)

$6\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2 + \frac{1}{2}\text{H}_2\text{O}$ . (Berthelot, l.c.)

**Ammonium chloride zinc oxychloride**,  $2\text{ZnCl}_2$ ,  $8\text{NH}_4\text{Cl}$ ,  $\text{ZnO}$

Sol. in a little  $\text{H}_2\text{O}$ , but decomp. by excess. (André)

$3\text{ZnCl}_2$ ,  $10\text{NH}_4\text{Cl}$ ,  $\text{ZnO}$ . As above (André, A. ch. (6) 3. 58)

**Ammonium chloride antimony fluoride**,  $\text{NH}_4\text{Cl}$ ,  $\text{SbF}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ . (de Haen, B 21. 901 R.)

**Ammonium chloride arsenic trioxide.**

See Arsenite chloride, ammonium.

**Ammonium chloride bismuth bromide,**  
 $3\text{NH}_4\text{Cl}, \text{BiBr}_3 + \text{H}_2\text{O}$ Deliquescent, decomp by  $\text{H}_2\text{O}$  (Muir, Chem Soc. 31. 148.) $2\text{NH}_4\text{Cl}, \text{BiBr}_3 + 3\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$  (Muir.) $5\text{NH}_4\text{Cl}, 2\text{BiBr}_3 + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Muir.)**Ammonium chloride chromic oxychloride,**  
 $2\text{NH}_4\text{Cl}, \text{CrOCl}_2$ Decomp in the air Sol<sup>h</sup> in conc HCl without decomp (Weinland, B. 1906, 39. 4045.)**Ammonium chloride cuprocupric thiosulphate,**  
 $2\text{NH}_4\text{Cl}, \text{Cu}_2\text{S}, \text{CuO}, 3\text{S}_2\text{O}_2$ 

See Thiosulphate ammonium chloride, cuprocupric.

**Ammonium chloride lead iodide,**  $3\text{NH}_4\text{Cl}, \text{PbI}_2$ Decomp with  $\text{H}_2\text{O}$  (Behrens, Pogg. 62. 252) $4\text{NH}_4\text{Cl}, \text{PbI}_2 + 2\text{H}_2\text{O}$ . Decomp. with  $\text{H}_2\text{O}$ . (Poggiale, C R 20. 1180)**Ammonium chloride mercuric bromide,**  
 $\text{NH}_4\text{Cl}, \text{HgBr}_2$ 

(Edhem-Bey, Dissert 1885.)

**Ammonium chloride platinum sulphite.**

See Chloroplatosulphite, ammonium.

**Ammonium chloride tin (stannous) bromide,**  
 $2\text{NH}_4\text{Cl}, \text{SnBr}_2 + 11\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$ . (Raymann and Preis, A. 223. 323)**Ammonium dichloroiodide,**  $\text{NH}_4\text{Cl}_2\text{I}$ Slowly decomp when exposed to dry air at ord temp Very sol in  $\text{H}_2\text{O}$ . (Chattaway, Chem Soc. 1915, 107. 107)**Ammonium tetrachloroiodide,**  $\text{NH}_4\text{Cl}_4\text{I}$ 

Decomp. in the air. (Chattaway, Chem. Soc. 1915, 107. 107)

**Ammonium lead chloroiodide,**  $\text{NH}_4\text{PbClI}_2 + 2\text{H}_2\text{O}$  and  $(\text{NH}_4)_2\text{PbCl}_2\text{I}_2 + 2\text{H}_2\text{O}$ .Sol. in  $\text{KOH} + \text{Ag}$  and in strong acids; decomp. by  $\text{H}_2\text{O}$ . (Fonzes-Diacon, Bull. Soc. 1897, (3) 17. 348.)**Ammonium fluoride,**  $\text{NH}_4\text{F}$ .Abundantly sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol. (Maignac, Ann. Min (5) 15. 221)Insol in liquid  $\text{NH}_3$  (Ruff and Geisel, B. 1903, 36. 820)Almost insol in liquid  $\text{NH}_3$  at  $50^\circ$ . (Moissan, C R. 1901, 133. 713)

Sol. in methyl alcohol. (Carrara, Gazz. ch. it 1896, 26. 119)

**Ammonium hydrogen fluoride,**  $\text{NH}_4\text{F}, \text{HF}$ .Deliquescent in moist air. Sol in  $\text{H}_2\text{O}$ .**Ammonium antimony fluoride,**  $2\text{NH}_4\text{F}, \text{SbF}_3$   
Deliquescent, sol. in 0.9 pt cold  $\text{H}_2\text{O}$   
Insol in alcohol or ether (Fluckinger, A. 84. 248.) $\text{NH}_4\text{F}, 4\text{SbF}_3$  3 pts sol in 2 pts  $\text{H}_2\text{O}$   
(Raad and Hauser, B. 1800, 23. R 125)  
 $\text{NH}_4\text{F}, \text{SbF}_3$  Easily sol. in  $\text{H}_2\text{O}$  (Marignac, A 145. 239)**Ammonium bismuth fluoride,**  $2\text{NH}_4\text{F}, \text{BiF}_3$ .Insol. in  $\text{H}_2\text{O}$ . Rather difficultly sol in acids. (Helmholt, Z anorg 3. 115)**Ammonium cadmium fluoride,**  $\text{NH}_4\text{F}, \text{CdF}_2$ Insol in  $\text{H}_2\text{O}$  Sol in acids on boiling (Helmholt, Z anorg. 3. 115)**Ammonium chromium fluoride,**  $3\text{NH}_4\text{F}, \text{CrF}_3$ Easily sol in  $\text{H}_2\text{O}$  Sl sol in  $\text{NH}_4\text{F} + \text{Ag}$ . (Petersen, J pi (2) 40. 52) $2\text{NH}_4\text{F}, \text{CrF}_3 + \text{H}_2\text{O}$ . (Wagner, B. 19. 896)**Ammonium cobaltous fluoride,**  $2\text{NH}_4\text{F}, \text{CoF}_2 + 2\text{H}_2\text{O}$ Sl sol in  $\text{H}_2\text{O}$  (Wagner, B. 19. 896)Easily sol. in  $\text{H}_2\text{O}$  (Helmholt, Z. anorg. 3. 132)**Ammonium columbyl fluoride.**

See Fluoxycolumbate, ammonium.

**Ammonium columbium fluoride oxyfluoride,**  
 $3\text{NH}_4\text{F}, \text{CbF}_3, \text{CbOF}_3$ 

See Fluoxycolumbate columbium fluoride, ammonium.

**Ammonium copper fluoride,**  $2\text{NH}_4\text{F}, \text{CuF}_2 + 2\text{H}_2\text{O}$ .Insol. in  $\text{H}_2\text{O}$  (Helmholt, Z. anorg 3. 115.)Nearly insol. in  $\text{H}_2\text{O}$  but decomp. thereby (Haas, Ch Z. 1906, 32. 8.)**Ammonium glucinum fluoride,**  $2\text{NH}_4\text{F}, \text{GlF}_3$ .Sol. in  $\text{H}_2\text{O}$ . (Maignac, A. ch. (4) 30. 51)Very sol in  $\text{H}_2\text{O}$  (Helmholt, Z. anorg. 3. 130)**Ammonium iron (ferrous) fluoride,**  $2\text{NH}_4\text{F}, \text{FeF}_2$ . (Wagner, B. 19. 896) $\text{NH}_4\text{F}, \text{FeF}_2 + 2\text{H}_2\text{O}$ . (W.)**Ammonium iron (ferric) fluoride,**  $2\text{NH}_4\text{F}, \text{FeF}_3$ More sol. in  $\text{H}_2\text{O}$  than the corresponding K compound Decomp. by boiling. (Nickles, J. Pharm. (4) 7. 15) $3\text{NH}_4\text{F}, \text{FeF}_3$ . Sl. sol in  $\text{H}_2\text{O}$  (Maignac, A. ch. (3) 60. 306.)

Easily sol. in acids. (Helmholt, Z anorg. 3. 124.)

**Ammonium manganic fluoride,**  $2\text{NH}_4\text{F}, \text{MnF}_4$ 

More sol. than the K salt. (Nickles, C. R 65. 107)

True composition is  $4\text{NH}_4\text{F}$ ,  $\text{Mn}_2\text{F}_6$ . (Christensen, J. pr. (2) 34. 41)

See also Fluomanganate, ammonium.

**Ammonium manganyl fluoride.**

See Fluoxymanganate, ammonium.

**Ammonium molybdenum fluoride.**

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq.}$  (Berzelius.)

See also Fluomolybdate, ammonium.

**Ammonium molybdenyl fluoride.**

See Fluoxymolybdate, ammonium.

**Ammonium nickel fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{NiF}_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wagner, B. 19. 896)

Easily sol. in  $\text{H}_2\text{O}$  (Helmholtz, Z anorg. 3. 143)

**Ammonium scandium fluoride**,  $(\text{NH}_4)_3\text{ScF}_6$ .

Easily sol in  $\text{H}_2\text{O}$ . Aqueous solution is not decomp. by boiling. Decomp. by acids. (R. I. Meyer, Z anorg. 1914, 86. 275)

**Ammonium silicon fluoride.**

See Fluosilicate, ammonium.

**Ammonium silver fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{AgF} + \text{H}_2\text{O}$

Not hygroscopic. Sol in  $\text{H}_2\text{O}$ ; sol in conc.  $\text{NH}_4\text{F} + \text{Aq.}$  Sol. in alcohol. (Grützner, Arch. Pharm 1900, 238. 3)

$15\text{NH}_4\text{F}$ ,  $\text{AgF} + 4\text{H}_2\text{O}$ . More deliquescent than  $\text{NH}_4\text{F}$ . (Bohm, Dissert 1906.)

**Ammonium tantalum fluoride.**

See Fluotantalate, ammonium.

**Ammonium tantaly fluoride.**

See Fluoxytantalate, ammonium.

**Ammonium tellurium fluoride**,  $\text{NH}_4\text{F}$ ,  $\text{TeF}_6$ .

Decomp. by  $\text{H}_2\text{O}$ . (Höghom, Bull. Soc. (2) 85. 60.)

**Ammonium tin (stannous) fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{SnF}_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Wagner, B. 19. 896.)

**Ammonium tin (stannic) fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{SnF}_4$ .

See Fluostannate, ammonium.

**Ammonium titanium sesquifluoride.**

See Fluotitanate, ammonium.

**Ammonium titanyl fluoride.**

See Fluoxypertitanate, ammonium.

**Ammonium tungstyl fluoride.**

See Fluoxytungstate, ammonium.

**Ammonium uranyl fluoride.**

See Fluoxuryanate, ammonium.

**Ammonium vanadium sesquifluoride.**

See Fluovanadate, ammonium.

**Ammonium vanadyl fluoride.**

See Fluoxyvanadate, ammonium.

**Ammonium zinc fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{ZnF}_2$

Sol in  $\text{H}_2\text{O}$  (R Wagner.)  
+  $2\text{H}_2\text{O}$ . Very sol in  $\text{H}_2\text{O}$  Easily sol in dil. acids (Helmholtz)

**Ammonium zirconium fluoride.**

See Fluozirconate, ammonium.

**Ammonium fluoride manganic oxyfluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{MnOF}_2$ .

Precipitate. (Nicklès.)

See also Fluoxymanganate, ammonium.

**Ammonium fluoride molybdenum trioxide**,  $2\text{NH}_4\text{F}$ ,  $\text{MoO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Mauro, Gazz. ch. it. 18. 120.)

**Ammonium fluoride tungsten oxyfluoride.**

See Fluoxytungstate, ammonium.

**Ammonium fluoride tungsten oxyfluoride ammonium tungstate**,  $4\text{NH}_4\text{F}$ ,  $\text{WO}_2\text{F}_2$ ,  $(\text{NH}_4)_2\text{WO}_4$

See Fluoxytungstate tungstate, ammonium.

**Ammonium fluoride vanadium oxyfluoride.**

See Fluoxyvanadate, and fluoxyhypovanadate, ammonium.

**Ammonium hydroselenide**,  $\text{NH}_4\text{HSe}$

Sol in  $\text{H}_2\text{O}$  with decomp. (Bineau, A. ch. (2) 67. 229.)

**Ammonium hydrosulphide**,  $\text{NH}_4\text{SH}$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. Solutions decomp on air

**Ammonium hydroxide**,  $\text{NH}_4\text{OH}$ .

See Ammonia,

**Ammonium imidosulphamide**,  $(\text{S}_2\text{O}_2\text{N}_2\text{H}_4)\text{NH}_4$ .

(Hantzsch, B. 1905, 38. 1033.)

**Ammonium iodide**,  $\text{NH}_4\text{I}$ .

Very deliquescent. Sol. in 0.60 pt  $\text{H}_2\text{O}$ . (Eder, Dingl. 221. 89)

Sp. gr. of aqueous solution of  $\text{NH}_4\text{I}$  at  $18^\circ$  containing—

	10	20	30	40	50% $\text{NH}_4\text{I}$
1	0.653	1.1397	1.2260	1.3260	1.4415

(Kohrausch, W. Ann 1879. 1.)

$\text{NH}_4\text{I} + \text{Aq}$  containing 12.51%  $\text{NH}_4\text{I}$  has sp. gr.  $20^\circ/20^\circ = 1.0846$ .

$\text{NH}_4\text{I} + \text{Aq}$  containing 19.19%  $\text{NH}_4\text{I}$  has sp. gr.  $20^\circ/20^\circ = 1.1359$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 279.)

Very easily sol in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 826.)

Very sol. in liquid  $\text{NH}_3$  at  $-50^\circ$ . (Moissan, C. R 1901, 133. 713.)

Sol. in  $\text{SOCl}_2$ . (Walden, Z anorg 1900, 25. 216)

Sol. in liquid  $\text{SO}_2$ . (Walden, Z. anorg 1902, 30. 160)

Sol. in 40 pts. abs alcohol (Eder, l.c.)

" 210 " ether (Eder, l.c.)

" 20 " alcohol-ether (1 : 1). (Eder, l.c.)

Sol. in acetone. (Eidmann, C.C. 1899, II. 1014.); (Naumann, B. 1904, 37. 4328)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314)

Sl sol in benzonitrile (Naumann, B. 1914, 47. 1369)

#### Ammonium diiodide, $\text{NH}_4\text{I}_2$

Sol. in alcohol, ether,  $\text{CS}_2$ , and  $\text{KI} + \text{Aq}$ , less sol. in chloroform. (Guthrie, Chem. Soc (2) 1. 239)

#### Ammonium triiodide, $\text{NH}_4\text{I}_3$

Sl. deliquescent. Sol in little  $\text{H}_2\text{O}$ , but decomp. by much  $\text{H}_2\text{O}$ . (Johnson, Chem Soc. 33. 397)

#### Ammonium antimony iodide, $\text{NH}_4\text{I}$ , $\text{SbI}_3 + 2\text{H}_2\text{O}$

Decomp. by  $\text{H}_2\text{O}$  (Nicklès, C. R. 51. 1097)

$3\text{NH}_4\text{I}$ ,  $4\text{SbI}_3 + 9\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ , with separation of  $\text{SbOI}$ . Sol. in  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{HCl}$ , and  $\text{H}_2\text{C}_2\text{H}_4\text{O}_6 + \text{Aq}$  Decomp. by  $\text{CS}_2$ . (Schäffer, Pogg 109. 611.)

$3\text{NH}_4\text{I}$ ,  $\text{SbI}_3 + 3\text{H}_2\text{O}$  As above

$4\text{NH}_4\text{I}$ ,  $\text{SbI}_3 + 3\text{H}_2\text{O}$  As above

#### Ammonium bismuth iodide, $\text{NH}_4\text{I}$ , $\text{BiI}_3 + \text{H}_2\text{O}$

Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Nicklès, C. R. 51. 1097.)

$4\text{NH}_4\text{I}$ ,  $\text{BiI}_3 + 3\text{H}_2\text{O}$  As above. (Linna, Pogg. 111. 240.)

$2\text{NH}_4\text{I}$ ,  $\text{BiI}_3 + 2\frac{1}{2}\text{H}_2\text{O}$ . Decomp by  $\text{H}_2\text{O}$ , or  $\text{MCl}$ ,  $\text{MBr}$ , or  $\text{MI} + \text{Aq}$  (Nicklès, J. pr. (2) 39. 116.)

#### Ammonium cadmium iodide, $2\text{NH}_4\text{I}$ , $\text{CdI}_2 + 2\text{H}_2\text{O}$

Deliquescent. (Croft.)

Sol. at  $15^\circ$  in 0.58 pt.  $\text{H}_2\text{O}$ , 0.70 pt. abs. alcohol., 8.9 pts ether (sp. gr 0.729), and 1.8 pts alcohol-ether (1 : 1). (Eder, Dingl. 221. 89.)

100 pts. of the solution in  $\text{H}_2\text{O}$  contain 85.97 pts. of the salt at  $14.5^\circ$ . (Rimbach, B. 1905, 38. 1563.)

$\text{NH}_4\text{I}$ ,  $\text{CdI}_2 + \frac{1}{2}\text{H}_2\text{O}$  Sol. at  $15^\circ$  in 0.90 pt  $\text{H}_2\text{O}$ , 0.88 pt. abs alcohol, and 2.4 pts. ether (sp. gr 0.729). (Eder, l.c.)

$+ \text{H}_2\text{O}$  (Grossmann, Z anorg 1902, 33. 154.)

#### Ammonium chloromolybdenum iodide, $2\text{NH}_4\text{I}$ , $\text{Cl}_2\text{MoO}_4 + 2\text{H}_2\text{O}$

Decomp. by  $\text{H}_2\text{O}$ . Cryst. from  $\text{HI} + \text{Aq}$ . (Blomstrand)

#### Ammonium cuprous iodide, $2\text{NH}_4\text{I}$ , $\text{Cu}_2\text{I}_2 + \text{H}_2\text{O}$

Decomp on the air, or by  $\text{H}_2\text{O}$ , or alcohol. (Saglier, C. R. 104. 1440)

$+ \frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{Cu}_2\text{I}_2$  (Gossnei, Zeit. Kryst 1903, 33. 501)

#### Ammonium cupric iodide ammonia, $2\text{NH}_4\text{I}$ , $\text{CuI}_2$ , $2\text{NH}_3 + 2\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$  or alcohol, sl. sol in  $\text{NH}_4\text{OH} + \text{Aq}$

$+ 8\text{H}_2\text{O}$ . Unstable. (Saglier, C. R. 104. 1440)

$\text{NH}_4\text{I}$ ,  $2\text{CuI}_2$ ,  $3\text{NH}_3$ . (Fleurent, C. R. 1891, 113. 1047)

#### Ammonium iridium diiodide, $2\text{NH}_4\text{I}$ , $\text{IrI}_2$

Insol in cold or hot  $\text{H}_2\text{O}$ , and in alcohol. Sol in warm dil. acids (Oppler)

#### Ammonium iridium sesquiodide.

See Iodiridite, ammonium.

#### Ammonium iridium tetraiodide.

See Iodiridate, ammonium.

#### Ammonium lead iodide, $\text{NH}_4\text{I}$ , $\text{PbI}_2 + 2\text{H}_2\text{O}$

Decomp by much  $\text{H}_2\text{O}$ . (Wells, Sil. Am. J. 146. 25)

$4\text{NH}_4\text{I}$ ,  $3\text{PbI}_2 + 6\text{H}_2\text{O}$ . Sl sol. in  $\text{H}_2\text{O}$ . (Mosmer, C. R. 1895, 120. 444.)

Sol in  $\text{H}_2\text{O}$  with decomp Sol. in strong  $\text{KOH} + \text{Aq}$  and in strong acids. (Fonze-Diacon, Bull. Soc 1897, (3) 17. 347.)

#### Ammonium magnesium iodide, $\text{NH}_4\text{I}$ , $\text{MgI}_2 + 6\text{H}_2\text{O}$

Very deliquescent. (Lereh, J. pr. (2) 28. 338.)

#### Ammonium mercuric iodide, $\text{NH}_4\text{I}$ , $\text{HgI}_2 + \text{H}_2\text{O}$

Decomp. into its constituents by  $\text{H}_2\text{O}$ . (Boullay, A. ch. (2) 34. 345.)

Sol without decomp. in alcohol and ether.  $\text{NH}_4\text{I}$ ,  $2\text{HgI}_2$  Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{KI} + \text{Aq}$ . Very sol. in alcohol, ether and nitrobenzol (Löw, Zeit Kryst, 51. 138)

#### Ammonium silver iodide, $2\text{NH}_4\text{I}$ , $\text{AgI}$

Deliquescent Decomp. by  $\text{H}_2\text{O}$ . (Poggale.)

#### Ammonium thallic iodide, $\text{NH}_4\text{I}$ , $\text{TlI}_3$

Sol in  $\text{H}_2\text{O}$  (Nicklès, J. Pharm. (4) 1. 32.)

#### Ammonium tin (stannous) iodide, $\text{NH}_4\text{I}$ , $\text{SnI}_2$

Decomp. by small amt  $\text{H}_2\text{O}$  but completely sol. in a large amt (Boullay, A. ch (2) 34. 376.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . (Personne.)

#### Ammonium zinc iodide, $2\text{NH}_4\text{I}$ , $\text{ZnI}_2$

Extremely deliquescent, and sol in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg 43. 665.)

$\text{NH}_4\text{I}$ ,  $\text{ZnI}_2 + 1\frac{1}{2}\text{H}_2\text{O}$  Hygroscopic  
(Ephraim, Z anorg 1910, 67. 384)

**Ammonium iodide arsenic trioxide.**

See Arsenite iodide, ammonium.

**Ammonium cobalt nitride.**

See Ammonium cobalt azoimide.

**Ammonium ruthenium dihydronitrosobromide**,  $\text{NO Ru}_2\text{H}_3(\text{NH}_4)_2\text{Br}_2 \cdot 2\text{HBr}$

Ppt. (Brizard, A ch 1900, (7) 21. 363)

**Ammonium ruthenium nitroschloride**,  
 $3\text{NH}_4\text{Cl} \cdot 2\text{HCl} \cdot \text{NO Ru}_2\text{H}_3\text{Cl}_2$

Ppt (Brizard, A ch 1900, (7) 21. 354)

**Ammonium ruthenium dihydronitroschloride**,  $\text{NO Ru}_2\text{H}_3(\text{NH}_4)_2\text{Cl}_2 \cdot 2\text{HCl}$

Ppt (Brizard, A ch. 1900, (7) 21. 358)

**Ammonium peroxide**,  $(\text{NH}_4)_2\text{O}_2$

M-ppt  $-2^\circ$  Sl. sol in ether without decomp (D'Ans, B 1913, 46. 3076)

Sol. in alcohol; insol in ether, decomp slowly in aq solution. (Melikoff, B 1897, 80. 3145.)

**Ammonium hydrogen peroxide**,  $(\text{NH}_4)_2\text{O}_2 \cdot \text{H}_2\text{O}_2$

Decomp at ordinary temp. (Mehkoff, B 1898, 31. 447)

+  $\text{H}_2\text{O}$ . Unstable, deliquesces at ordinary temp; sol in alcohol; insol in light petroleum. (Mehkoff, B 1898, 31. 152)

**Ammonium selenide**,  $(\text{NH}_4)_2\text{Se}$

Sol. in  $\text{H}_2\text{O}$  with decomp (Bineau, A. ch (2) 67. 229.)

Stable in the air. Sol. in  $\text{H}_2\text{O}$ ; aq solution decomp. slowly (Lenher and Smith, J. Am. Chem. Soc 1898, 20. 277.)

**Ammonium hydrogen selenide**,  $\text{NH}_4\text{HSe}$

Sol. in  $\text{H}_2\text{O}$  (Fabre, C. R. 103. 269)

**Ammonium monosulphide**,  $(\text{NH}_4)_2\text{S}$

Decomp. on air. Sol. in  $\text{H}_2\text{O}$ , but solution decomposes rapidly.

Very sol in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 826.)

**Ammonium disulphide**,  $(\text{NH}_4)_2\text{S}_2$

Sol. in  $\text{H}_2\text{O}$  with decomp.

Does not exist (Bloxam, Chem. Soc 1895, 67. 293)

**Ammonium tetrasulphide**,  $(\text{NH}_4)_2\text{S}_4$

Easily sol in  $\text{H}_2\text{O}$ . Conc solution is stable, dil solution decomp. on air. Easily sol in alcohol without decomp., but solution decomp. on the air more rapidly than the aqueous solution (Fritzsche, J. pr 32. 313.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . When dissolved in  $\text{H}_2\text{O}$ , it is at once dissociated with deposition of S. (Bloxam, Chem. Soc. 1895, 67. 303)

**Ammonium pentasulphide**,  $(\text{NH}_4)_2\text{S}_5$

Decomp on air Sol in  $\text{H}_2\text{O}$  with separation of S Sol. in alcohol without decomp., but solution decomposes quickly on standing. (Fritzsche, J pr 32. 313.)

Rapidly decomp. by  $\text{H}_2\text{O}$  with separation of S (Bloxam, Chem. Soc. 1895, 67. 298.)

+  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  with separation of S (Bloxam, Chem. Soc 1895, 67. 298)

**Ammonium heptasulphide**,  $(\text{NH}_4)_2\text{S}_7$

More stable on air, and less easily decomposed by  $\text{H}_2\text{O}$  than  $(\text{NH}_4)_2\text{S}_5$

+  $1\frac{1}{2}\text{H}_2\text{O}$ . Decomp by  $\text{H}_2\text{O}$  with separation of S Slowly attacked by dil.  $\text{HCl}$  + Aq. (Bloxam, Chem. Soc. 1895, 67. 307)

**Tetrammonium heptasulphide**,  $(\text{NH}_4)_4\text{S}_7 + 4\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . Solution can be kept for a long time without depositing S (Bloxam, Chem Soc 1895, 67. 298.)

**Diammonium enneasulphide**,  $(\text{NH}_4)_2\text{S}_9 + \frac{1}{2}\text{H}_2\text{O}$

Decomposed by  $\text{H}_2\text{O}$  with separation of S. Not attacked by boiling dil  $\text{HCl}$  + Aq on account of formation of a hard crust of S on the crystals (Bloxam, Chem. Soc 1895, 67. 306)

**Tetrammonium enneasulphide**,  $(\text{NH}_4)_4\text{S}_9$

Solution in  $\text{H}_2\text{O}$  deposits crystals of  $(\text{NH}_4)_2\text{S}_9$  on standing. (Bloxam, Chem. Soc 1895, 67. 302.)

+  $3\frac{1}{2}\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$  with separation of S (Bloxam, Chem. Soc. 1895, 67. 299.)

**Ammonium polysulphides.**

Conc  $\text{NH}_3$  + Aq dissolves  $\text{H}_2\text{S}$  to form  $(\text{NH}_4)_2\text{S}_2 \cdot 2\text{NH}_4\text{SH}$  On dilution more  $\text{H}_2\text{S}$  is absorbed to form  $(\text{NH}_4)_2\text{S}_4 \cdot 4\text{NH}_4\text{SH}$ , then  $(\text{NH}_4)_2\text{S}_8 \cdot 8\text{NH}_4\text{SH}$ , then  $(\text{NH}_4)_2\text{S}_{16} \cdot 16\text{NH}_4\text{SH}$  and finally  $\text{NH}_4\text{SH}$ . (Bloxam, Chem. Soc. 1895, 67. 284)

**Ammonium copper sulphide**,  $(\text{NH}_4)_2\text{S}_2 \cdot 2\text{CuS}_2$  (?)

Sol. in warm  $\text{H}_2\text{O}$ , but decomp. on standing. Warm  $\text{KOH}$  + Aq acts similarly; sl. sol. in  $\text{NH}_4\text{OH}$  + Aq,  $\text{Na}_2\text{CO}_3$  + Aq, or absolute alcohol. Insol in ether. Decomp. by dil. acids. (Priwoznik, B. 6. 1291.)

Correct formula is  $\text{NH}_4\text{CuS}_4$  Sl. sol. in  $\text{H}_2\text{O}$  Decomp by conc. and dil. acids. Easily sol in  $\text{NaOH}$  Sl sol. in alcohol. (Biltz, B 1907, 40. 976)

**Ammonium gold polysulphide**,  $\text{AuS}_2 \cdot \text{NH}_4$

Ppt (Hofmann, B 1903, 36. 3092; B. 1904, 37. 245)

**Ammonium iridium pentadecasulphide**,  
 $\cdot \text{IrS}_{15}(\text{NH}_4)_2$

Ppt. (Hofmann, B. 1904, 37. 247.)

**Ammonium palladium undecaculphide,**  
 $\text{PdS}_{11}(\text{NH}_4)_2 + \frac{1}{2}\text{H}_2\text{O}$

Ppt. (Hofmann, B. 1904, 37, 248)

**Ammonium platinum pentadecaculphide,**  
 $\text{PtS}_{15}(\text{NH}_4)_2 + 2\text{H}_2\text{O}$

Can be washed with  $\text{CS}_2$  without decomp.  
 Sol in alcohol Insol in ether (Hofmann,  
 B. 1903, 36, 3091)

**Ammonium stannic sulphide.**

See Sulphostannate, ammonium.

**Ammonium telluride,  $\text{NH}_4\text{HTe}$**

Easily sol in  $\text{H}_2\text{O}$ . (Bineau, A. ch. (2) 67,  
 229.)

**Ammonium sulphide ammonia,  $(\text{NH}_4)_2\text{S}$ ,  
 $2\text{NH}_3$**

Very unstable (Bloxam, Chem Soc 1895,  
 67, 294)

**Ammonium acisulphomelid,  $(\text{NSO ONH}_4)_2$   
 (?)**

(Hantzsch and Stuer, B. 1905, 38, 1039)

**Ammonplatindiamine comps.**

See Platindiamine comps.

**Ammondisulphonic acid,  $\text{NH}_2(\text{SO}_3\text{H})_2$ .**

Known only in its salts (Claus, A. 158,  
 52 and 194)

Contains 2 at. H less, and is identical with  
 imidosulphonic acid  $\text{NH}(\text{SO}_3\text{H})_2$ , which see  
 (Raschig, A. 241, 161.)

**Ammontrisulphonic acid,  $\text{NH}_2(\text{SO}_3\text{H})_3$**

Known only in its salts (Claus, A. 158,  
 52 and 194)

Contains 2 at. H less, and is nitrosulphonic  
 acid  $\text{N}(\text{SO}_3\text{H})_2$ , which see (Raschig, A. 241,  
 161.)

**Ammontetrasulphonic acid,  $\text{NH}(\text{SO}_3\text{H})_4$**

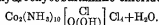
Known only in its salts (Claus, A. 158,  
 52 and 194.)

Does not exist, but was impure nitrosulpho-  
 nic acid, which see. (Raschig, A. 241,  
 161)

**Anhydroarseniotungstic acid,  $\text{H}_2\text{As}_2\text{W}_3\text{O}_{28}$ .**

See under Arseniotungstic acid.

**Anhydrooxycobaltamine chloride,**



Easily sol. in  $\text{H}_2\text{O}$ , but decomposes after a  
 few minutes; can be recrystallized from dil  
 $\text{HCl} + \text{Aq}$  Precipitated from sat.  $\text{H}_2\text{O}$  solu-  
 tion by conc.  $\text{HCl} + \text{Aq}$ , or alcohol. (Vort-  
 mann, M. Ch. 6, 404)

$\text{Co}_2(\text{NH}_3)_{10} \left( \frac{\text{Cl}}{\text{OH}} \right) \text{Cl}_4$  Sol. in  $\text{H}_2\text{O}$ . (Vort-  
 mann.)

**Anhydrooxycobaltamine chloride · mercuric  
 chloride,  $\text{Co}_2(\text{NH}_3)_{10}(\text{ClO}_2\text{H})\text{Cl}_4 \cdot 3\text{HgCl}_2$ .**

Can be recryst. from very dil hot  $\text{HCl} + \text{Aq}$ .

— chloroplatinate,  $\text{Co}_2(\text{NH}_3)_{10}(\text{ClO}_2\text{H})\text{Cl}_4$ ,  
 $2\text{PtCl}_4$ .

Can be recrystallized from  $\text{H}_2\text{O}$  containing  
 $\text{HCl}$

— chloronitrate,  
 $\text{Co}_2(\text{NH}_3)_{10}\text{Cl}(\text{O OH})(\text{NO}_2)_4 + \text{H}_2\text{O}$ .

Can be recrystallized from dil.  $\text{HCl} + \text{Aq}$ .

$\text{Co}_2(\text{NH}_3)_{10}\text{Cl}(\text{O OH})\text{Cl}_2(\text{NO}_2)_2 + \text{H}_2\text{O}$ .

More easily sol. in  $\text{H}_2\text{O}$  than the preceding  
 comp.

— chlorosulphate,  
 $\text{Co}_2(\text{NH}_3)_{10}\text{Cl}(\text{O} \cdot \text{OH})(\text{SO}_4)_2$ .

— dichromate,  $[\text{Co}_2(\text{NH}_3)_{10}\text{O OH}]_2(\text{Cr}_2\text{O}_7)_2$   
 $+ 8\text{H}_2\text{O}$ .

Sl sol. in  $\text{H}_2\text{O}$ .

— nitrate,  $\text{Co}_2(\text{NH}_3)_{10}(\text{NO}_3)(\text{O} \cdot \text{OH})(\text{NO}_2)_4$   
 $+ \text{H}_2\text{O}$

Sl sol in pure  $\text{H}_2\text{O}$  with immediate decomp.  
 Can be recrystallized from  $\text{H}_2\text{O}$  containing  
 $\text{HNO}_3$

— sulphate,  $[\text{Co}_2(\text{NH}_3)_{10} \text{O} \cdot \text{OH}]_2(\text{SO}_4)_2$ ,  
 $2\text{H}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Sl sol. in cold  $\text{H}_2\text{O}$ . When crystallized  
 from dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , is converted into—

$[\text{Co}_2(\text{NH}_3)_{10}\text{O} \cdot \text{OH}]_2(\text{SO}_4)_2 \cdot \text{H}_2\text{SO}_4 + 3\text{H}_2\text{O}$ ,  
 which by further recrystallization from very  
 dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  becomes—

$[\text{Co}_2(\text{NH}_3)_{10}\text{O} \cdot \text{OH}]_2(\text{SO}_4)_2 + 8\text{H}_2\text{O}$ . Sl sol.  
 in cold  $\text{H}_2\text{O}$ . (Vortmann.)

**Anhydrophospholutedungstic acid,**  
 $\text{H}_2\text{PW}_3\text{O}_{28}$

See under Phosphotungstic acid.

**Antimonic Acid.**

**Metantimonic acid,  $\text{HSbO}_3$**

Very sl. sol. in  $\text{H}_2\text{O}$ ; sol in conc  $\text{HCl} + \text{Aq}$ ;  
 sl. sol. in dil  $\text{HNO}_3 + \text{Aq}$ ; easily sol. in tar-  
 tartic acid +  $\text{Aq}$ ; easily sol in hot  $\text{KOH}$ , or  
 $\text{NaOH} + \text{Aq}$ ; completely insol in  $\text{NH}_4\text{OH} +$   
 $\text{Aq}$  (Fremy, A. ch. (3) 23, 407.)

Sl sol in  $\text{H}_2\text{O}$ . Very sl. sol in  $\text{KOH}$  and  
 $\text{K}_2\text{CO}_3 + \text{Aq}$  Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol.  
 in  $\text{HNO}_3 + \text{H}_2\text{SO}_4$ . Slowly sol. in cold, quickly  
 in hot  $\text{HCl} + \text{Aq}$ . Sl sol in tartaric and  
 oxalic acid and in  $\text{KHC}_2\text{O}_4 + \text{Aq}$  (Senderens,  
 Bull. Soc. 1899, (3) 21, 48.)

Insol. in acetone. (Naumann, B. 1904, 37,  
 4329.)

**Pyroantimonic acid,  $\text{H}_2\text{Sb}_2\text{O}_7$**

More sol. in  $\text{H}_2\text{O}$  and acids than  $\text{H}_2\text{SbO}_3$ .  
 Sol. in cold  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . (Fremy.)

Slowly sol in cold  $\text{H}_2\text{O}$ .

5.88 g  $\text{Sb}_2\text{O}_5$  in 1 l.  $\text{H}_2\text{O}$  at 15°

8.55 " " " " " " 25°

21.30 " " " " " " 60°

(Delacroix, J. Pharm. 1897, 6, 337-41.)

Sl. sol. in  $H_2O$ . Very sl. sol. in KOH and  $K_2CO_3 + Aq$ . Insol. in  $NH_4OH + Aq$ , and in  $HNO_3 + H_2SO_4$ . Slowly sol. in cold, quickly in hot  $HCl + Aq$ . Sl. sol. in tartaric acid, oxalic acid and  $KHC_2O_4 + Aq$ . (Senderens, Bull. Soc. 1899, (3) 21. 48.)

#### Orthoantimonic acid, $H_3SbO_4$

Sl. sol. in  $H_2O$ . Insol. in  $NH_4OH + Aq$ . Easily sol. in KOH +  $Aq$  (Fremy)

Does not exist. (Raschig, B 18. 2745.)

Has, however, been prepared by Daubrawa (A. 186. 110), Conrad (C. N. 40. 198), and Beilstein and Blaeue (Bull. Ac St Petersb. 33. 97).

Very sol. in  $H_2O$  (Delacroix, Bull. Soc. 1899 (3) 21. 1049)

Very sl. sol. in  $H_2O$ , in KOH and  $K_2CO_3 + Aq$ . Slowly sol. in cold, quickly in hot  $HCl + Aq$ . Insol. in  $NH_4OH + Aq$ , and in  $HNO_3 + H_2SO_4$ . Sl. sol. in tartaric acid, oxalic acid and  $KHC_2O_4 + Aq$  (Senderens, Bull. Soc. 1899, (3) 21. 52)

+  $\frac{1}{2}H_2O$  (Beilstein and Blaeue.)

According to Beilstein and Blaeue only one antimonic acid,  $H_3SbO_4$ , exists

#### Tetraantimonic acid, $Sb_2O_3 + 4H_2O = H_8Sb_2O_5$

Slowly sol. in cold  $H_2O$ .

Solution sat at  $t^\circ$  contains g  $Sb_2O_3$  per litre—

$t^\circ$	15°	25°	60°	70°
g. $Sb_2O_3$	5.88	8	3-8	75
	21	30	53	89

Decomp. in solution by heating to 100° or long standing in the cold to  $Sb_2O_3$ ,  $3H_2O$  (Delacroix, Bull. Soc. 1899, (3) 21. 1049.)

Insol. in  $H_2O$ . Very sl. sol. in KOH and  $K_2CO_3 + Aq$ . Slowly sol. in cold, quickly in hot  $HCl + Aq$ . Insol. in  $NH_4OH + Aq$ . Insol. in  $HNO_3 + H_2SO_4$ . Sl. sol. in tartaric acid, oxalic acid and in  $KHC_2O_4 + Aq$  (Senderens, Bull. Soc. 1899, (3) 21. 51)

#### Hexantimonic acid, $Sb_2O_3 + 6H_2O =$



Sol. in  $H_2O$  to the extent of 22 g.  $Sb_2O_3$  per l. but on standing becomes turbid and a white powder is pptd. until finally only 3 g  $Sb_2O_3$  are dissolved per l (Senderens, Bull. Soc. 1899, (3) 21. 48-49.)

#### Antimonates.

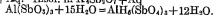
$\alpha$  *Antimonates*. From  $HSbO_3$ . Some of the K and  $NH_4$  salts are sol. in  $H_2O$ , the others are slightly sol. or insol.

$\beta$ . *Pyroantimonates*. From  $H_2Sb_2O_7$ . As a class, insol. in  $H_2O$ , but decomp. thereby except in presence of large excess of alkali (Fremy, A. ch. (3) 12. 499.)

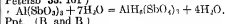
Probably do not exist (Beilstein and Blaeue.)

#### Aluminum antimonate, $Al_2O_3, 3Sb_2O_3$ (?)

Ppt. Somewhat sol. in excess of Al salts +  $Aq$ . Insol. in  $K_2Sb_2O_7 + Aq$



Ppt (Beilstein and Blaeue, Bull. Ac St. Petersb. 33. 101)



Ppt. (B and B.)

$Al_2O_3, Sb_2O_3 + 9H_2O$ . Ppt. (Ebel, B. 22. 3043.)

#### Ammonium antimonate, $NH_4SbO_3 + 2H_2O$ ,

Insol. in  $H_2O$

+  $2\frac{1}{2}H_2C$ . Insol. in  $H_2O$  (Senderens,

Bull. Soc. 1899, (3) 21. 56.)

+  $6H_2O$  Ser ( $NH_4$ ) $_2H_3Sb_2O_7 + 5H_2O$

#### Ammonium pyroantimonate, $(NH_4)_2Sb_2O_7$

Known only in solution.



Sol. in  $H_2O$ , but decomp. by standing or boiling into insol salt. Insol. in alcohol. (Fremy, J. pr. 45. 215). Composition is  $NH_4SbO_3 + 6H_2O$ , according to Raschig (B. 18. 2743)

#### Barium antimonate, $Ba(SbO_3)_2$ .

Ppt. Scarcely sol. in  $H_2O$ . Slowly sol. in  $BaCl_2 + Aq$

+  $2H_2O$ . Somewhat sol. in  $H_2O$ . Easily

sol. in  $HCl + Aq$ . (Delacroix, Bull. Soc. 1899, (3) 21. 1051.)

+  $5$ , or  $6H_2O$  Ppt

$BaSb_2O_7 + 5H_2O$ . Sol. in conc.  $HCl$ . (Delacroix, Bull. Soc. 1899, (3) 21. 1051.)

$BaO, 3Sb_2O_3 + 5H_2O$ . Insol. in  $H_2O$ . In-

completely sol. in  $HCl$  (Delacroix, *l.c.*)

$BaO, 4Sb_2O_3 + 15H_2O$ . (Delacroix, *l.c.*)

$9BaO, 10Sb_2O_3 + 18H_2O$ . Insol. in  $HCl +$

$Aq$ . (Delacroix, *l.c.*)

#### Bismuth antimonate, $BiSbO_4 + H_2O$ .

Ppt. Insol. in  $H_2O$ , sol. in  $HCl + Aq$ . (Cavazzi, Gazz. ch. it. 15. 37.)

$3Bi_2O_3, Sb_2O_3 + H_2O$ . Insol. in  $H_2O$ ; sol

in  $HCl + Aq$ . (Cavazzi)

$2Bi_2O_3, Sb_2O_3$  As above (Cavazzi.)

#### Cadmium antimonate, $Cd(SbO_3)_2 + 2H_2O$

Insol. in  $H_2O$  (Senderens, Bull. Soc. 1899, (3) 21. 56.)

+  $3\frac{1}{2}H_2O$ . Very sol. in  $H_2O$ . Sol. in  $HCl$

+  $Aq$  (Ebel, Dissert. 1890.)

+  $5H_2O$ . Insol. in  $H_2O$  (Senderens, *l.c.*)

+  $6H_2O$  Ppt. Insol. in  $H_2O$  (Ebel, B.

22. 3043.)

#### Calcium antimonate, $Ca(SbO_3)_2$ .

Ppt

+  $5H_2O$  Ppt. (Heffter, Pogg. 86. 418.)

+  $6H_2O$  Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 56.)

$3CaO, 2Sb_2O_3 + 6H_2O$ . Min. *Ullmanite*.

#### Chromic antimonate, $Cr(SbO_3)_3 + 14H_2O$

Ppt. (Beilstein and Blaeue.)

#### Cobaltous antimonate, $Co(SbO_3)_2 + 5H_2O$ .

Insol. in  $H_2O$ . Loses  $3H_2O$  in the presence of  $H_2SO_4$  and passes into  $Co(SbO_4)_2 + 2H_2O$ ,

also insol in  $H_2O$  (Senderens, Bull. Soc. 1899, (3) 21. 55)

+  $6H_2O$  Ppt. (Ebel, B. 22. 3043)

+  $7H_2O$  Sl sol in  $H_2O$ . Sl sol in boiling

\* solutions of cobalt salts

+  $12H_2O$  Ppt (Heffter, Pogg 86. 448)

**Cobaltous hydrogen antimonate**,  $CoH_4(SbO_4)_2 + H_2O$

(Gorgeul, Ann Phys. Beihl 1897, 21. 198.)

**Cupric antimonate**,  $3CuO, 2Sb_2O_3$ .

Ppt (Beilstein and Blaesé)

$Cu(SbO_3)_2$ . Insol in  $H_2O$ , acids, or alkalis. (Berzelius)

+  $2H_2O$  Insol in  $H_2O$  (Senderens, Bull. Soc. 1899, (3) 21. 55)

+  $5H_2O$  Ppt (Ebel, B. 22. 3043)

Insol in  $H_2O$  (Senderens, *l.c.*)

$CuO, 2Sb_2O_3 + 9H_2O$  Insol in  $H_2O$ . Sol in  $8Sb_2O_3, 4H_2O + Aq$ . (Delacroix, Bull. Soc. 1899, (3) 21. 1054.)

$2CuO, 3Sb_2O_3 + 10H_2O$  Insol. in  $H_2O$ . Sol. in  $NH_4OH$  and in triantimonie acid + Aq. (Delacroix, *l.c.*)

$CuO, 6Sb_2O_3 + 16H_2O$  (Delacroix, *l.c.*)

**Cupric antimonate ammonia**,  $Cu(SbO_3)_2, 4NH_3 + 4H_2O$

Insol. in  $H_2O$  and  $NH_4OH + Aq$  (Schiff, A. 123. 39)

$CuSb_2N_3H_{12}O_{12} = Cu(ONH_2)_2OH, 2(NH_4SbO_3 + 2H_2O)$  (Raschig, B. 18. 2743.)

$Cu(SbO_3)_2, 3NH_3 + 9H_2O$  (Delacroix, Bull. Soc. 1901, (3) 25. 289)

**Glucinum antimonate**,  $Gl(SbO_3)_2 + 6H_2O$ .

Somewhat sol. in hot  $H_2O$  Easily sol. in warm  $HCl$ . (Ebel, Dissert. 1890.)

**Iron (ferrous) antimonate.**

Sl sol in  $H_2O$  (Berzelius.)

**Iron (ferric) antimonate.**

Insol. in  $H_2O$ . (B.)

$Fe_2O_3, Sb_2O_3 + 7H_2O$  Ppt. (Ebel, B. 22. 3043)

$Fe_2O_3, 2Sb_2O_3 + 11H_2O$  Ppt (Beilstein and Blaesé)

$Fe(SbO_3)_3 + 6\frac{1}{2}H_2O$  Ppt. (B. and B.)

**Lead antimonate, basic**,  $Pb_2(SbO_3)_2(OH)_4 + 2H_2O = Pb_2(SbO_3)_2 + 4H_2O$ .

Min. *Bleinerite, Bindschwarte*.

$2Pb(SbO_3)_2, PbO + 11H_2O$  Ppt. (B. and B.)

**Lead antimonate**,  $Pb(SbO_3)_2$ .

Insol. in  $H_2O$  Incompletely decomp. by acids. (Berzelius.)

*Naples Yellow* Insol in  $H_2O$ .

+  $2H_2O$  Insol in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 57)

+  $5H_2O$  Ppt. (Ebel, B. 22. 3043)

+  $6H_2O$  Ppt. (Beilstein and Blaesé)

+  $9H_2O$  Insol. in  $H_2O$ . (Senderens, *l.c.*)

**Lead antimonate chloride**,  $Pb(SbO_3)_2, PbCl_2$ .

Min. *Nadorite*. Sol. in  $HCl, HNO_3$ , and tartaric acid + Aq.

**Lithium antimonate**,  $LiSbO_3$ .

Sl sol in cold, sol. in hot  $H_2O$ , and crystallizes on cooling. Much more sol. than  $NaSbO_3$ .

+  $3H_2O$  Ppt Sl sol in  $H_2O$ . (Beilstein and Blaesé)

**Magnesium antimonate**,  $Mg(SbO_3)_2 + 12H_2O$ .

Sol in hot, less sol in cold  $H_2O$  (Heffter.)

Sol in  $MgSO_4 + Aq$ , insol. in  $KSbO_3 + Aq$  (Berzelius)

**Manganous antimonate**,  $Mn(SbO_3)_2$ .

Difficultly sol. in  $H_2O$ .

When heated, is sol. only in strong acids.

+  $2H_2O$  Insol. in  $H_2O$  (Senderens, Bull. Soc. 1899, (3) 21. 56.)

+  $5H_2O$  Ppt (Ebel, B. 22. 3043)

+  $6H_2O$  Insol. in  $H_2O$ . (Senderens, *l.c.*)

+  $7H_2O$  Ppt (Beilstein and Blaesé)

**Mercurous antimonate.**

Insol. in  $H_2O$  (Berzelius.)

**Mercuric antimonate**,  $Hg(SbO_3)_2$

Insol in  $H_2O$ , alkalis, and most acids.

Sl. attacked by boiling  $H_2SO_4$ , and  $HCl + Aq$

+  $2H_2O$  Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 55.)

+  $5H_2O$  Insol. in  $H_2O$  (Senderens)

+  $6H_2O$  Ppt. (Beilstein and Blaesé)

**Nickel antimonate**,  $Ni(SbO_3)_2 + 2H_2O$ .

Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 54.)

+  $5H_2O$  Insol. in  $H_2O$ . (Senderens.)

+  $6H_2O$  Ppt. Insol in  $H_2O$ . (Heffter, Pogg 86. 446.)

+  $12H_2O$  Sl sol. in  $H_2O$ . (Heffter)

**Potassium antimonate**,  $KSbO_3$ .

Insol in  $H_2O$ . Sol. in warm  $KOH + Aq$ , but separates nearly completely on cooling. By boiling with  $H_2O$ , or by standing for a long time with cold  $H_2O$ , it gradually dissolves as  $2KSbO_3 + 5H_2O$ , or  $K_2H_3Sb_2O_7 + 4H_2O$ , or  $2KH_2SbO_4 + 3H_2O$

Insol. in  $CS_2$  (Aretowski, Z. anorg. 1894, 6. 257.)

+  $H_2O$  Insol. in  $H_2O$  (Senderens, Bull. Soc. 1899, (3) 21. 57.)

+  $1\frac{1}{2}H_2O$  (=  $2KSbO_3 + 5H_2O$  of Fremy). Easily sol. in  $H_2O$ , especially if warm. Solution is pptd by  $NH_4Cl + Aq$  (Fremy, A. ch. (3) 12. 499.)

+  $2\frac{1}{2}H_2O$  100 pts.  $H_2O$  at  $20^\circ$  dissolve 2.81 pts. anhydrous salt, sp. gr. of solution sat at  $18^\circ = 1.0263$  Composition is given as  $K_2H_3Sb_2O_7 + 4H_2O$  (Knorre and Olschewsky, B. 20. 3043.)

+  $3\frac{1}{2}H_2O$  Insol. in  $H_2O$ . (Senderens, *l.c.*)

+ $4\frac{1}{2}$ H<sub>2</sub>O. Sol. in H<sub>2</sub>O (Delacroix, J Pharm 1897, (6) 6. 533.)  
 2K<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>+10H<sub>2</sub>O Sl. sol in H<sub>2</sub>O (Delacroix, J Pharm. 1897, 6. 337)  
 +10H<sub>2</sub>O (Delacroix, l.c.)

**Potassium pyroantimonate**, K<sub>3</sub>Sb<sub>2</sub>O<sub>7</sub>.

Deliquescent; decomp. by boiling with H<sub>2</sub>O into K<sub>2</sub>SbO<sub>3</sub>+5H<sub>2</sub>O, by cold H<sub>2</sub>O into K<sub>2</sub>H<sub>2</sub>SbO<sub>7</sub>+6H<sub>2</sub>O. (Freymy)

Does not exist (Knorre and Olschewsky)  
 Insol in liquid NH<sub>3</sub> (Franklin, Am. Ch J 1898, 20. 829)

Insol. in acetone (Naumann, B 1904, 37. 4320.)

Insol. in methyl acetate (Naumann, B 1909, 42. 3790)

Insol in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

**Potassium hydrogen pyroantimonate**, K<sub>2</sub>H<sub>2</sub>Sb<sub>2</sub>O<sub>7</sub>.

Insol in acetone (Eidmann, C C 1899, II. 1014.)

+2 $\frac{1}{2}$ H<sub>2</sub>O. (Senderens, Bull. Soc. 1899, (3) 21. 57)

+3 $\frac{1}{2}$ H<sub>2</sub>O Very difficultly sol. in hot or cold H<sub>2</sub>O. (Knorre and Olschewsky, B. 18. 2358)

+6H<sub>2</sub>O Quite difficultly sol. in cold H<sub>2</sub>O Not precipitated by NH<sub>4</sub>Cl+aq. Aqueous solution gradually decomposes (Freymy.)

+4H<sub>2</sub>O. See 2K<sub>2</sub>SbO<sub>3</sub>+5H<sub>2</sub>O

**Potassium antimonate sulphantimonate**, K<sub>2</sub>SbO<sub>3</sub>, K<sub>2</sub>SbS<sub>4</sub>+5H<sub>2</sub>O.

Decomp. on an, and with cold H<sub>2</sub>O Sol in hot H<sub>2</sub>O. (Rammelsberg)

**Silver antimonate**.

Insol in H<sub>2</sub>O. (Berzelius)

AgSbO<sub>3</sub>+3H<sub>2</sub>O=AgH<sub>2</sub>SbO<sub>4</sub>+2H<sub>2</sub>O Easily sol. in NH<sub>4</sub>OH+aq, when freshly pptd (Beilstein and Blaesé)

+1 $\frac{1}{2}$ H<sub>2</sub>O. Ppt (Ebel, B. 22. 3043)

**Silver antimonate ammonia**, AgH<sub>2</sub>SbO<sub>4</sub>, 2NH<sub>3</sub>+H<sub>2</sub>O

(Beilstein and Blaesé.)

**Sodium antimonate**, NaSbO<sub>3</sub>

Sol. in much H<sub>2</sub>O, but soon becomes decomposed into Na<sub>2</sub>H<sub>2</sub>SbO<sub>7</sub>

+3 $\frac{1}{2}$ H<sub>2</sub>O, composition of Na<sub>2</sub>H<sub>2</sub>SbO<sub>7</sub>+6H<sub>2</sub>O, according to Beilstein and Blaesé 1000 pts. H<sub>2</sub>O dissolve 0.31 pt. NaSbO<sub>3</sub>+3 $\frac{1}{2}$ H<sub>2</sub>O at 12.3°.

1000 pts. alcohol of 15.8% dissolve 0.13 pt NaSbO<sub>3</sub>+3 $\frac{1}{2}$ H<sub>2</sub>O at 12.3°.

1000 pts. alcohol of 25.6% dissolve 0.07 pt. NaSbO<sub>3</sub>+3 $\frac{1}{2}$ H<sub>2</sub>O at 12.3°.

Somewhat more sol. when freshly precipitated.

Absolutely insol. in glacial HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>

Presence of NaOH or Na salts diminish solubility, while NH<sub>4</sub>OH or K salts increase it

slightly. (Beilstein and Blaesé, Bull. Ac. St Petersb. 33. 201)

+1 $\frac{1}{2}$ H<sub>2</sub>O. Sol in H<sub>2</sub>O. (Delacroix, Bull Soc 1899, (3) 21. 1051)

2Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>+10H<sub>2</sub>O (Delacroix, l.c.)  
 Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>+11H<sub>2</sub>O. (Delacroix, l.c.)

**Sodium pyroantimonate**, Na<sub>2</sub>H<sub>2</sub>Sb<sub>2</sub>O<sub>7</sub>+6H<sub>2</sub>O

Boiling H<sub>2</sub>O dissolves  $\frac{1}{15}$  pt. of this salt. (Freymy) 1000 pts H<sub>2</sub>O dissolve 2.5 pts. salt (Ebel, B 22. 3044) See also NaSbO<sub>3</sub>+3 $\frac{1}{2}$ H<sub>2</sub>O  
 +5H<sub>2</sub>O (Knorre and Olschewsky.)

**Strontium antimonate**, Sr(SbO<sub>3</sub>)<sub>2</sub>+6H<sub>2</sub>O.

Ppt. Less sol in H<sub>2</sub>O than SrSO<sub>4</sub> (Heffter, Pogg. 86. 418.)

**Thallous antimonate**, TlSbO<sub>3</sub>+2H<sub>2</sub>O = TlH<sub>2</sub>SbO<sub>4</sub>+H<sub>2</sub>O.

Somewhat sol. in H<sub>2</sub>O, when freshly precipitated; insol when dried (Beilstein and Blaesé)

**Tin (stannous) antimonate**, 2SnO, Sb<sub>2</sub>O<sub>3</sub>.

Ppt. (Lewissen, A 114. 113.)

Sn(SbO<sub>3</sub>)<sub>2</sub>+2H<sub>2</sub>O Attacked with difficulty by acids or alkalis, most easily by hot conc. H<sub>2</sub>SO<sub>4</sub> (Schiff, A 120. 55.)

2SnO, 3Sb<sub>2</sub>O<sub>3</sub>+4H<sub>2</sub>O.

SnO, 2Sb<sub>2</sub>O<sub>3</sub>.

**Tin (stannic) antimonate**.

Insol in H<sub>2</sub>O. (Levol, A ch. (3) 1. 504.)

**Uranium antimonate**, 5UO<sub>2</sub>, 3Sb<sub>2</sub>O<sub>3</sub>+15H<sub>2</sub>O.

Ppt. Sol. in hot conc. HCl+aq, and in UCl<sub>4</sub>+aq. (Rammelsberg)

**Zinc antimonate**, Zn(SbO<sub>3</sub>)<sub>2</sub>.

Very slightly sol. in H<sub>2</sub>O (Berzelius); sol. in solutions of Zn salts.

+2H<sub>2</sub>O (Ebel, Dissert. 1890.)

Insol in H<sub>2</sub>O (Senderens, Bull. Soc 1899, (3) 21. 57)

+5H<sub>2</sub>O. Not wholly insol. in cold, moderately sol. in hot H<sub>2</sub>O (Ebel, Dissert. 1890.)

+6H<sub>2</sub>O Insol. in H<sub>2</sub>O. (Senderens)

**Antimoniomolybdic acid**.

**Ammonium antimoniomolybdate**, 5(NH<sub>4</sub>)<sub>2</sub>O, 4Sb<sub>2</sub>O<sub>3</sub>, 7MoO<sub>3</sub>+12H<sub>2</sub>O

Readily sol. in hot H<sub>2</sub>O. (Gibbs, Am. Ch. J. 7. 392.)

**Antimoniotungstic acid**, 3Sb<sub>2</sub>O<sub>3</sub>, 4WO<sub>3</sub>+11H<sub>2</sub>O.

Sol in H<sub>2</sub>O. (Hallopeau, C. R. 1896, 123. 1068)

**Potassium antimoniotungstate**, 3K<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>, 4WO<sub>3</sub>+4H<sub>2</sub>O.

Much more sol. in hot than in cold H<sub>2</sub>O. Decomp by HCl, H<sub>2</sub>SO<sub>4</sub> and HNO<sub>3</sub>. (Hallopeau, C R 1896, 123. 1066.)

+16H<sub>2</sub>O. Much more easily sol in hot than cold H<sub>2</sub>O. Decomp by HCl, H<sub>2</sub>SO<sub>4</sub>, and HNO<sub>3</sub> (Hallopeau, l.c.)  
 6K<sub>2</sub>O, 4Sb<sub>2</sub>O<sub>5</sub>, 12WO<sub>3</sub>+25H<sub>2</sub>O.  
 Sl sol. in H<sub>2</sub>O (Gibbs, Am Ch J 7. 392.)

### Antimoniuretted hydrogen.

See Antimony hydride.

### Antimonosomolybdic acid.

Ammonium antimonosomolybdate, 6(NH<sub>4</sub>)<sub>2</sub>O,  
 3Sb<sub>2</sub>O<sub>3</sub>, 17MO<sub>3</sub>+21H<sub>2</sub>O

Insol. in cold H<sub>2</sub>O (Gibbs, Am Ch J 7. 313)

### Antimonosophosphotungstic acid.

Potassium antimonosophosphotungstate,  
 12K<sub>2</sub>O, 5Sb<sub>2</sub>O<sub>3</sub>, 6P<sub>2</sub>O<sub>5</sub>, 22WO<sub>3</sub>+48H<sub>2</sub>O,  
 Nearly insol in cold or warm H<sub>2</sub>O. (Gibbs, Am. Ch. J. 7. 392.)

### Antimonosotungstic acid.

Ammonium antimonosotungstate.

Sol. in H<sub>2</sub>O

Barium antimonosotungstate, 4BaO, 6Sb<sub>2</sub>O<sub>3</sub>,  
 22WO<sub>3</sub>+36H<sub>2</sub>O

Precipitate; very sl. sol. in hot H<sub>2</sub>O (Gibbs, Am Ch. J. 7. 313)

### Antimonous acid, HSbO<sub>2</sub>

(Long, J. Am. Chem. Soc 1895, 17. 87)  
 +1½H<sub>2</sub>O Ppt. (Schaffner, A. 51. 182)  
 H<sub>2</sub>SbO<sub>3</sub>, Ppt (Clarke and Stallo, B 13. 1793.)

Does not exist (Guntz, C R. 102. 1472.)  
 H<sub>2</sub>SbO<sub>3</sub>. When freshly pptd, is sol. in dil KOH, and NaOH+Aq. Scarcely sol in NH<sub>4</sub>OH+Aq, or in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>, or KHCO<sub>3</sub>+Aq

Completely sol. in K<sub>2</sub>CO<sub>3</sub>, and Na<sub>2</sub>CO<sub>3</sub>+Aq, especially if warm. When recently pptd is sl. sol. in succinic acid+Aq.

Calcium antimonite, CaSb<sub>2</sub>O<sub>4</sub> (?)

Min. *Romeite* Insol. in acids.

Cobaltous antimonite (?).

Sl. sol. in H<sub>2</sub>O. (Berzelius.)

Cuprous antimonite, Cu<sub>2</sub>(SbO<sub>2</sub>)<sub>2</sub>.

Insol in H<sub>2</sub>O Sol. in acids, most easily in conc. HCl+Aq (Hausmann and Stromeyer, Schw J 19. 241)

Cupric antimonite (?)

Insol. in H<sub>2</sub>O. (Berzelius)

CuSb<sub>2</sub>O<sub>4</sub> Min. *Annimolite*.

CuSb<sub>2</sub>O<sub>4</sub> Sol in HCl+Aq, tartaric and citric acids (Harding, Z. anorg. 1899, 20. 238)

Iron (ferrous) antimonite (?).

More sol in H<sub>2</sub>O than the antimonate. (Dumas)

Potassium antimonite, K<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>

Easily decomp. by cold H<sub>2</sub>O Not decomp. by KOH+Aq containing over 20.9% K<sub>2</sub>O (Corrumbœuf, C R 115. 1305.)  
 +3H<sub>2</sub>O As above (C)

Potassium antimonite iodide, K<sub>2</sub>O, 8Sb<sub>2</sub>O<sub>3</sub>,  
 2KI

Insol and not decomp. by cold or hot H<sub>2</sub>O. Not decomp by acids or alkalis Aqua regia decomp slowly. Tartaric acid dissolves gradually. (Gruhl, Dissert. 1897.)

Sodium antimonite, NaSbO<sub>3</sub>+3H<sub>2</sub>O.

Difficultly sol. in H<sub>2</sub>O (Terreil, A. ch (4) 7. 380.)

2Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>+H<sub>2</sub>O Decomp. by H<sub>2</sub>O, but not by NaOH+Aq containing 94.3 g. NaOH per l. (Corrumbœuf)

Na<sub>2</sub>O, 2Sb<sub>2</sub>O<sub>3</sub> Decomp by H<sub>2</sub>O but not by NaOH+Aq containing 188.6 g. NaOH per l. (C.)

Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub> Decomp. by H<sub>2</sub>O, but not by NaOH+Aq containing 113.2 g. NaOH per l. (C)

+2H<sub>2</sub>O=NaH<sub>2</sub>(SbO<sub>2</sub>)<sub>2</sub> (Terreil)

### Antimony, Sb.

Does not decomp H<sub>2</sub>O Not attacked by HCl+Aq (Berzelius); slowly sol in conc HCl+Aq (Debray), slowly sol in conc warm HCl+Aq (Troost). Attacked by very conc HCl+Aq only when finely divided (Schutzenberger, Willm); very sl attacked by dil or conc. acid (Guntz) Not attacked by boiling HCl+Aq (Gmelin) By careful experiments, pure Sb is absolutely insol in dil. or conc., hot or cold HCl+Aq, except when in contact with oxygen. (Ditte and Metzner, A. ch (6) 29. 889)

Insol in dil. or cold conc., but sol in hot conc H<sub>2</sub>SO<sub>4</sub> Oxidized but not dissolved by HNO<sub>3</sub>+Aq Easily and completely sol in aqua regia.

Very slowly attacked by pure HNO<sub>3</sub>+Aq of 1.51-1.42 sp gr, weaker acid has no marked action whether it contains NO<sub>2</sub> or not HCl+HNO<sub>3</sub> has no action if dil. or at low temp., but when even very dil. and KNO<sub>3</sub> is added, the action will begin (Millon, A. ch. (3) 6. 101.)

Not attacked in 10 months by 2% HNO<sub>3</sub>+Aq. Sb is not dissolved by HNO<sub>3</sub>+Aq of any concentration, a white powder being always left, which is insol in HNO<sub>3</sub>+Aq or H<sub>2</sub>O (Montemartini, Gazz. ch. 17-22-384)

Insol in alkalis+Aq

Somewhat sol. in distilled H<sub>2</sub>O. More or less sol in solutions of acids, alkalis and salts and in alcohol and ether Only sl sol in a mixture of alcohol and ether. (Ruff and Albest, B. 1905, 38. 54)

Alkaline H<sub>2</sub>O<sub>2</sub> converts Sb into antimonic acid, but neutral H<sub>2</sub>O<sub>2</sub> is without action (Clark, Chem. Soc 1893, 63. 886)

Insol in liquid NH<sub>3</sub> (Gore, Am Ch. J 1898, 20. 826)

Easily attacked by pyrosulphuryl chloride (Heumann and Kochlin, B. 16. 479)

Sb is sol. in a mixture of  $\text{HNO}_3$  and tartaric acid or other polybasic acids (Czerwek, Z anal 1900, 45. 507)

Not attacked by a mixture of alcohol and ether (Cohen, Z. phys. Ch 1904, 47. 12)

$\frac{1}{2}$  cc. oleic acid dissolves 0.0007 g Sb in 6 days. (Gates, J. phys. Ch. 1911, 15. 143)

There are three modifications

1. Ordinary gray metallic

2. Black amorphous. Unstable at ord. temp. By boiling with  $\text{H}_2\text{O}$  is changed to metallic Sb

3. Yellow. Very unstable. At  $-50^\circ$  goes over rapidly into the ordinary black modification Sol. in  $\text{CS}_2$  at a little above  $-90^\circ$ . (Stock, B. 1903, 37. 898)

Unstable above  $-90^\circ$  (Stock, B. 1905, 38. 3837.)

#### Antimony arsenide, $\text{Sb}_2\text{As}$

(Descamps, C. R. 88. 1065)

#### Antimony tribromide, $\text{SbBr}_3$

Deliquescent; decomp. by  $\text{H}_2\text{O}$

Very sol. in liquid  $\text{NH}_3$ . (Goie, Am Ch J. 1898, 20. 826.)

Very sol. in warm liquid  $\text{AsBr}_3$ , forming a solution with sp gr = 3.685 at  $47^\circ$ . (Retzeis, Z. phys. Ch 1893, 11. 339.)

Sol in  $\text{S}_2\text{Cl}_2$  (Walden, Z. anorg. 1900, 25. 217)

Sol in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84. 27)

Easily sol in  $\text{PCl}_5$  and  $\text{PB}_5$ . (Walden, Z. anorg. 1900, 25. 211)

Sol. in alcohol and  $\text{CS}_2$

Sol. in ether forming two layers. (Hayes, J. Chem Soc 1902, 24. 360)

Sol in acetone (Naumann, B. 1904, 37. 4328)

Solubility of  $\text{SbBr}_3$  in organic liquids  
Data in parentheses indicate labile equilibrium.

Solvent	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100
Benzene	5.6°	0	66°	17.1	91.6°	73.7
	4.5	1.9	76	24.9	90	70.7
	15	3.0	80	30.7	85	81.9
	25	4.3	85	38.4	90	91.4
	35	6.0	90	48.2	92	94.8
	45	8.6	91.5	58.1	94	100
Chlorobenzene	55	12.1	92.5	66.6		
	-45.2°	0	0°	7.2	60°	37.6
	-47	1.7	10	9.2	70	50.0
	-40	2.2	20	11.8	80	66.6
	-30	3.2	30	15.4	90	89.6
	-20	4.3	40	20.8	94	100
Bromobenzene	-10	5.6	50	28.1		
	-31°	0	15°	17.4	75°	65.2
	-32	2.6	25	22.2	85	81.1
	-25	4.4	35	27.7	90	90.0
	-15	6.9	45	34.4	94	100
	-5	9.9	55	42.6		
	5	13.4	65	52.0		

#### Solubility of $\text{SbBr}_3$ in organic liquids—Cont

Solvent	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100
Iodobenzene	-28.6°	0	10°	25.3	70°	67.0
	-30.5	4.0	20	31.5	80	78.2
	-32	8.7	30	37.3	90	91.9
	-20	13.5	40	43.7	94	100
	-10	17.5	50	50.7		
	0	21.7	60	58.5		
Paradi-chlorobenzene	54.5°	0	65°	29.5	85°	68.9
	51.5	6.3	70	37.0	90	85.2
	48.5	12.8	75	45.6	91	100
	55	18.7	80	53.2		
Paradi-bromobenzene	83°	0	43°	52.0	90°	91.8
	85	4.8	70	50.1	92	95.4
	80	18.0	75	66.5	91	100
	75	29.5	80	74.4		
	70	41.5	85	83.0		
Nitrobenzene	0°	0	-5°	32.3	56°	59.1
	1	8.6	5	35.3	65	69.4
	4	17.0	15	38.8	75	74.9
	9	24.0	25	42.5	85	88.0
	15	29.7	35	47.0	90	93.0
	(-17)	(31.9)	45	52.8	94	100
Metadi-nitrobenzene	90°	0	55°	49.1	70°	70.8
	85	8.1	50	53.0	75	76.0
	80	16.2	47.5	54.4	80	81.7
	75	24.2	50	56.1	85	87.8
	70	31.8	55	58.8	90	94.2
	65	38.5	60	62.2	94	100
Toluene	60	41.3	65	66.2		
	-63°	0	10°	28.8	70°	60.4
	-63.5	0.3	20	36.7	80	70.4
	-70	1.2	30	47.5	85	85.2
	-60	2.6	(34)	(54.0)	90	92.6
	-30	5.2	40	51.5	94	100
Ethylbenzene	-10	13.9	50	60.3		
	-1	22.4	60	62.3		
	-63°	0	10°	9.8	70°	59.8
	-60	0.4	20	19.5	80	67.1
	-40	1.0	25	28.6	90	77.4
	-20	2.3	30	37.8	85	85
Propylbenzene	-10	3.9	40	44.6	90	92.6
	0	6.4	50	51.6	94	100
	-80°	0	(-1.5°)	(33.3)	50°	44.3
	-8°	1.2	(-20°)	(23.3)	60	51.5
	-40	3.4	0	25.8	70	61.5
	-30	5.5	10	27.8	80	73.5
Isocamylbenzene	-20	9.5	20	30.5	90	90
	-10	17.2	30	31.1	94	100
	-5	24.3	40	38.0		
	-70°	1.9	(-13°)	(24.0)	50°	35.8
	-50	3.6	-10	17.0	60	43.3
	-40	5.1	0	18.2	70	51.0
Isocamylbenzene	-30	7.1	10	19.9	80	58.5
	-20	13.4	20	22.5	90	90
	-17	16.4	30	25.9	94	100
	(-15)	(19.4)	40	30.3		

(Menschutkin, Ann. Inst. Pol. P. le Gr. 13. 1.)

#### Antimony bromide with MBr.

See Bromantimonate, M.

Also below

#### Antimony hydrogen bromide, $\text{SbBr}_3$ , $\text{HBr} + 3\text{H}_2\text{O}$

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Weinland and Feige, B. 1903, 36. 256)

See Metabromantimonate acid.

**Antimony caesium bromide**,  $2\text{SbBr}_3 \cdot 3\text{CsBr} + 2\text{H}_2\text{O}$   
Loses  $\text{Br}_2$  in the air (Weinland, B. 1903, 36. 257)

**Antimony calcium bromide**,  $\text{SbBr}_3 \cdot \text{CaBr}_2 + 8\text{H}_2\text{O}$ .  
Easily decomp. (Benedict, Proc. Am. Acad. 1895, 30. 9)

**Antimony glucinum bromide**,  $3\text{SbBr}_3 \cdot 2\text{GIBr}_2 + 18\text{H}_2\text{O}$ .  
Hygroscopic. Easily decomp. (Weinland, B. 1903, 36. 258)

**Antimony magnesium bromide**,  $\text{SbBr}_3 \cdot \text{MgBr}_2 + 8\text{H}_2\text{O}$   
As Ca salt (Benedict, Proc. Am. Acad. 1895, 30. 9)

**Antimony potassium bromide**,  $10\text{SbBr}_3 \cdot 23\text{KBr} + 27\text{H}_2\text{O}$   
(Herty, Am. Ch. J. 1894, 16. 496)

**Antimony rubidium bromide**,  $2\text{SbBr}_3 \cdot 3\text{RbBr}$ .  
Decomp. by  $\text{H}_2\text{O}$ ; can be recryst. from dil  $\text{HBr} + \text{Aq}$  (Wheeler, Z. anorg. 5. 258)  
 $\text{SbRb}_2\text{Br}_4$  Slowly loses  $\text{Br}_2$  in the air  
Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1903, 36. 259.)

$10\text{SbBr}_3 \cdot 23\text{RbBr}$  (?) Cryst. from conc  $\text{HBr} + \text{Aq}$ . (Wheeler.)  
The composition assigned to this salt by Wheeler (Z. anorg. 5. 253) is incorrect. (Ephraim, B. 1903, 36. 1817.)

**Antimony vanadium bromide**,  $\text{SbBr}_3 \cdot \text{VBr}_4 + 7\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$  Sol. in dil  $\text{HCl}$  and in tartaric acid. (Weinland, B. 1903, 36. 260.)

**Antimony bromide potassium chloride**,  $\text{SbBr}_3 \cdot 3\text{KCl} + 1\frac{1}{2}\text{H}_2\text{O}$ .  
Slowly deliquescent. Very sol. in  $\text{H}_2\text{O}$ .  
Sat. solution contains 120.5 g. to 100 cc.  $\text{H}_2\text{O}$ , and has sp. gr. = 1.9.  
Decomp. by much  $\text{H}_2\text{O}$ . (Atkinson, Chem. Soc. 43. 290.)

Does not exist (Herty, Am. Ch. J. 1894, 16. 497.)  
See also Antimony chloride potassium bromide.

**Antimony bromofluoride**,  $\text{SbF}_3\text{Br}$ .  
Decomp. by  $\text{H}_2\text{O}$ . (Ruff, B. 1906, 39. 4319.)

**Antimony trichloride**,  $\text{SbCl}_3$ .  
Deliquescent. Decomp. by  $\text{H}_2\text{O}$  with precipitation of  $\text{SbOCl}$  This precipitation is prevented by tartaric, citric, or hydrochloric acid, or by conc solutions of chlorides of alkalies and alkaline earths.

Solubility in  $\text{H}_2\text{O}$ .  
100 pts.  $\text{SbCl}_3$  sol in pts.  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{H}_2\text{O}$
$0^\circ$	16.6
$15^\circ$	12.3
$20^\circ$	10.9
$25^\circ$	10.1
$30^\circ$	9.4
$35^\circ$	8.7
$40^\circ$	7.3
$50^\circ$	5.2
$60^\circ$	2.2

(Meerburg, Z. anorg. 1903, 33. 299.)

Solubility in  $\text{HCl} + \text{Aq}$   
100 mol.  $\text{H}_2\text{O}$  dissolve mol.  $\text{SbCl}_3$  in presence of mol.  $\text{HCl}$  at  $20^\circ$ .

Mol. $\text{HCl}$	Mol. $\text{SbCl}_3$
0	72.1-72.8
2.4	73.0
6.5	67.5
8.4	67.6
8.6	66.5
9.8	65.0
12.2	65.3
20.6	54.5

(Meerburg, Z. anorg. 1903, 33. 304)

Solubility in  $\text{HCl} + \text{Aq}$

Solid phase	100 mol $\text{H}_2\text{O}$ dissolve at $20^\circ$			
	1	2	3	4
	Mol $\text{SbCl}_3$	Mol $\text{HCl}$	Mol $\text{SbOCl}$	Mol $\text{HCl}$
$\text{SbOCl}$	8.7	7.2	9.8	6.9
	8.6	7.5	16.1	7.9
	19.6	8.0	21.7	7.4
	19.8	8.9	25.0	8.8
			28.0	8.6
$(\text{SbOCl})_2 \cdot (\text{SbCl}_3)_2$	37.5	8.7	32.0	7.9
	44.0	6.8	35.8	7.9
	63.7	6.2	59.5	6.4
	69.1	5.6	61.0	6.5
	66.1	4.6	62.7	4.4
$\text{SbCl}_3$ and $(\text{SbOCl})_2 \cdot (\text{SbCl}_3)_2$	69.3	4.3		
	68.3	3.6		

1 & 2 (Meerburg, Z. anorg. 1903, 33. 302.)  
3 & 4. (Noodt, Z. anorg. 1903, 33. 302)

Somewhat sol. in liquid  $(\text{CN})_2$ . (Centnerszwer, Bull. Soc. 1901, (3) 28. 405)  
Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 826.)  
Easily sol. in  $\text{PCl}_5$  and  $\text{PBr}_5$ . (Walden, Z. anorg. 1900, 25. 211.)  
Sol. in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 217.)

Easily sol in  $\text{AsBr}_3$  (Walden, Z. anorg. 1902, 29, 374)

Sol in alcohol without decomp. Very sol. in hot  $\text{CS}_2$ , but solubility diminishes rapidly on cooling (Cooke, Proc Am Acad 13, 72)

1 g  $\text{SbCl}_3$  is sol in 0.186 g acetone at  $18^\circ$  Sp gr of sat. solution  $18^\circ/4^\circ = 2.216$  (Naumann, B. 1904, 37, 4332)

Sol. in ethyl acetate (Naumann, B. 1904, 37, 3601)

1 pt sol in 16.97 pts of ethyl acetate at  $18^\circ$ . Sp gr of sat. solution  $18^\circ/4^\circ = 1.7968$  (Naumann, B. 1910, 43, 320)

Sol in benzonitrile (Naumann, B. 1914, 47, 1369)

Sol. in methylal (Eidmann, C C 1899, II, 1014.)

Solubility of  $\text{SbCl}_3$  in organic liquids.  
Data in parentheses indicate labile equilibrium

Solvent	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100
Benzene	$5.0^\circ$	0	$50^\circ$	27.2	$75^\circ$	78.5
	1	2.6	60	34.7	70	83.3
	4	7.1	70	45.2	62	89.3
	10	10.1	75	53.1	67.5	94.2
	20	13.1	77.5	58.7	73	100
	30	16.4	79	66.6		
	40	21.4	77.5	73.1		
Chlorobenzene	$-45.2^\circ$	0	$-10^\circ$	14.4	$30^\circ$	47.1
	$-47$	2.2	5	19.4	40	56.2
	$-40$	3.6	0	28.1	50	66.0
	$-30$	6.0	(4)	(41.1)	60	78.7
	$-20$	9.0	10	32.5	70	94.3
Bromobenzene	$-15$	11.6	20	38.7	73	100
	$-31^\circ$	0	$-5^\circ$	21.7	$40^\circ$	50.2
	$-32.5$	3.4	0	26.0	50	68.8
	( $-35$ )	(6.4)	3	31.8	60	80.6
	$-30$	4.8	(6)	(41.9)	65	87.2
Iodobenzene	$-25$	7.6	(7)	(50.0)	70	95.0
	$-20$	10.7	10	36.4	73	100
	$-15$	14.1	20	43.2		
	$-10$	17.8	30	50.8		
Paradichlorobenzene	$-28.6^\circ$	0	( $-6^\circ$ )	(40.7)	$25^\circ$	53.0
	$-30$	2.4	$-34.5$	10.7	35	60.4
	( $-35$ )	(11.7)	$-25$	16.4	45	67.5
	( $-40$ )	(20.7)	$-15$	24.7	55	76.2
	( $-45$ )	(27.2)	30	1.05	65	87.4
	( $-35$ )	(30.9)	( $-3$ )	(47.2)	70	95.0
	( $-25$ )	(33.9)	5	44.5	73	100
Paradibromobenzene	$54.5^\circ$	0	$39.5^\circ$	29.5	$60^\circ$	66.5
	50	8.3	45	37.5	65	78.1
	45	15.5	50	46.1	70	91.1
	40	28.0	55	56.0	73	100
	88	0	65	45.4	85	87.1
Nitrobenzene	85	5.9	90	53.8	70	95.2
	80	15.8	49.5	64.9	73	100
	75	28.7	55	78.5		
	70	33.7	60	79.8		
	0	0	$-13.5^\circ$	27.3	$15^\circ$	59.2
Nitrobenzene	2	7.0	$-10.5$	29.8	25	63.0
	$-2$	12.1	$-7.5$	35.2	35	67.6
	6	16.5	$-6.5$	40.7	45	72.8
	$-10$	20.3	$-6$	50.0	55	79.0
	$-14$	23.5	$-6.5$	52.8	65	87.2
	( $-18$ )	(29.2)	$-5$	53.0	70	92.7
	$-16.5$	25.2	5	55.8	73	100

Solubility of  $\text{SbCl}_3$  in organic liquids—Cont.

Solvent	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100
Metadinitrobenzene	$90^\circ$	0	( $-10^\circ$ )	(37.7)	(0)	(78.1)
	80	14.3	(10)	(62.4)	20	65.2
	70	25.3	(27.5)	(41.5)	30	68.8
	60	33.8	(28.5)	(50.0)	40	73.2
	40	15.6	27.5	55.0	50	78.5
	(20)	(53.6)	25	60.2	60	85.8
	(1)	(59.9)	(20)	(66.2)	70	95.2
Toluene	( $-11$ )	(62.2)	(10)	(73.5)	73	100
	$-93^\circ$	0	$-10^\circ$	14.1	$40^\circ$	39.3
	$-84$	0.5	0	22.1	42.5	46.6
	$-70$	1.4	6	28.0	40	71.1
	$-60$	3.3	11	35.7	50	77.1
	$-40$	5.1	( $-8$ )	(27.0)	60	83.8
	$-30$	7.2	20	40.5	70	91.7
Ethylbenzene	$-20$	10	30	47.6	73	100
	$-93^\circ$	0.1	$35^\circ$	36.4	(38.5)	(68.1)
	$-60$	0.6	30	50	(33)	(65.7)
	$-30$	1.1	37	57.7	40	70.3
	$-10$	3.0	35	61.8	50	77.3
	0	5.6	(33)	(65.7)	60	85.5
	10	9.4	(15)	(37.8)	65	90.3
Propylbenzene	20	16.5	(23)	(47.5)	70	95.6
	30	27.2	37	66.6	73	100
	( $-70^\circ$ )	(0.0)	$-70^\circ$	0.2	8.5	53.2
	( $-50$ )	(2.8)	$-50$	1.5	10	53.6
	( $-40$ )	(5.2)	$-40$	3.0	20	59.9
	( $-30$ )	(8.8)	$-30$	5.3	30	66.6
	( $-20$ )	(14.8)	$-20$	9.7	40	65.5
Isobutylbenzene	( $-10$ )	(25.1)	$-10$	16.2	50	72
	( $-5$ )	(32.4)	$-5$	20.5	60	81
	(0)	(43.3)	0	26.2	65	86.8
	(1.5)	(50)	5	35.6	70	95.1
	(1)	(51.1)	7	41.6	73	100
	$-30^\circ$	3	( $-43^\circ$ )	(17.1)	17	46.3
	$-70$	5.4	( $-35$ )	(22.8)	10	48.8
Isobutylbenzene	$-60$	8.4	$-25$	29.3	20	52.5
	$-50$	12.4	$-15$	36.1	30	57.3
	$-40$	17.0	$-5$	45.6	40	63.4
	( $-30$ )	(27.3)	(0)	(52.3)	50	71.4
	( $-25$ )	(34.4)	(5)	(60.3)	60	81.7
	( $-22$ )	(40.7)	(7.5)	(66.6)	65	88
	( $-20.5$ )	(50)	( $-21$ )	(44.2)	70	95.5
Methylal	( $-22$ )	(54)	( $-10$ )	(44.9)	73	100

(Menschutkin, Ann Inst. Pol. P.-le Gr, 13, 1)

Antimony hydrogen trichloride,  $2\text{SbCl}_3, \text{HCl} + 2\text{H}_2\text{O}$ .

Deliquescent. Decomp by  $\text{H}_2\text{O}$   
Melts in crystal  $\text{H}_2\text{O}$  at  $16^\circ$ . (Engel, C. R. 106, 1797)

Antimony pentachloride,  $\text{SbCl}_5$ .

Deliquesces to  $\text{SbCl}_3 + 4\text{H}_2\text{O}$ , which can be crystallized out of a little  $\text{H}_2\text{O}$ . Decomp by more  $\text{H}_2\text{O}$  into  $\text{SbO}_2\text{Cl}$ . Sol in a large amt. of  $\text{H}_2\text{O}$ , if it is added all at one time. Precipitation by  $\text{H}_2\text{O}$  is also hindered by presence of tartaric, or hydrochloric acid.

$+ \text{H}_2\text{O}$  Deliquescent. Sol in chloroform. (Anschutz and Evans, A. 239, 285.)

$+ 4\text{H}_2\text{O}$ . Insol in chloroform. (Anschutz and Evans.)

Antimony pentachloride with  $\text{MCl}$ .

See Chlorantimonate, M.

See also below.

**Antimony hydrogen pentachloride**,  $\text{SbCl}_5$ ,  $\text{HCl} + 4\frac{1}{2}\text{H}_2\text{O}$

"*Metachlorantimonie acid*" according to Weinland and Schmid. (Z. anorg. 1905, 44, 43.)

Very easily sol in  $\text{H}_2\text{O}$ , alcohol, acetone and glacial acetic acid. Aqueous solution decomp. on standing with separation of  $\text{Sb}_2\text{O}_5$  but remains clear in presence of 10%  $\text{HCl}$  (Weinland and Schmid, Z. anorg. 1905, 44, 43.)

$\text{SbCl}_5$ ,  $5\text{HCl} + 10\text{H}_2\text{O}$  Not deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at about  $55^\circ$  (Engel, C. R. 106, 1797.)

**Antimony antimonyl chloride**,  $\text{SbCl}_3$ ,  $\text{SbOCl}$

More easily attacked by  $\text{H}_2\text{O}$  than  $\text{SbOCl}$  (Bemmelen, Z. anorg. 1903, 33, 293.)

**Antimony antimonyl potassium chloride**,  $\text{SbCl}_3$ ,  $\text{SbOCl}$ ,  $2\text{KCl}$

Not deliquescent. Immediately decomp. by hot or cold  $\text{H}_2\text{O}$ , sol. in hot glacial  $\text{HC}_2\text{H}_3\text{O}_2$ , or in  $\text{HCl}$ , or tartaric acid +  $\text{Aq}$

Insol. in  $\text{KCl} + \text{Aq}$ , hot or cold alcohol,  $\text{CS}_2$ , or ligroine. (Benedikt, Proc. Am. Acad. 29, 217.)

**Antimony antimonyl rubidium chloride**,  $\text{SbCl}_3$ ,  $\text{SbOCl}$ ,  $2\text{RbCl}$

Sol. in very dil.  $\text{HCl} + \text{Aq}$ . (Wells, Am. J. Sci. 1897, (4) 3, 463.)

**Antimony barium chloride**,  $\text{SbCl}_3$ ,  $\text{BaCl}_2 + \frac{3}{2}\text{H}_2\text{O}$

Decomp. by  $\text{H}_2\text{O}$

**Antimony caesium chloride**,  $\text{SbCl}_3$ ,  $6\text{CsCl}$

Decomp. by  $\text{H}_2\text{O}$ . Cryst. from dil.  $\text{HCl} + \text{Aq}$ . (Godefroy, Arch. Pharm. (3) 12, 47.)

$2\text{SbCl}_3$ ,  $3\text{CsCl}$  Decomp. by  $\text{H}_2\text{O}$ , sl. sol. in cold, easily in hot dil.  $\text{HCl} + \text{Aq}$ . This is identical with the above salt. (Saunders, Am. Ch. J. 14, 152.)

$\text{SbCl}_3$ ,  $2\text{CsCl}$  Sol. in boiling conc.  $\text{HCl} + \text{Aq}$  without decomp. (Setterberg, Oef. Vet. Akad. 1882, 6, 23.)

$\text{SbCl}_3$ ,  $\text{CsCl}$  Cryst. from  $\text{HCl} + \text{Aq}$  without decomp. Decomp. by  $\text{H}_2\text{O}$  (Setterberg, Oef. Vet. Akad. 1882, 6, 27.)

**Antimony calcium chloride**,  $\text{SbCl}_3$ ,  $\text{CaCl}_2 + 8\text{H}_2\text{O}$

Easily decomp. (Benedikt, Proc. Am. Acad. 1895, 30, 9.)

$\text{SbCl}_3$ ,  $\text{CaSbCl}_3$ ,  $\text{OH} + 9\text{H}_2\text{O}$ . Deliquescent; sl. sol. in  $\text{H}_2\text{O}$ . (Weinland, B. 1901, 34, 2635.)

**Antimony chromium chloride**,

$\text{CrCl}_3$ ,  $3\text{SbCl}_3 + 13\text{H}_2\text{O}$ . (Weinland)

should be

$[\text{SbCl}_4][\text{Cr}(\text{OH})_3] + 7\text{H}_2\text{O}$ ,

and  $\text{CrCl}_3$ ,  $\text{SbCl}_3 + 10\text{H}_2\text{O}$  should be

$[\text{SbCl}_4][\text{Cr}(\text{OH})_2\text{Cl}] + 6\text{H}_2\text{O}$ .

(Pfeiffer, Z. anorg. 1903, 36, 349.)

**Antimony glucinum chloride**,  $\text{SbCl}_3$ ,  $\text{GlCl}_3 + 3\text{H}_2\text{O}$

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ .

Very easily sol. in  $\text{HCl}$ . (Ephraim, B. 1903, 36, 1822.)

$+4\text{H}_2\text{O}$  Ppt. Decomp. by  $\text{H}_2\text{O}$ . Sol.

in  $\text{HCl}$ . (Ephraim, B. 1903, 36, 1822.)

**Antimony hydrazine chloride**,  $\text{SbCl}_3$ ,

$3\text{N}_2\text{H}_4\text{Cl}$

Sol. in conc.  $\text{HCl} + \text{Aq}$ , decomp. by  $\text{H}_2\text{O}$ .

(Ferratin, C. A. 1912, 1613.)

**Antimony lithium chloride**,  $\text{SbCl}_3$ ,  $2\text{LiCl} + 5\text{H}_2\text{O}$

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Very

easily sol. in  $\text{HCl}$ . (Ephraim, B. 1903, 36, 1821.)

$+6\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ , easily sol. in

$\text{HCl}$ . (Ephraim, B. 1903, 36, 1822.)

**Antimony magnesium chloride**,  $\text{SbCl}_3$ ,  $\text{MgCl}_2 + 5\text{H}_2\text{O}$

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Can be

cryst. from  $\text{HCl}$  without decomp. (Ephraim,

B. 1903, 36, 1823.)

$2\text{SbCl}_3$ ,  $\text{MgCl}_2$  Hygroscopic. Decomp.

by  $\text{H}_2\text{O}$ . Very sol. in  $\text{HCl}$ . (Ephraim.)

$\text{SbCl}_3$ ,  $\text{MgSbCl}_3$ ,  $\text{MgOH} + 17\text{H}_2\text{O}$  Hydro-

scopic. Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland,

B. 1901, 34, 2635.)

**Antimony nitrosyl chloride**,  $\text{SbCl}_3$ ,  $\text{NOCl}$

Very deliquescent; decomp. by pure  $\text{H}_2\text{O}$ ;

sol. in  $\text{H}_2\text{O}$  containing tartaric acid. (Weber,

Pogg. 123, 347.)

$2\text{SbCl}_3$ ,  $5\text{NOCl}$  Decomp. by  $\text{H}_2\text{O}$ . (Sud-

borough, Chem. Soc. 59, 661.)

**Antimony phosphorus chloride**,  $\text{SbCl}_3$ ,  $\text{PCl}_3$

Deliquescent. (Weber, Pogg. 125, 78.)

**Antimony phosphoryl chloride**,  $\text{SbCl}_3$ ,  $\text{POCl}_3$

Deliquescent (Weber.)

**Antimony platinum potassium chloride**,

$(\text{Sb}, \text{Pt})_2\text{Cl}_6\text{K}_2$

Ppt. (Weinland, B. 1905, 38, 1086.)

**Antimony potassium chloride**,  $\text{SbCl}_3$ ,  $2\text{KCl}$

Sol. in  $\text{H}_2\text{O}$  without decomp. (Jacquelin,

A. ch. (2) 66, 128.)

Not deliquescent. Immediately decomp.

by hot or cold  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ; or tartaric

acid +  $\text{Aq}$ . (Benedikt, Proc. Am. Acad. 29,

219.)

$+2\text{H}_2\text{O}$  Very efflorescent

$\text{SbCl}_3$ ,  $3\text{KCl}$  Deliquescent. Decomp. by

hot  $\text{H}_2\text{O}$  (Poggiale.)

$+2\text{H}_2\text{O}$  (Romanus, C. N. 49, 273.)

Not obtained by Benedikt (l.c.)

$10\text{SbCl}_3$ ,  $23\text{KCl}$ . True composition of above

salts. Sol. in  $\text{H}_2\text{O}$  (Herty, Am. Ch. J. 1894,

16, 495.)

$\text{SbCl}_3$ ,  $2\text{KCl}$  is the only true compound, all

others being isomorphous mixtures. (Jords, B. 1903, 36 2539)

$2SbCl_5, 3KCl$  Deliquescent Decomp. by  $H_2O$ . (Bosek, Chem Soc 1895, 67. 516)

$SbCl_5K_2SbCl_6KOH$  Hydrosropic Sol in  $H_2O$  with decomp. (Wenland, B. 1901, 34. 2635)

See also Antimony antimonyl potassium chloride.

**Antimony rubidium chloride,  $SbCl_5, RbCl$ .**

Decomp on air or with  $H_2O$ . (Saunders, Am. Ch. J. 14. 162)

$2SbCl_5, RbCl + H_2O$  Decomp. on air (Wheeler, Z. anorg. 5. 253)

$SbCl_5, 6RbCl$  Decomp. by  $H_2O$  (Godefroy, Arch. Pharm (3) 9. 343)

Formula is  $10SbCl_5, 23RbCl$  (?). (Saunders Am. Ch. J. 14. 159)

$10SbCl_5, 23RbCl$  (?). Decomp. by  $H_2O$ ; sol in  $HCl + Aq$  (Saunders)

Formula is  $3SbCl_5, 7RbCl$ . (Wells and Foote, Am J Sci 1897, (4) 3. 461.)

Composition assigned to this salt by Saunders (Am. Ch. J. 14. 155) is incorrect. (Ephraim, B. 1903, 36. 1817)

$3SbCl_5, 5RbCl$  As above. (Saunders)

Formula is  $2SbCl_5, 3RbCl$ . (Wheeler.)

$Rb_2SbCl_6$  Ppt. Decomp by  $H_2O$ . (Wenland, B. 1905, 38. 1083)

$Rb_2SbCl_6, 2Rb_2SbCl_6$  Ppt. Decomp by  $H_2O$  (Wenland, B. 1901, 34. 2635.)

**Antimony selenium chloride,  $SbCl_5, SeCl_4$ .**

Deliquescent. (Weber.)

**Antimony selenyl chloride,  $SbCl_5, SeOCl_2$**

Very deliquescent. (Weber, Pogg. 125. 325.)

**Antimony sodium chloride,  $SbCl_5, 3NaCl$  (?).**

Decomp. by much  $H_2O$ . (Poggiale)

**Antimony sulphur chloride,  $2SbCl_5, 3SbCl_3$ .**

Decomp. by  $H_2O$ .

$SbCl_5, SbCl_3$  Sol in dil.  $HNO_3 + Aq$ .

Mpt.  $125-126^\circ$  in an atmos. of chlorine. Violently decomp. by  $H_2O$ . (Ruff, B. 1904, 37. 4515.)

**Antimony thallium chloride,  $SbCl_5, 3TlCl$ .**

Ppt. (Ephraim, Z. anorg. 1909, 61. 249)

$SbCl_5, TlCl$ . (Ephraim and Barteczko, Z. anorg. 1909, 61. 251)

$2SbCl_5, 2TlCl, TlCl_3$  Slowly decomp. by cold  $H_2O$ . (Ephraim and Barteczko, Z. anorg. 1909, 61. 253)

**Antimony trichloride ammonia,  $SbCl_3, NH_3$ .**

Not very deliquescent Decomp. by  $H_2O$ .

**Antimony pentachloride ammonia,  $SbCl_5, 6NH_3$**

Decomp. by  $H_2O$  (Persoz.)

**Antimony pentachloride cyanhydric acid,  $SbCl_5, 3HCN$**

Deliquescent, decomp. by  $H_2O$ . (Klein, A. 74. 85)

**Antimony pentachloride nitric oxide,  $2SbCl_5, NO$**

Decomp by  $H_2O$ . (Beeson, C. R. 108. 1012)

**Antimony pentachloride nitrogen peroxide,  $3SbCl_5, 2N_2O_2$**

Decomp. by  $H_2O$ . (Beeson.)

**Antimony pentachloride nitrogen sulphide,  $SbCl_5, N_2S_4$**

Easily decomp (Davis, Chem. Soc. 1906, 89. 1577.)

Decomp by cold  $H_2O$ ,  $HCl$ ,  $H_2SO_4$  and warm alcohol, also by boiling with  $KOH + Aq$ . Almost insol. in organic solvents. (Walbling, Z. anorg. 1908, 57 283)

**Antimony chloride potassium bromide,  $SbCl_5, 3KBr + 1\frac{1}{2}H_2O$ .**

Very deliquescent. Decomp. by much  $H_2O$ . (Atkinson, Chem. Soc. 43. 286.)

$2SbCl_5, 3KBr + 2H_2O$ . (Atkinson.)

$SbCl_5, KBr + H_2O$  (Atkinson.)

Above are mixtures. (Herty, Am. Ch. J. 1894, 16. 497)

See Antimony bromide potassium chloride.

**Antimony chlorofluoride,  $SbCl_2F_3$**

(Swarts, Z. anorg. 1896, 12. 71.)

**Antimony fluoride,  $SbF_3$ .**

Slowly decomp by  $H_2O$ . (Ruff, B. 1906, 39. 4321.)

$(SbF_3)_2$ . Sol in  $H_2O$  with pptn of  $I_2$ . (Ruff, B. 1906, 39. 4321.)

**Antimony trifluoride,  $SbF_3$ .**

Deliquescent. Sol. in  $H_2O$ .

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	100 g of the solution contain g. $SbF_3$	100 g $H_2O$ contain g. $SbF_3$
0°	79.37	384.7
20	81.64	444.7
22.5	81.01	452.8
25	83.12	492.4
30	84.93	563.6

(Rosenheim, Z. anorg. 1909, 61. 189)

Solubility in  $HF + Aq$  at  $0^\circ$ .

Normality of $HF + Aq$	100 g $H_2O$ of the $HF$ solution dissolve g. $SbF_3$
2	474.9
1	432.5
0.5	404.0

(Rosenheim, Z. anorg. 1909, 61. 192.)

Solubility of  $\text{SbF}_3$  in salts + Aq at  $0^\circ$ .

Salt	Normality of salt solution	100 g. $\text{H}_2\text{O}$ of the salt solution dissolve g. $\text{SbF}_3$
KCl	1	461.8
	0.5	448.3
	0.25	431.9
	0.125	407.3
KBr	1	448.7
	0.5	450.0
	0.25	455.6
	0.125	417.2
$\text{KNO}_3$	1	458.2
	0.5	451.9
	0.25	418.3
	0.125	401.4
$\frac{1}{2}\text{K}_2\text{SO}_4$	1	419.9
	0.5	408.5
	0.25	406.6
$\frac{1}{2}\text{K}_2\text{C}_2\text{O}_4$	1	465.7
	0.5	481.2
	0.25	451.3
	0.125	405.2
$\frac{1}{2}(\text{NH}_4)_2\text{C}_2\text{O}_4$	0.5	431.9
	0.25	442.3
	0.125	433.3
$\frac{1}{2}\text{K}_2\text{C}_4\text{H}_4\text{O}_6$	1	461.4
	0.5	430.5
	0.25	430.8
	0.125	435.2

(Rosenheim, Z. anorg. 1909, 61. 192.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 826.)

Antimony pentafluoride,  $\text{SbF}_5$ 

Sol. in  $\text{H}_2\text{O}$ . (Magnac, A. 145. 239.)  
Very hygroscopic; bpt.  $155^\circ$ . Sol. in  $\text{H}_2\text{O}$  with hissing. (Ruff, B. 1904, 37. 678.)  
+  $2\text{H}_2\text{O}$ . (Ruff, B. 1904, 37. 679.)

Antimony pentafluoride diantimony trifluoride,  $\text{Sb}_2\text{F}_{11} = 2\text{SbF}_5 \cdot \text{SbF}_3$ 

Hygroscopic; bpt.  $390^\circ$ . Easily sol. in  $\text{H}_2\text{O}$  (Ruff, B. 1904, 37. 680.)

Antimony pentafluoride pentantimony trifluoride,  $\text{SbF}_5 \cdot 5\text{SbF}_3$ 

B pt.  $384^\circ$  (corr.). (Ruff, B. 1904, 37. 681.)

## Antimony caesium fluoride,

$\text{CsF} \cdot 2\text{SbF}_5$   
 $\text{CsF} \cdot 3\text{SbF}_5$   
 $4\text{CsF} \cdot 7\text{SbF}_5$   
 $\text{CaF} \cdot \text{SbF}_3$   
 $2\text{CsF} \cdot \text{SbF}_3$   
(Wells, Am. J. Sci. 1901, (4) 11. 451.)

Antimony lithium fluoride,  $\text{SbF}_3 \cdot 2\text{LiF}$ .

Sol. in more than 20 pts.  $\text{H}_2\text{O}$  (Flückinger, Pogg. 87. 245.)

$\text{SbF}_3 \cdot \text{LiF}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Stein, Chem. Z. 13. 357.)

Antimony potassium fluoride,  $\text{SbF}_3 \cdot 2\text{KF}$ .

Sol. in less than 2 pts. boiling, and in 9 pts. cold  $\text{H}_2\text{O}$ . Insol. in alcohol or ether.

$\text{SbF}_3 \cdot \text{KF}$ . More sol. than  $\text{SbF}_3 \cdot 2\text{KF}$ . Sol. in 2.8 pts.  $\text{H}_2\text{O}$  (Flückinger, Pogg. 87. 245.)

$\text{SbF}_3 \cdot \text{KF}$ . Easily sol. in  $\text{H}_2\text{O}$ .

$\text{SbF}_3 \cdot 2\text{KF} + 2\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Magnac, A. 145. 239.)

Antimony sodium fluoride,  $\text{SbF}_3 \cdot 3\text{NaF}$ .

Sol. in 14 pts. cold, and 4 pts. boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{HF}$  (Flückinger, Pogg. 87. 245.)

$\text{SbF}_3 \cdot \text{NaF}$ . 100 pts. cold  $\text{H}_2\text{O}$  dissolve 93 pts. 100 pts. hot  $\text{H}_2\text{O}$  dissolve 166 pts. (Stein, Wagners' J. B. 1887. 1160.)

$4\text{SbF}_3 \cdot \text{NaF}$  As  $\text{NH}_4$  salt. (Raad and Hauser, B. 1890, 23. R. 125.)

$\text{SbF}_3 \cdot 2\text{NaF}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Magnac, A. 145. 329.)

Antimony thallium fluoride,  $\text{TlF} \cdot \text{SbF}_3$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (Ephraim, B. 1909, 42. 4458.)

$\text{TlF} \cdot 2\text{SbF}_3$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Ephraim.)

$\text{TlF} \cdot 3\text{SbF}_3$ . Sol. in  $\text{H}_2\text{O}$  without decomp. Decomp. by cold conc.  $\text{H}_2\text{SO}_4$ . (Ephraim.)

Antimony trifluoride ammonia,  $\text{SbF}_3 \cdot 2\text{NH}_3$ .

Sl. sol. in liquid  $\text{NH}_3$ . (Ruff, B. 1906, 39. 4326.)

## Antimony trifluoride ammonium chloride.

$\text{SbF}_3 \cdot \text{NH}_4\text{Cl}$

Easily sol. in  $\text{H}_2\text{O}$  (de Haen, B. 21. 901 R.)

## Antimony trifluoride ammonium sulphate,

$\text{SbF}_3 \cdot (\text{NH}_4)_2\text{SO}_4$

More sol. than K or Na salt. 1 pt.  $\text{H}_2\text{O}$  dissolves 1.4 pts. at  $24^\circ$  and 15 pts. at  $100^\circ$ . (de Haen, B. 21. 902 R.)

Antimony fluoride lithium chloride,  $\text{SbF}_3 \cdot \text{LiCl}$ .

Sol. in  $\text{H}_2\text{O}$ . (Stein, Chem. Z. 13. 357.)

Antimony pentafluoride nitrosyl fluoride,  $\text{SbF}_5 \cdot \text{NOF}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in liquid  $\text{NH}_3$  with decomp. Sl. sol. in  $\text{NOCl}$ ,  $\text{SiCl}_4$ ,  $\text{PCl}_5$ ,  $\text{AsCl}_3$ ,  $\text{SO}_2\text{Cl}_2$  and  $\text{SOCl}_2$ . (Ruff, Z. anorg. 1908, 58. 334.)

Antimony trifluoride potassium chloride,  $\text{SbF}_3 \cdot \text{KCl}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 51 pts. at  $24^\circ$  and 300 pts. at  $100^\circ$ . (de Haen, B. 21. 901 R.)

- Antimony trifluoride potassium sulphate**,  $\text{SbF}_3, \text{K}_2\text{SO}_4$ .  
Sol. in  $\text{H}_2\text{O}$ . (de Haen)  
 $2\text{SbF}_3, \text{K}_2\text{SO}_4$ . Very sol in  $\text{H}_2\text{O}$  (Mayer, B. 1894, 27, R. 922.)
- Antimony trifluoride sodium chloride**,  $\text{SbF}_3, \text{NaCl}$ .  
Easily sol in  $\text{H}_2\text{O}$ . (de Haen, B. 21. 901 R.)
- Antimony trifluoride sodium sulphate**,  $\text{SbF}_3, \text{Na}_2\text{SO}_4$ .  
Sol in  $\text{H}_2\text{O}$ . (de Haen)
- Antimony fluoiodide**,  $\text{SbFI}$ .  
Mpt.  $80^\circ$ , slowly decomp. by  $\text{H}_2\text{O}$  (Ruff, B. 1906, 39, 4321.)  
 $(\text{SbF}_2)_2\text{I}$ . Mpt  $110-115^\circ$ , decomp by  $\text{H}_2\text{O}$ . (Ruff.)
- Antimony fluosulphide**,  $\text{SbFS}$ .  
Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$  Sol. with decomp in alcohol. Sol. in  $\text{CCl}_4$ . (Ruff, B. 1906, 39, 4332.)
- Antimony gold**,  $\text{Au}_2\text{Sb}$ .  
Insol in equal pts of  $\text{HNO}_3$  and tartaric acids (Roessler, Z. anorg. 1895, 9, 72)
- Antimony hydride**,  $\text{SbH}_3$ .  
Scarcely sol in  $\text{H}_2\text{O}$ . 1000 ccm.  $\text{H}_2\text{O}$  absorb 4.12 cc.  $\text{SbH}_3$  at  $10.5^\circ$ . Decomp. by long contact with  $\text{H}_2\text{O}$ ; also by conc  $\text{H}_2\text{SO}_4$  or  $\text{KOH} + \text{Aq}$ . (Jones, Chem. Soc. 29. 641)
- Antimony trihydroxide**,  $\text{Sb}_2\text{O}_3, 2\text{H}_2\text{O} = \text{Sb}_2\text{O}_3(\text{OH})_3$ .  
(Schaffner, A. 51. 182.)  
 $\text{Sb}(\text{OH})_3$ . Ppt. (Clarke and Stolla, B. 13. 1787.)  
Does not exist. (Guntz, C. R. 102. 1473)  
See Antimonous acid and antimony trioxide.
- Antimony triiodide**,  $\text{SbI}_3$ .  
Decomp. by  $\text{H}_2\text{O}$  or 80% alcohol Sol. in  $\text{HI} + \text{Aq}$ ; sol. in boiling  $\text{CS}_2$ , and in boiling benzene, but separates out on cooling. Almost insol. in  $\text{CHCl}_3$  (Cooke, Proc. Am. Acad. (2) 5. 72.)  
Easily sol in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 974)  
Sol. in warm  $\text{AsBr}_3$ . Sp. gr. of a solution sat. at  $40^\circ$ , which solidifies at  $37^\circ$ , = 3.720. This dissolves further  $\text{AsI}_3$ , whereby the mpt. sinks to  $31^\circ$  and sp. gr. rises to 3.801. By mixing the latter solution with a solution of  $\text{AsI}_3$  in  $\text{CH}_2\text{I}_2$ , a liquid can be obtained with a sp. gr. of 3.702 at  $20^\circ$  (Retgers, Z. phys. Ch. 1893, 11. 340)  
Sol. in  $\text{PCl}_5$ . (Beckmann, Z. anorg. 1906, 51. 110.)  
Sol. in  $\text{SO}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 215)
- Sol. in  $\text{SOCl}_2$  and  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 216.)  
Sol. in  $\text{AsCl}_3$ . (Walden, Z. anorg. 1900, 25. 214.)  
Sol. in  $\text{SnCl}_4$ . (Walden, Z. anorg. 1900, 25. 218)  
Sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25. 212.)  
Easily sol in  $\text{PCl}_3$  and  $\text{PBr}_3$ . (Walden, Z. anorg. 1900, 25. 211.)  
Partly sol. up, and partly decomp. by alcohol or ether. (M'Ilvri, Chem. Soc. (2) 14. 328)  
Insol. in oil of turpentine and  $\text{CCl}_4$ , 100 pts. methylene iodide dissolve 11.3 pts.  $\text{SbI}_3$  at  $12^\circ$ ; sp. gr. of solution = 3.453. (Retgers, Z. anorg. 3. 343)  
Sol. in  $\text{C}_6\text{H}_6$ . (Retgers, Z. phys. Ch. 1893, 11. 334.)  
Sol. in acetone (Naumann, B. 1904, 37. 4328)
- Antimony penta iodide**,  $\text{SbI}_5$ .  
Very unstable (Pendleton, C. N. 48. 97.)
- Antimony barium iodide**,  $\text{SbI}_3, \text{BaI}_2 + 9\text{H}_2\text{O}$ .  
Decomp by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{C}_4\text{H}_7\text{O}_6 + \text{Aq}$ .  $\text{CS}_2$  dissolves out  $\text{SbI}_3$ . (Schaffer, Pogg. 109. 611.)
- Antimony cesium iodide**,  $2\text{SbI}_3, 3\text{CsI}$ .  
Sl sol. in  $\text{HI} + \text{Aq}$  Exists in two distinct forms (Wells, Am. J. Sci. 1901, (4) 11. 455.)
- Antimony potassium iodide**,  $2\text{SbI}_3, 3\text{KI} + 3\text{H}_2\text{O}$ .  
Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{C}_4\text{H}_7\text{O}_6 + \text{Aq}$ .  $\text{CS}_2$  dissolves out  $\text{SbI}_3$ . (Schaffer, Pogg. 109. 611.)  
 $\text{SbI}_3, 2\text{KI} + 2\frac{1}{2}\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . (Nickles, J. Pharm. (3) 39. 116)
- Antimony rubidium iodide**,  $2\text{SbI}_3, 3\text{RbI}$ .  
Decomp by  $\text{H}_2\text{O}$ . (Wheeler, Z. anorg. 5. 259.)
- Antimony sodium iodide**,  $2\text{SbI}_3, 3\text{NaI} + 12\text{H}_2\text{O}$   
As  $2\text{SbI}_3, 3\text{KI}$  (Schaffer, Pogg. 109. 611.)
- Antimony thalious iodide**,  $2\text{SbI}_3, 3\text{TlI}$ .  
Decomp. by  $\text{H}_2\text{O}$  and by  $\text{HCl} + \text{Aq}$ , also by alcohol. (Ephraim, Z. anorg. 1908, 58. 354.)
- Antimony nitride**,  $\text{Sb}_2\text{N}_3$ .  
Decomp. by heat. (Franz Fischer, B. 1910, 43. 1471.)
- Antimony trioxide**,  $\text{Sb}_2\text{O}_3$ .  
Very sl sol. in  $\text{H}_2\text{O}$  Sol. in 8900-10,000 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ , 55,000-61,100 pts. at  $15^\circ$ . (Schulze, J. pr. (2) 27. 320)  
Sol. in  $\text{HCl} + \text{Aq}$ . Insol. in  $\text{HNO}_3 + \text{Aq}$ , but not as insol as metastannic acid. Sol. in cold fuming  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Insol. in dil., but sol. in conc. alkalis, or alkali carbonates +

Aq. Sol. in cold  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  Sol. in 15 pts boiling  $\text{SbCl}_3$ . (Schneider, Pogg 108. 407.)

Sol. in  $\text{H}_2\text{C}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{C}_2\text{H}_4\text{O}_6 + \text{Aq.}$  and hot pptd. from these solutions by  $\text{H}_2\text{O}$ . Easily sol. in benzoic acid. Insol. in pyrotartaric acid. Very sol. in  $\text{KHC}_2\text{H}_3\text{O}_6 + \text{Aq.}$  Sol. in glycerine.

Somewhat sol. in  $\text{H}_3\text{PO}_4 + \text{Aq.}$  (Kohler, Dingl. 1885, 258. 520.)

Insol. in liquid  $\text{NH}_3$  (Gore, Am. Ch. J. 1898, 20. 826.)

Sol. in lactic acid (Kietzschmar, Ch. Z. 1888, 12. 943.)

Sol. in grape sugar solution to which  $\text{Ca(OH)}_2$  has been added. (Vogel, B. 1885, 18. R. 38.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eichmann, C. C. 1899, II. 1014.)

Sol. in glycerine in presence of alkalis. (Kohler, Dingl. 1885, 258. 520.)

Exists in a sol. colloidal modification. (Spring, B. 16. 1142.)

Min. *Valentinite*, *Senarmontite*

+  $\text{H}_2\text{O}$ . See Antimonous acid.

#### Antimony tetroxide, $\text{Sb}_2\text{O}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Slightly attacked by acids; hot conc.  $\text{HCl} + \text{Aq}$  acts only slightly (Fresenius.)

Min. *Cervantite*. Sl. sol. in  $\text{HCl} + \text{Aq}$

#### Antimony pentoxide, $\text{Sb}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq.}$  Sl. sol. in conc.  $\text{KOH} + \text{Aq.}$

"Antimonoyd" is sol. in glycerine in presence of alkalis.

100 g. glycerine, to which have been added 10 g.  $\text{NaOH} + \text{Aq}$  (1.1), dissolve 20.6 g. at b.-pt., 20 g.  $\text{NaOH} + \text{Aq}$  (1.1), dissolve 36.0 g. at b.-pt.; 40 g.  $\text{NaOH} + \text{Aq}$  (1.1), dissolve 68.5 g. at b.-pt.; 80 g.  $\text{NaOH} + \text{Aq}$  (1.1), dissolve 93.0 g. at b.-pt., 120 g.  $\text{NaOH} + \text{Aq}$  (1.1), dissolve 119.2 g. at b.-pt. (Kohler, Dingl. 258. 520.)

See also Antimonie acid.

#### Antimony nitrogen pentoxide, $2\text{Sb}_2\text{O}_5, \text{N}_2\text{O}_5$ .

Not decomp. by  $\text{H}_2\text{O}$ . (Thomas, C. R. 1895, 120. 1116.)

#### Antimony oxybromide.

See Antimonyl bromide.

#### Antimony oxychloride.

See Antimonyl chloride.

#### Antimony oxyfluoride.

See Antimonyl fluoride.

#### Antimony oxysulphide, $\text{Sb}_2\text{OS}_2$ .

Min. *Antimony blende (kermesite)*.

Insol. in  $\text{H}_2\text{O}$  or dil. acids, except  $\text{HCl} + \text{Aq.}$  (Schneider, Pogg 110. 147.)

#### Antimony palladium, $\text{Sb}_2\text{Pd}$

Sl. sol. in equal pts. of  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9. 69.)

#### Antimony platinum, $\text{Sb}_2\text{Pt}$ .

Insol. in equal pts. of  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9. 67.)

#### Antimony phosphide, $\text{SbP}$ .

Insol. in benzene, ether, or  $\text{CS}_2$ . (M'Ivor, B. 6. 1362.)

#### Antimony selenide, $\text{SbSe}$

(Chrétien, C. R. 1906, 142. 1341.)

$\text{Sb}_2\text{Se}_4$ . (Chrétien, l.c.)

$\text{Sb}_2\text{Se}_3$ . (Chrétien, l.c.)

$\text{Sb}_2\text{Se}_3$ . Sol. in  $\text{KOH} + \text{Aq.}$  (Hofacker, A. 107. 6.)

$\text{Sb}_2\text{Se}_4$ . (Hofacker.)

#### Antimony selenide, with M selenide.

See Selenoantimonates, M.

#### Antimony trisulphide, $\text{Sb}_2\text{S}_3$ (Kermes).

Insol. in  $\text{H}_2\text{O}$  and dil. acids.

1 l.  $\text{H}_2\text{O}$  dissolves  $5.2 \times 10^{-6}$  mole pptd.  $\text{Sb}_2\text{S}_3$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)

Decomp. by conc.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Sol. in conc.  $\text{HCl} + \text{Aq}$ . Easily sol. in dil.  $\text{KOH}$ ,  $\text{NaOH}$ ,  $(\text{NH}_4)_2\text{S}$ , and  $\text{K}_2\text{S} + \text{Aq}$ . Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , very sl. sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , insol. in  $\text{KSH} + \text{Aq}$  (Fresenius.)

Sol. in a mixture of 50 pts  $\text{H}_2\text{O}$  and 18 pts.  $\text{HCl}$  (sp. gr. 1.16) even when completely sat. with  $\text{H}_2\text{S}$  (Lang and Carson, J. Soc. Chem. Ind. 1902, 21. 1018.)

Sl. sol. in  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Gueudet, C. R. 1872, 75. 1276.)

Cryst.  $\text{Sb}_2\text{S}_3$  is only sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt. in about 2000 pts  $\text{NH}_3$ ).

Pptd. amorphous  $\text{Sb}_2\text{S}_3$  is appreciably more sol. (1 pt. in 600 pts.  $\text{NH}_3$ ). (Garot, J. pr. 1843, 29. 83.)

Sl. sol. in hot 2%  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq.}$ , still less sol. in cold. (Materne, C. C. 1906, II. 557.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$

Sol. in 14-15 pts pure  $\text{SbCl}_3$ . (Schneider, Pogg 108. 407.)

Slowly sol. in  $\text{H}_2\text{C}_2\text{H}_3\text{O}_6 + \text{Aq.}$

Sol. in boiling  $\text{Na}_2\text{SbS}_4 + \text{Aq.}$

Sol. in hot citric, tartaric and oxalic acids. Sl. sol. in malic, benzoic, picric and pyrogallic acids. Insol. in formic and acetic acids. Especially easily sol. in citric and oxalic acids with addition of  $\text{KNO}_3$ ,  $\text{KNO}_2$  or  $\text{KClO}_3$ . (Bolton, C. N. 1878, 37. 88 and 99.)

Sol. in ethylamine sulphhydrate +  $\text{Aq.}$

Min. *Stibnite*. Sol. in cold citric acid +  $\text{Aq}$  (Bolton, C. N. 37. 14.)

*Soluble modification*  $\text{Sb}_2\text{S}_3$  may be obtained in a colloidal state in aqueous solution containing 1 pt  $\text{Sb}_2\text{S}_3$  to 200 pts  $\text{H}_2\text{O}$ . This can be boiled without decomp., but  $\text{Sb}_2\text{S}_3$  is pptd. by acids and salts.

Table of 'maximum' dilution of solutions of acids and salts which cause pptn. of  $\text{Sb}_2\text{S}_3$ .

HCl	1 : 270
$\text{H}_2\text{SO}_4$	1 : 140
$\text{H}_2\text{C}_2\text{O}_4$	1 : 45
$\text{K}_2\text{SO}_4$	1 : 65
$(\text{NH}_4)_2\text{SO}_4$	1 : 130
$\text{MgSO}_4$	1 : 1720
$\text{MnSO}_4$	1 : 2060
NaCl	1 : 135
$\text{BaCl}_2$	1 : 2050
$\text{MgCl}_2$	1 : 5800
$\text{CoCl}_2$	1 : 2500
$\text{KNO}_3$	1 : 75
$\text{Fe}_2\text{Cl}_6$	1 : 2500
$\text{Ba}(\text{NO}_3)_2$	1 : 1250
$\text{K}_2\text{Al}_2(\text{SO}_4)_4$	1 : 35,000
$(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_4$	1 : 800
$\text{K}_2\text{Cr}_2(\text{SO}_4)_4$	1 : 40,000
$\text{KSbOCl}_4\cdot\text{H}_2\text{O}$	1 : 18

(Schulze, J. pr. (2) 27. 320)

### Antimony trisulphide with $\text{M}_2\text{S}$ .

See Sulphantimonites, M.

### Antimony pentasulphide, $\text{Sb}_2\text{S}_5$

Insol in  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  containing  $\text{H}_2\text{S}$ . Sol in conc.  $\text{HCl} + \text{Aq}$ . Completely sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , traces dissolve in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Easily sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ , or in alkali sulphides +  $\text{Aq}$ . Sol. in 50 pts cold dil.  $\text{NH}_4\text{OH} + \text{Aq}$  (Geiger).

Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ .

Insol. in cold, but sol. in hot alkali carbonates +  $\text{Aq}$  (Berzelius).

Insol. in  $\text{Na}_2\text{SbS}_4 + \text{Aq}$ .

When boiled with alcohol, ether,  $\text{CS}_2$ , oil of turpentine, etc., portion of the S is dissolved out. (Berzelius).

$\text{CS}_2$  dissolves about 5% of the sulphur (Rammelsberg).

### Antimony pentasulphide with $\text{M}_2\text{S}$ .

See Sulphantimonates, M.

### Antimony sulphochloride, $\text{SbSCl}_2$

Decomp. by moist air or  $\text{H}_2\text{O}$  (Cloeys, A. ch. (3) 30. 374).

$\text{SbS}_2\text{Cl}$ . Easily attacked by acids; insol. in  $\text{CS}_2$  (Ouvrard, C. R. 116. 1516.)

$\text{Sb}_2\text{S}_2\text{Cl}$  (Ouvrard.)

$2\text{SbSCl}$ ,  $3\text{Sb}_2\text{S}_3$ . Decomp. by dil.  $\text{HCl} + \text{Aq}$ . (Schneider)

$\text{SbSCl}$ ,  $2\text{SbCl}_2$ . Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Schneider, Pogg. 108. 407)

### Antimony sulphofluoride, $\text{SbF}_2\text{S}$

See Antimony fluosulphide.

### Antimony sulphoiodide, $\text{SbSI}$ .

Not attacked by  $\text{H}_2\text{O}$ , and decomp. only by conc. acids. Insol. in  $\text{CS}_2$ . (Schneider, Pogg. 110. 147)

$\text{Sb}_2\text{S}_2\text{I}_2$ . (Henry and Garot.)

$\text{Sb}_2\text{S}_2\text{I}_2$ . Sol. in dry  $\text{CS}_2$ . Very easily decomp. (Ouvrard, C. R. 117. 108.)

### Antimony sulphur dioxide, $\text{SbSO}_2$ .

Ppt. (Faktor, C. C. 1900, I 1211)

### Antimony telluride, $\text{SbTe}$

Insol. in  $\text{H}_2\text{O}$

$\text{Sb}_2\text{Te}_3$  Insol. in  $\text{H}_2\text{O}$  (Oppenheim, J. pr. 71. 277)

### Antimonyl bromide, $\text{SbOBr}$ .

Insol in  $\text{CS}_2$ . (Cooke, Proc. Am. Acad. 13. 104)

Sl sol in liquid  $\text{NH}_3$  (Gore, Am. Ch. J. 1898, 20. 826)

$\text{Sb}_2\text{O}_3\text{Br}_2$  (M'Ivor, C. N. 29. 179.)

$10\text{Sb}_2\text{O}_3\text{Br}_3$ ,  $\text{SbBr}_3$

### Antimonyl chloride.

From  $\text{SbCl}_3$ ,  $\text{SbOCl}$  Insol in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . Insol. in alcohol or ether; sol. in  $\text{CS}_2$ ,  $\text{CHCl}_3$ , or  $\text{C}_6\text{H}_6$ . (Sabannajew, Zeit. Ch. 1871. 204)

Insol in liquid  $\text{NH}_3$  (Gore, Am. Ch. J. 1898, 20. 826.)

Insol in acetone (Naumann, B. 1904, 37. 4329.)

$\text{Sb}_2\text{O}_3\text{Cl}_2$  Algaroth powder. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$  (Cooke, Proc. Am. Acad. 13. 1), tartaric acid +  $\text{Aq}$  (Schaffer, A. 152. 135)

$\text{Sb}_2\text{O}_3\text{Cl}_2$ . (Cooke.)

$\text{Sb}_2\text{OCl}_2$

$\text{Sb}_2\text{O}_3\text{Cl}_2$

From  $\text{SbCl}_3$ ,  $\text{SbOCl}_3$ . Deliquescent. Decomposed by  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Daubrawa, A. 184. 118.)

Does not exist. (Anschütz and Evans, A. 239. 285)

$\text{Sb}_2\text{OCl}_3$ . Deliquescent. Insol. in  $\text{CS}_2$ ; easily sol. in tartaric acid +  $\text{Aq}$ . (Williams, C. N. 24. 224.)

$\text{Sb}_2\text{O}_3\text{Cl}$ . (Williams.)

$\text{Sb}_2\text{O}_3\text{Cl}$ . Decomp. by hot  $\text{H}_2\text{O}$  into  $\text{HSbO}_3$ .

### Antimonyl fluoride.

From  $\text{SbF}_3$ ,  $\text{Sb}_2\text{O}_3\text{F}_3$ . Not deliquescent. (Flückiger, Pogg. 87. 249.)

### Antimonyl caesium fluoride, $\text{SbF}_4\text{OH}$ , $\text{CsF}$ .

(Wells, Am. J. Sci. 1901, (4) 11. 456.)

### Antimonyl sodium fluoride, $\text{SbOF}_2$ , $\text{NaF} + \text{H}_2\text{O}$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Marignac, A. 145. 239)

### Antimonyl iodide, $\text{Sb}_2\text{O}_3\text{I}_2$

Difficultly sol. in solution of tartaric acid or tartrates. Decomp. by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily sol. in alkalies, or  $(\text{NH}_4)_2\text{S} + \text{Aq}$

$\text{SbOI}$  Insol. in  $\text{CS}_2$ . (Cooke, Proc. Am. Acad. (2) 5. 72.)

### Antimonyl sulphide.

See Antimony oxysulphide.

**Argon, A.**

100 cc  $H_2O$  dissolve + 05 cc. argon at 13.9°  
Critical t—121.6° under 50.6 atmos. Bpt.—  
186.9°. Sp. gr. 19.9. (Rayleigh, C. N. 1895,  
71. 51-62, 299-302, C. C. 1895. 467.)

Coefficient of absorption in  $H_2O$  at 12° =  
0.0394; at 13.9° = 0.0405 (Ramsay, Phil.  
Trans. 1895, 186. A. 225.)

**Absorption by  $H_2O$  at t°.**

t°	Coefficient of absorption
0°	0.0561
10	0.0438
20	0.0379
30	0.0348
40	0.0338
50	0.0343

(Antropoff, Roy Soc. Proc. 1910, 83. A. 480.)

**Absorption of argon by  $H_2O$  at t° and 760 mm. pressure.**

t°	Coefficient of absorption
0°	0.05780
1	0.05612
5	0.05080
10	0.04525
15	0.04099
20	0.03790
25	0.03470
30	0.03256
35	0.03053
40	0.02865
45	0.02731
50	0.02567

(Estricher, Z. phys. Ch. 1899, 31. 184.)

1 l.  $H_2O$  at 38° absorbs 25.7 cc. A.

1 l. blood absorbs 25.3 cc. A. (Regnard  
and Schloesing, C. R. 1897, 124. 303.)

Not absorbed by members of the fatty  
series of organic compounds; with members  
of the aromatic series absorption was ob-  
served varying from 8% of the volume em-  
ployed for benzene to 1% for aniline. (Berth-  
elot, C. R. 1899, 129. 71.)

**Arsenamide,  $As(NH_2)_3$ .**

Insol. in liquid  $NH_3$ . Decomp. by  $H_2O$ .  
(Hugot, C. R. 1904, 139. 55.)

**Arsenic, As.**

Unaltered by pure  $H_2O$ . Insol. in  $HCl$ +  
 $Aq$  if air is excluded, but sl. sol. in presence of  
air. Not attacked by dil.  $H_2SO_4$ + $Aq$ . Oxid-  
ized by conc.  $H_2SO_4$ ,  $HNO_3$ , or aqua regia.  
Not attacked at 20° by  $HNO_3$ , conc. or dil.,  
or containing  $NO_2$ ; nor by  $HNO_3$ + $HCl$ , as  
long as they do not act on each other, but if  
treated with the above mixture in extremely  
dilute state, and a few drops of  $KNO_3$ + $Aq$

are added, the As is attacked at once. (Mil-  
lon, A. ch. (3) 6. 101.)

Sol. in sea water; 0.009 mg. per liter off  
Brittany, 0.01 to 0.09 mg. per liter near  
Azores. (Gautier, C. R. 1903, 137. 232.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch.  
J. 1898, 20. 827.)

Insol. in liquid  $NH_3$ . (Hugot, A. ch. 1900,  
7) 21. 31.)

Insol. in  $NaOH$ ,  $KOH$ , or  $NH_4OH$ + $Aq$ .  
Sol. in  $S_2Br_2$ . (Hannay, Chem. Soc. (2) 11.  
823.)

Insol. in alcohol and ether

Sol. in certain fatty oils

Insol. in methylene iodide. (Retgers, Z.  
anorg. 3. 343.)

$\frac{1}{2}$  cm. oleic acid dissolves 0.0032 g. As in  
6 days. (Gates, J. phys. Ch. 1911, 15. 143.)

Yellow modification. Very unstable (Mc-  
Leod, C. N. 1894, 70. 139.)

Fairly stable in liquid air. (Thomson,  
Chem. Soc. 1906, 90. (2) 745.)

100 cc.  $CS_2$  dissolve at.

46° 20° 12° 0° —15° —60°  
11 8 6 4 2 0-2.5 1.0 g. As.

Less sol. in benzene and ethyl acetate.  
(Erdmann, Z. anorg. 1902, 32. 448.)

**Arsenic acid.** See page 59.

**Arsenic bromide,  $AsBr_3$ .**

Decomp. by  $H_2O$ . Completely sol. in  
about 3 pts. boiling  $H_2O$ , and much less, in  
presence of  $HBr$ . (Wallace, Phil. Mag. (4)  
17. 261.)

Sol. in  $CS_2$

Sol. in  $AlBr_3$ . (Isabekow, Z. anorg. 1913,  
84. 26.)

Easily sol. in  $PCl_3$  and  $PBr_3$ . (Walden,  
Z. anorg. 1900, 25. 211.)

Sol. in  $S_2Cl_2$ . (Walden, Z. anorg. 1900,  
25. 217.)

**Arsenic caesium bromide,  $2AsBr_3, 3CsBr$ .**

Decomp. by  $H_2O$ , can be recryst. from  
conc.  $HBr$ + $Aq$ . (Wheeler, Z. anorg. 4. 451.)

**Arsenic rubidium bromide,  $2AsBr_3, 8RbCl$** 

As the corresponding Cs comp.

**Arsenic bromide ammonia,  $AsBr_3, 3NH_3$ .**

Decomp. by  $H_2O$ . (Besson, C. R. 110.  
1258.)

**Arsenic bromide copper,  $2AsBr_3, 7Cu$ .**

Stable toward hot  $H_2O$ . Decomp. by  $KOH$ .  
(Hilpert and Herrman, B. 1913, 46. 2224.)

**Arsenic bromide silver,  $AsBr_3, 3Ag$ .**

Scarcely decomp. by cold  $H_2O$ . (Hilpert  
and Herrmann.)

**Arsenic chloride,  $AsCl_3$ .**

Miscible with little  $H_2O$ , and with alcohol,  
ether, and volatile oils. Decomp. by much  
 $H_2O$ , or by boiling. (Gmelin.)

Miscible with oil of turpentine, and with olive oil. Somewhat sol in  $\text{HCl} + \text{Aq}$ .

Easily sol in  $\text{PCl}_5$  and  $\text{PBr}_3$  (Walden, Z. anorg. 1900, 25, 211.)

Sol in liquid  $\text{CN}$ . (Centnerszwer, J. russ. phys. Ges. 1901, 33, 545.)

Sol in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25, 217.)

**Arsenic pentachloride,  $\text{AsCl}_5$ .**

Fumes in the air with evolution of hydrogen chloride. Readily sol in  $\text{CS}_2$ , and absolute ether cooled to  $-30^\circ$ . (Baskerville, J. Am. Chem. Soc. 1902, 24, 1070.)

**Arsenic caesium chloride,  $2\text{AsCl}_3, 3\text{CsCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . 100 pts  $\text{HCl} + \text{Aq}$  (1.2 sp. gr.) dissolve 0.429 pt salt (Wheeler, Z. anorg. 4, 451.)

**Arsenic iridium phosphorus chloride.**

See Iridium phosphorus chloride arsenic chloride.

**Arsenic rubidium chloride,  $2\text{AsCl}_3, 3\text{RbCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . 100 pts  $\text{HCl} + \text{Aq}$  (sp. gr. 1.2) dissolve 2.935 pts salt (Wheeler, Z. anorg. 4, 451.)

**Arsenic sulphur chloride,  $2\text{AsCl}_3, 3\text{SCl}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  (Rose.)

Above compound is a mixture. (Nilson, C. N. 81, 81.)

**Arsenic chloride ammonia,  $2\text{AsCl}_3, 7\text{NH}_3$ .**

Decomp. by cold  $\text{H}_2\text{O}$ , with evolution of  $\text{NH}_3$ . From the solution crystallizes  $\text{As}_2\text{Cl}_3, \text{N}_2\text{H}_{12}\text{O}_3$ .

Sol in alcohol without decomp (Rose, Pogg. 52, 62.)

Composition is  $\text{AsCl}_3, 4\text{NH}_3$ . (Besson, C. R. 110, 1258.)

**Arsenic chloride copper,  $2\text{AsCl}_3, 7\text{Cu}$ .**

Somewhat decomp. by  $\text{H}_2\text{O}$ . Decomp. by  $\text{KOH}$ , or hot  $\text{HCl}$ . (Hilpert and Herrman, B. 1913, 46, 2224.)

**Arsenic chloride silver,  $2\text{AsCl}_3, 7\text{Ag}$ .**

$\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$  and  $\text{KOH}$  split off  $\text{Ag}$ . (Hilpert and Herrmann.)

**Arsenic trifluoride,  $\text{AsF}_3$ .**

Sol. in  $\text{H}_2\text{O}$  with evolution of heat and decomposition. (Berzelius.)

Easily sol. in benzene (Moissan, C. R. 99, 874.)

Miscible with alcohol and ether. (M'Ivor, C. N. 30, 169.)

**Arsenic pentafluoride,  $\text{AsF}_5$ .**

Sol. in  $\text{H}_2\text{O}$ , alkalis +  $\text{Aq}$  and liquid  $\text{AsF}_3$  with evolution of heat. Absorbed by ether, alcohol and benzene with evolution of heat. (Ruff, B. 1906, 39, 67.)

**Arsenic potassium fluoride,  $\text{AsF}_6, \text{KF} + \frac{1}{2}\text{H}_2\text{O}$ .**

$\text{AsF}_3, 2\text{KF} + \text{H}_2\text{O}$

$\text{AsF}_3, \text{AsOF}_3, 4\text{KF} + 3\text{H}_2\text{O}$ . (Marignac, A. 145, 237.)

**Arsenic fluoride ammonia,  $2\text{AsF}_3, 5\text{NH}_3$ .**

Easily decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 110, 1258.)

**Arsenic pentafluoride nitrosyl fluoride,  $\text{AsF}_5, \text{NOF}$ .**

Decomp. by  $\text{H}_2\text{O}$ , fuming  $\text{HCl}$ ,  $\text{NaOH} + \text{Aq}$ , dry ether and dry alcohol with evolution of  $\text{NO}$ . Sol. in conc.  $\text{HNO}_3$ , hot conc.  $\text{H}_2\text{SO}_4$ , boiling  $\text{NOCl}$  and  $\text{AsF}_3$ . Insol. in  $\text{CCl}_4$  and  $\text{CS}_2$  (Ruff, Z. anorg. 1908, 58, 327.)

**Arsenic bisfluoride sulphur tetrachloride,  $2\text{AsF}_5, \text{SCl}_4$ .**

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$  and  $\text{NaOH}$ . Decomp. by thionyl chloride,  $\text{CCl}_4$ ,  $\text{CS}_2$ , abs. alcohol and ether. Decomp. by ligroin, benzene and toluene. (Ruff, B. 1904, 37, 4520.)

**Arsenic hydride,  $\text{AsH}_3$ .**

Sl. sol in  $\text{H}_2\text{O}$  and alkali hydrates +  $\text{Aq}$ , with subsequent decomposition.  $\text{H}_2\text{O}$  absorbs  $\frac{1}{2}$  vol.  $\text{AsH}_3$ . Decomp. by conc. acids. Absorbed rapidly by oil of turpentine, slightly by fixed oils, and not at all by alcohol, ether, or  $\text{KOH} + \text{Aq}$ . (Gmelin.)

Insol. in  $\text{KOH} + \text{Alcohol}$ . (Meissner.)

Not more sol. in alkaline solutions than in pure  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{AsH}$ . Solid. Insol. in  $\text{H}_2\text{O}$ , alcohol, ether, and  $\text{CS}_2$ . (Wiederhold, Pogg. 118, 615.)

Insol. in  $\text{H}_2\text{O}$ , sol. in methylene iodide, xylene, or in conc.  $\text{KOH} + \text{Aq}$ . (Retgers, Z. anorg. 4, 403.)

**Arsenic hydride boron bromide,  $\text{AsH}_3, \text{BBr}_3$ .**

Easily decomp. Decomp. by  $\text{H}_2\text{O}$ . Appreciably sol. in  $\text{AsH}_3$  or  $\text{BBr}_3$ . Insol. in  $\text{CS}_2$ . (Stock, B. 1901, 34, 949.)

**Arsenic diiodide,  $\text{As}_2\text{I}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  or alkalis; easily sol in alcohol, ether, chloroform, or carbon disulphide. (Bamberger and Philip, B. 14, 2643.)

Not attacked by cold conc.  $\text{H}_2\text{SO}_4$  or by cold fuming  $\text{HNO}_3$ . The latter oxidizes on warming. Decomp. by pyridine. Sol. in boiling acetic anhydride. (Hewitt and Winmill, Chem. Soc. 1907, 91, 962.)

**Arsenic triiodide,  $\text{AsI}_3$ .**

Sol. in 332 pts. boiling  $\text{H}_2\text{O}$ , and solution if boiled down deposits pure  $\text{AsI}_3$ , but if left to cool slowly, deposits crystals of  $\text{As}_2\text{O}_3$  and  $\text{AsOI}$ .

Sl. sol. in  $\text{HCl} + \text{Aq}$ .

Sol. in  $\text{POCl}_3$ ,  $\text{PCl}_5$  and  $\text{PBr}_3$ . (Walden, Z. anorg. 1900, 25, 212.)

Sol in  $\text{PCl}_5$  (Beckmann, Z anorg 1906, 51. 110)  
 Sol. in  $\text{SOCl}_2$ ,  $\text{S}_2\text{Cl}_2$  and  $\text{SO}_2\text{Cl}_2$ . (Walden, Z anorg 1900, 25. 216)  
 Sol. in  $\text{SnCl}_4$ . (Walden, l.c.)  
 Easily sol. in  $\text{AsBr}_3$ . (Walden, Z anorg 1902, 29. 374)  
 Sol. in  $\text{AsCl}_3$  (Walden, Z. anorg. 1900, 25. 214)  
 Sol. in alcohol without decomp  
 Sol. in ether, benzene, chloroform, and  $\text{CS}_2$ .  
 100 pts. methylene iodide dissolve 17.4 pts.  $\text{AsI}_3$  at  $12^\circ$ . (Retgers, Z anorg 3. 343.)

#### Arsenic pentoxide, $\text{As}_2\text{O}_5$ .

More or less sol. in  $\text{H}_2\text{O}$ , alcohol,  $\text{CHCl}_3$ , ether and  $\text{CS}_2$ . (Sloan, C. N. 1882, 46. 194.)

#### Arsenic caesium iodide, $2\text{AsI}_3$ , $3\text{CsI}$

Decomp. by  $\text{H}_2\text{O}$ , sol. in conc.  $\text{HI} + \text{Ag}$  (Wheeler, Z anorg 4. 451)

#### Arsenic rubidium iodide, $2\text{AsI}_3$ , $3\text{RbI}$

As the corresponding Cs comp

#### Arsenic sulphur iodide.

See Arsenic sulphoxide.

#### Arsenic triiodide ammonia, $2\text{AsI}_3$ , $9\text{NH}_3$ .

Insol. in benzene. (Bamberger and Philip, B. 14. 2643)

$\text{AsI}_3$ ,  $4\text{NH}_3$  (Besson, C. R. 110. 1258.)

#### Arsenic nitride, $\text{AsN}$ .

Easily decomp. into As and N. (Hugot, C. R. 1904, 139. 56)

Decomp. by heat (Frau Fischer, B. 1910, 43. 1471.)

#### Arsenic suboxide, $\text{As}_2\text{O}$ (?)

Insol. in  $\text{H}_2\text{O}$ ; decomp. by dil. acids or  $\text{NH}_4\text{OH} + \text{Ag}$

Does not exist. (Geuther, A. 240. 208.)

#### Arsenic trioxide, $\text{As}_2\text{O}_3$ .

"White arsenic" exists in two modifications  $\alpha\text{As}_2\text{O}_3$ —crystalline, octahedral, opaque, porcelainous, etc.,  $\beta\text{As}_2\text{O}_3$ —amorphous, vitreous, "arsenic glass"

The data concerning the solubility of  $\text{As}_2\text{O}_3$  are very contradictory, the reasons being that (1) the solubility of the two modifications is different, (2) that the length of time necessary to effect solution differs in the two modifications; and (3) that there is a tendency of the amorphous  $\text{As}_2\text{O}_3$  to go over into the crystalline state during the process of solution.  $\alpha\text{As}_2\text{O}_3$  is also not easily moistened, especially when in a pulverulent condition, which is not the case with the  $\beta$  modification. (Winkler, J. pr (2) 31. 247.)

The older data are very unreliable, but possess a certain historical interest.

1 pt.  $\text{As}_2\text{O}_3$  is sol. in 1055 pts. (Wenzel), 11.34 pts. (Fischer); 11.88 pts. in  $\frac{1}{2}$  hour (Klaproth); 12.2 pts. (Bucholz); 15.0 pts. (Brandt, Bergmann); 10.0 pts. (Vogel); 24 pts. (Lamethière), 40 pts. (Pörner); 64 pts.

(Baumé), 80 pts. (Navier), 200 pts. (Aschof and Nasse, 1812), 640 pts. (Hagen, 1796) boiling  $\text{H}_2\text{O}$

1 pt.  $\alpha\text{As}_2\text{O}_3$  is sol. in 772 pts.  $\text{H}_2\text{O}$  if  $\alpha$ , or 9.33 pts. if  $\beta$  (Gubior), in 24 pts.  $\text{H}_2\text{O}$  if  $\alpha$ , or 21 pts. if  $\beta$  (Taylor).

Sol. in 53.3 pts.  $\text{H}_2\text{O}$  at  $15.75^\circ$ . (Abt)

Sol. in 30 pts.  $\text{H}_2\text{O}$ . (Nussebrook)

After the solution in  $\text{H}_2\text{O}$  at  $100^\circ$  has been left stand-

ing at ordinary temperatures—

1 pt.  $\alpha\text{As}_2\text{O}_3$  remains dissolved in 16 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and 20 pts.  $\text{H}_2\text{O}$  at  $7^\circ$  (Bucholz), in 83 pts.  $\text{H}_2\text{O}$  at  $7^\circ$  (Klaproth), in 38.45 pts.  $\text{H}_2\text{O}$  after 3 days, 55 pts.  $\text{H}_2\text{O}$  after 8 days, 64.50 pts.  $\text{H}_2\text{O}$  after 23 weeks at  $10^\circ$  (Fischer), in 33.52 pts. if  $\alpha\text{As}_2\text{O}_3$  was used, 55.03 pts. if  $\beta\text{As}_2\text{O}_3$  was used (Gubior); in 38 pts. if  $\alpha\text{As}_2\text{O}_3$  after 6 months, 53.71 pts. if  $\beta\text{As}_2\text{O}_3$  after 48 hours (Taylor).

When an excess of pulverized  $\text{As}_2\text{O}_3$  is left to digest for several days with cold  $\text{H}_2\text{O}$ —

1 pt. dissolves in 50 pts. (Bucholz), in 63 pts. (Fischer), in 80 pts. at  $15^\circ$  (Bergmann), in 80 pts. if  $\alpha$ , and 104 pts. if  $\beta$  (Gubior), 96 pts. at  $10^\circ$  (Spelman); 90 pts. at  $35.5^\circ$  (Hahnemann), 320 pts.  $\text{H}_2\text{O}$  at  $20^\circ$  (Aschof and Nasse, 1812)

$\text{H}_2\text{O}$  at  $15.6^\circ$  or below dissolves less than  $\frac{1}{2}\%$   $\alpha\text{As}_2\text{O}_3$ . (Dalton)

To dissolve 1 pt.  $\text{As}_2\text{O}_3$  in 12 pts.  $\text{H}_2\text{O}$ , it is necessary to boil an excess of  $\text{As}_2\text{O}_3$  with  $\text{H}_2\text{O}$ , if 1 pt.  $\text{As}_2\text{O}_3$  is boiled with 12 pts.  $\text{H}_2\text{O}$ , considerable remains undissolved, and even with 1 pt.  $\text{As}_2\text{O}_3$  to 50–80 pts.  $\text{H}_2\text{O}$  long continued boiling is necessary to effect solution.

If a clear solution saturated by long boiling with an excess of  $\text{As}_2\text{O}_3$  is poured off and evaporated continuously to  $\frac{1}{2}$  its original bulk, no  $\text{As}_2\text{O}_3$  separates out, and the solution contains 1 pt.  $\text{As}_2\text{O}_3$  to 6 pts.  $\text{H}_2\text{O}$ . (Fischer)

100 pts. aqueous solution of  $\beta\text{As}_2\text{O}_3$  sat. at  $15^\circ$  contain 0.96 pt.  $\alpha\text{As}_2\text{O}_3$ , and 9.68 pts. when sat. at  $100^\circ$ . (Gubior)

If 1 pt. pulverized  $\text{As}_2\text{O}_3$  be digested 10 days at  $10\text{--}25^\circ$  in 5–10 pts.  $\text{H}_2\text{O}$ , the solution contains 1 pt.  $\text{As}_2\text{O}_3$  to 50 pts.  $\text{H}_2\text{O}$ . A solution of same strength is obtained in 25 days by digesting 1 pt.  $\text{As}_2\text{O}_3$  in 40 pts.  $\text{H}_2\text{O}$ . If 1 pt.  $\text{As}_2\text{O}_3$  be immersed in 80 pts.  $\text{H}_2\text{O}$ , the resulting solution contains 1 pt.  $\text{As}_2\text{O}_3$  to 80 pts.  $\text{H}_2\text{O}$ ; if in 130 pts.  $\text{H}_2\text{O}$ , 1 pt.  $\text{As}_2\text{O}_3$  to 180 pts.  $\text{H}_2\text{O}$ ; if in 240 pts.  $\text{H}_2\text{O}$ , 1 pt.  $\text{As}_2\text{O}_3$  to 280 pts.  $\text{H}_2\text{O}$ ; if in 1000 pts.  $\text{H}_2\text{O}$ , 1 pt.  $\text{As}_2\text{O}_3$  to 1200 pts.  $\text{H}_2\text{O}$ ; and even when 1 pt.  $\text{As}_2\text{O}_3$  is digested at ordinary temperatures for several days with 10,000–100,000 pts.  $\text{H}_2\text{O}$ , a portion remains undissolved. Pulverized  $\alpha\text{As}_2\text{O}_3$  was set aside with  $\text{H}_2\text{O}$  in closed bottles for 18 years, when 1 pt.  $\text{As}_2\text{O}_3$  was present in 1000 pts.  $\text{H}_2\text{O}$ , a perfect solution was obtained, when 1 pt.  $\text{As}_2\text{O}_3$  in 100 pts.  $\text{H}_2\text{O}$ , 0.017%  $\text{As}_2\text{O}_3$  was undissolved; when 1 pt.  $\text{As}_2\text{O}_3$  in 35 pts.  $\text{H}_2\text{O}$ , 0.35%  $\alpha\text{As}_2\text{O}_3$  was undissolved, so that the solution contained 1 pt.  $\text{As}_2\text{O}_3$  to 54 pts.  $\text{H}_2\text{O}$ . (Gmelin)

Porcelainous modification ( $\alpha\text{As}_2\text{O}_3$ ) is much more sol. in  $\text{H}_2\text{O}$  than the vitreous ( $\beta\text{As}_2\text{O}_3$ ) 100 pts.  $\text{H}_2\text{O}$  at ordinary temperature dissolves 0.96 pt.  $\beta\text{As}_2\text{O}_3$  and 1.25 pts.  $\alpha\text{As}_2\text{O}_3$ , 100 pts. boiling  $\text{H}_2\text{O}$  dissolve 9.68 pts.  $\beta\text{As}_2\text{O}_3$  and 11.47 pts.  $\alpha\text{As}_2\text{O}_3$ ; and when the temperature of this solution has fallen to  $15^\circ$ , the solution from  $\beta\text{As}_2\text{O}_3$  retains 1.78 pts. and that from  $\alpha\text{As}_2\text{O}_3$  retains 2.9 pts. (Berzelius [not Gmelin])

$\beta\text{As}_2\text{O}_3$  dissolves more quickly and abundantly than  $\alpha\text{As}_2\text{O}_3$ . The same amount  $\text{H}_2\text{O}$  which will take up 36–38 pts.  $\beta\text{As}_2\text{O}_3$  at  $12\text{--}13^\circ$  will dissolve only 12–14 pts.  $\alpha\text{As}_2\text{O}_3$ , or 100 pts.  $\text{H}_2\text{O}$  dissolve 4 pts.  $\beta\text{As}_2\text{O}_3$  and 1.2–1.3 pts.  $\alpha\text{As}_2\text{O}_3$ . By long boiling with  $\text{H}_2\text{O}$ ,  $\alpha\text{As}_2\text{O}_3$  is converted into  $\beta\text{As}_2\text{O}_3$ , and thus acquires the solubility of the latter, so that 100 pts. boiling  $\text{H}_2\text{O}$  can take up 11 pts.  $\text{As}_2\text{O}_3$ . But at low temperature  $\beta\text{As}_2\text{O}_3$  is converted into  $\alpha\text{As}_2\text{O}_3$  when in contact with  $\text{H}_2\text{O}$ , so that the solution becomes weaker after a while, and retains only the proportion of  $\text{As}_2\text{O}_3$  corresponding to the solubility of  $\alpha\text{As}_2\text{O}_3$ . Communion, which hastens the rate of solubility of  $\alpha\text{As}_2\text{O}_3$  without increasing the amount dissolved, diminishes the solubility of  $\beta\text{As}_2\text{O}_3$ , as this is converted into  $\alpha\text{As}_2\text{O}_3$ .

by the friction or contact with  $H_2O$ .  $As_2O_3$ , which has been rendered opaque by  $NH_4OH$ , and that which has been crystallized from an aqueous solution, are equally sol. in  $H_2O$ . (Bussy, C. R. 24, 774, A. 64, 286.)

100 pts.  $H_2O$  dissolve 1.707 pts.  $\beta As_2O_3$  in  $2\frac{1}{2}$  years; 100 pts. boiling  $H_2O$  dissolve 11.46 pts.  $\beta As_2O_3$  in 3 hours, and 11.86 pts. in 12 hours, 10.14 pts.  $\alpha As_2O_3$  in 3 hours, and 10.18 pts. in 12 hours. (Rose, Ann. Phys. (1) 36, 494.)

A cold sat. solution which stood over excess of  $As_2O_3$  for 10 months at  $10-20^\circ$  contains 1.2%  $As_2O_3$ ; hot sat. solution a few days after saturation contains 2.25-2.50%  $As_2O_3$ . If trace of  $HCl$  is present, the solution contains 3.8%  $As_2O_3$ . Hot sat. solution of porcelain mod. of  $As_2O_3$  contains 4 days after saturation 2.4%  $As_2O_3$  at  $24^\circ$ ; after 82 days at  $14^\circ$ , 1.5%; after 4 months at  $12^\circ$ , 1.3%  $As_2O_3$ . (Bacalaglio, J. pr. 83, 111.)

According to later experiments, 1 pt.  $\alpha As_2O_3$  dissolves in 355 pts.  $H_2O$  in 1 day at  $15^\circ$ , while 1 pt.  $\beta As_2O_3$  dissolves in 108 pts.  $H_2O$  under the same conditions. 1 pt.  $\alpha As_2O_3$  dissolves in 46 pts.  $H_2O$ , if solution is prepared at  $100^\circ$ , and allowed to stand 24 hours at  $15^\circ$ , while 1 pt.  $\beta As_2O_3$  dissolves in 30 pts.  $H_2O$  under the same conditions. (Buchner, N. Rep. Pharm. 22, 265.)

100 pts.  $H_2O$  dissolve pts.  $\alpha As_2O_3$  and  $\beta As_2O_3$  at ordinary temperature:

Time	$\alpha As_2O_3$	$\beta As_2O_3$
1 hour	0.023	1.589
3 hours	0.088	2.356
6 hours	0.353	3.666
12 hours	0.364	3.361
24 hours	0.956	3.306
2 days	1.627	2.629
4 days	1.814	2.429
1 week	1.673	1.763
3 weeks	1.776	1.713
$2\frac{1}{4}$ years	1.712	1.707

In the solution of  $\beta As_2O_3$ , octahedral crystals were deposited on the sides of the vessel after 12 hours, which continued to increase. There was no such deposit in the case of  $\alpha As_2O_3$ .

From the maxima in the above table, 100 pts.  $H_2O$  can dissolve 3.7 pts.  $\beta As_2O_3$  and 1.7 pts.  $\alpha As_2O_3$  at ordinary temperature.

100 pts. boiling  $H_2O$  dissolve 11.46 pts.  $\beta As_2O_3$  and 10.140 pts.  $\alpha As_2O_3$  in 3 hours; 11.86 pts.  $\beta As_2O_3$  and 10.176 pts.  $\alpha As_2O_3$  in 12 hours. (Cl. Winkler, J. pr. (2) 31, 247.)

100 pts.  $H_2O$  dissolve 1.75 pts. of a third modification (hexagonal crystalline) at ordinary temperature, and 2.75 pts. at  $100^\circ$ . (Claudet, Chem. Soc. (2) 6, 179.)

$\beta As_2O_3$  dissolves more rapidly in  $HCl + Aq$  than  $\alpha As_2O_3$ . (Schultz-Sellac, B. 4, 109.)

While 100 cem.  $H_2O$  dissolve 0.8507 g.  $\beta As_2O_3$  at  $18.5^\circ$ , 100 cem.  $H_2O$  containing 4.3195 g.  $HCl$  dissolve 1.1513 g.  $\beta As_2O_3$ ; containing 6.09 g.  $HCl$ , 1.2724 g.  $\beta As_2O_3$ . (Chodounsky, Lusty Chemické, 13, 114.)

100 cem.  $H_2O$  dissolve 1.495 g.  $As_2O_3$  at  $15^\circ$ . (Wood, Chem. Soc. 1908, 93, 412.)

Solubility of crystalline  $As_2O_3$  in  $H_2O$ .

1 l. of the sat. solution contains at:

$2^\circ$      $15^\circ$      $25^\circ$      $39.8^\circ$     bpt.  
12.006 16.566 20.384 29.302 60.4 g.  $As_2O_3$   
(Bruner, Z. anorg. 1903, 37, 456.)

Much more easily sol. in many acids than in  $H_2O$ . Easily sol. in fuming  $H_2SO_4$ . (Schultz-Sellac.)

100 pts. dilute  $H_2SO_4 + Aq$  of various strengths dissolve at  $1^\circ$ .

$t^\circ$	Pts. $\beta As_2O_3$	$t^\circ$	Pts. $\beta As_2O_3$	Ratios of amts. dissolved at $80^\circ$ 18.5°
80°	1.0195	18.5°	0.5422	1.88 : 1
	1.3664		0.7203	1.89 : 1
	1.1933		0.6522	1.84 : 1

(Chodounsky, l.c.)

Decomp. by  $HNO_3$  or aqua regia into  $As_2O_5$ . Sol. in  $H_3PO_4 + Aq$ . (Bergman.)

More sol. in  $HCl + Aq$  than in  $H_2SO_4$ , or  $HNO_3 + Aq$ , and still less in  $HCl + H_2O_2 + Aq$ . Solubility in  $HCl + Aq$ .

Conc. of $HCl + Aq$	Grams of $As_2O_3$ per 100 cc. of solution
0.46N	1.52
0.98N	1.41
2.03N	1.17
3.13N	1.11
3.81N	1.13
5.32N	2.20
6.50N	5.11
7.85N	12.28
9.17N	18.16

As the concentration of the acid increases, the solubility of the oxide decreases, a minimum being reached when the concentration of the solvent is about 3.2N. Beyond this point, an increase in the concentration of the solvent leads to a corresponding increase in the solubility. (Wood, Chem. Soc. 1908, 93, 413.)

Insol. in liquid  $CO_2$ . (Büchner, Z. phys. Ch. 1906, 54, 674.)

Easily sol. in cold  $H_2C_2O_4 + Aq$ . (Bergman.)

When pulverized, it dissolves in hot  $H_2C_2O_4 + Aq$ , but separates out on cooling.

Easily sol. in hot benzoic acid +  $Aq$ .

Sol. in tartaric acid +  $Aq$ .

Easily sol. in alkali hydrates, or carbonates +  $Aq$ .

Easily sol. in  $\text{NH}_4$  arsenite + Aq at  $70-80^\circ$ , crystallizing out on cooling. (Berzelius.)

Sol. in hot  $\text{K}_2\text{C}_2\text{O}_4$  + Aq.

Sol. in  $\text{AsCl}_3$ . (Penney and Wallace.)

More sol. in  $\text{Na}_2\text{B}_4\text{O}_7$  + Aq than in  $\text{H}_2\text{O}$

Very sl. sol. in absolute alcohol (Vogel)

Sol. in 80 pts. highly rectified spirit (Wenzel.)

When 1 pt. powdered  $\text{As}_2\text{O}_3$  is digested 30 days in 10-40 pts. alcohol, a solution is formed containing 1 pt.  $\text{As}_2\text{O}_3$  to 80 pts. alcohol, when 1 pt.  $\text{As}_2\text{O}_3$  is digested with 80-150 pts. alcohol, a solution is formed containing 1 pt.  $\text{As}_2\text{O}_3$  to 124-140 pts. alcohol. (Fischer)

Sol. in 70-80 pts. alcohol (Thompson.)

Alcohol dissolves 0.446 pt.  $\beta\text{As}_2\text{O}_3$ . (Rose, A. Phys. (1) 52. 455.)

100 pts. alcohol dissolve pts.  $\text{As}_2\text{O}_3$ :

Vol % of alcohol	$\alpha\text{As}_2\text{O}_3$ at $15^\circ$	$\alpha\text{As}_2\text{O}_3$ at $15^\circ$ of alcohol	$\beta\text{As}_2\text{O}_3$ at $15^\circ$
56	1 680	4 895	0 504
79	1 430	4 551	0 540
84			0 565
86	0 715	3 197	
88			0.717
100	0 025	3 402	1 060

(Girardin, J. Pharm. (3) 46. 269.)

100 pts. absolute alcohol dissolve 0.446 pt.  $\beta\text{As}_2\text{O}_3$  in  $2\frac{1}{2}$  years (Winkler, J. pr (2) 31. 347.)

Nearly insol. in ether

100 pts. ether dissolve 0.454 pt.  $\beta\text{As}_2\text{O}_3$ . (Winkler.)

Ether extracts 1 mg.  $\text{As}_2\text{O}_3$  from sat.  $\text{As}_2\text{O}_3$  + Aq for every 15 cc. ether used, less is extracted when the solution is acidified with  $\text{HCl}$ , and almost none if acidified with  $\text{H}_2\text{SO}_4$  or  $\text{H}_2\text{C}_2\text{O}_4$ . (Selm, B. 13. 206.)

$\alpha\text{As}_2\text{O}_3$  is sol. in 50 pts. boiling nitrobenzol  $\beta\text{As}_2\text{O}_3$  is insol. in boiling nitrobenzol (Auerbach, Z. anorg. 1903, 37. 353)

$\beta\text{As}_2\text{O}_3$  dissolves in oil of turpentine, but  $\alpha\text{As}_2\text{O}_3$  is insol. therein.  $\alpha\text{As}_2\text{O}_3$  is very sl. sol. in benzene or petroleum ether, but more sol. in methyl alcohol, ethyl alcohol, ether, or chloroform. (Selm.)

100 pts.  $\text{CS}_2$  dissolve 0.001 pt.  $\beta\text{As}_2\text{O}_3$  in  $2\frac{1}{2}$  years. (Winkler.)

Sl. sol. in the fatty oils.

1000 pts. castor-oil dissolve 1.33 pts.  $\text{As}_2\text{O}_3$  at ordinary temperature, and 9 pts. at boiling temperature. 1000 pts. other oils dissolve 0.6-0.8 pt.  $\text{As}_2\text{O}_3$  in the cold, and about 1.7 pts. on boiling. (Berzelius.)

Insol. in chinoline or amline. (Hoffmann, A. ch. (3) 9. 143, 169.)

Moderately sol. in chinolin. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329), (Edmann, C. C. 1899, II. 1014.)

Sol. in amyl alcohol and is divided between it and  $\text{H}_2\text{O}$  in the constant ratio of 1 : 5.47 at  $25^\circ$ . (Auerbach, Z. anorg. 1903, 37. 376.)

Min. *Arsenolite*.

**Arsenic trioxide pentoxide**,  $3\text{As}_2\text{O}_5$ ,  $2\text{As}_2\text{O}_3$  +  $3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Joly, C. R. 100. 1221.)

$2\text{As}_2\text{O}_5$ ,  $\text{As}_2\text{O}_3$  +  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Joly.)

$\text{As}_2\text{O}_3$ ,  $\text{As}_2\text{O}_5$  +  $\text{H}_2\text{O}$ . (Joly.)

**Arsenic tetroxide**,  $\text{As}_2\text{O}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$  from which it is partially pptd. by alcohol. More easily sol. in alkali carbonates or  $\text{HCl}$  + Aq. Most easily sol. in  $\text{NaOH}$  or  $\text{KOH}$  + Aq. (Heibst, Dissert. 1894.)

**Arsenic pentoxide**,  $\text{As}_2\text{O}_5$

Deliquescent in moist air; slowly sol. in  $\text{H}_2\text{O}$ , forming  $\text{H}_3\text{AsO}_4$ , which see. Easily sol. in alcohol, much more sol. in alcohol than  $\text{As}_2\text{O}_3$ . Very sl. sol. in the fatty oils, 100 pts. of oil dissolving 0.2 pt.  $\text{As}_2\text{O}_5$  in the cold, and 1 pt. with partial decomp. on boiling. (Berzelius.)

1000 pts. boiling poppy-oil dissolve 27 pts.  $\text{As}_2\text{O}_5$ ; 1000 pts. boiling castor-oil dissolve 34 pts.  $\text{As}_2\text{O}_5$ . (Hempel and Grundner.)

+  $4\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{H}_3\text{AsO}_4$ in 100 pts. solution	$t^\circ$	Pts $\text{H}_3\text{AsO}_4$ in 100 pts. solution
$-55^\circ$	69.9	$-5^\circ$	80.0
$-50$	70.9	0	81.0
$-45$	71.9	+5	82.1
$-40$	72.9	10	83.3
$-35$	73.9	15	84.7
$-30$	74.9	20	86.3
$-25$	75.9	25	88.0
$-20$	76.9	30	90.1
$-15$	77.9	35	92.8
$-10$	78.9		

(Menzies and Potter, J. Am. Chem. Soc. 1912, 34. 1464.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{H}_3\text{AsO}_4$ in 100 pts. of solution
+ $10^\circ$	88.4
20	89.1
30	89.8
40	90.5
50	91.2
60	91.9
70	92.6
80	93.2
90	93.8
100	94.4
110	95.0
120	95.6
130	96.2
140	96.8

(Menzies and Potter, J. Am. Chem. Soc. 1912, 34. 1464.)

$As_2O_3 + 4H_2O$  and  $3As_2O_3 + 5H_2O$  are the only hydrates that can be isolated (Menzies and Potter.)

See also Arsenic Acid.

**Arsenic trioxide, with alkali haloid.**

See Arsenite, alkali haloid.

**Arsenic sulphur trioxide,  $As_2O_3, SO_2$**

Deliquescent, decomp. by  $H_2O$ . (Adie, Chem. Soc. 55, 157.)

$As_2O_3, 2SO_2$ . As above (Adie)

$As_2O_3, 3SO_2$ . (Weber, B. 19, 3186.)

$As_2O_3, 4SO_2$ . As above (Adie.)

$As_2O_3, 6SO_2$ . (Weber)

$As_2O_3, 8SO_2$ . As above. (Adie.)

**Arsenic oxychloride, etc.**

See Arsenyl chloride, etc

**Arsenic phosphide,  $AsP$ .**

Decomp. by  $H_2O$ . Not attacked by cold  $H_2SO_4$  or  $HCl$ , and only sl. sol. therein on warming. Easily decomp. by  $HNO_3$ ,  $KOH$ ,  $NaOH$ ,  $BaO_2H_2 + Aq$ . Insol. in alcohol, ether, chloroform, sl. sol. in  $CS_2$ .

$P_2As_2O_2$ . Product of action of  $H_2O$  on above compound, which it resembles (Janowsky, B. 6, 216.)

**Arsenic monoselenide,  $As_2Se$**

Insol. in most organic and inorganic solvents. Sol. very slowly in conc.  $HCl$  and  $H_2SO_4$ . Sol. in boiling alkali hydroxides +  $Aq$  (Szarvasy, B. 1897, 30, 1245)

**Arsenic triselenide,  $As_2S_3$**

Partially sol. in  $KOH + Aq$  if boiled with it for a long time. (Uelsmann, A. 116, 123)

**Arsenic pentaselenide,  $As_2Se_5$**

Insol. in most solvents, as conc.  $HCl$ . Sol. in alkali hydrates and sulpho-hydrates +  $Aq$  (Szarvasy, B. 1895, 28, 2855-2856)

Insol. in  $H_2O$ , in dil. acids and in conc.  $HCl$ . Sl. sol. in warm  $HNO_3 + Aq$ . Oxidized by cold fuming  $HNO_3$ . Sol. in alkalis and in hot alkali carbonates +  $Aq$ . Insol. in alcohol, ether,  $CS_2$ , etc (Clever, Z. anorg. 1895, 10, 129.)

**Arsenic selenosulphide.**

See Arsenic sulphoselenide.

**Arsenic sulphide,  $As_2S$**

Ppt. Insol. in  $NH_4OH$  or in colorless  $(NH_4)_2S + Aq$ . Sol. in yellow  $NH_4SH + Aq$ . (Scott, Chem. Soc. 1900, 77, 652.)

**Arsenic disulphide,  $As_2S_2$**

Min. Realgar. Difficultly sol. in alkali sulphides +  $Aq$ . Partly dissolved by  $KOH + Aq$  with decomposition. Sol. at  $150^\circ$  in a sealed tube in  $NaHCO_3 + Aq$ , and crystallizes out on cooling. (Senarmont, A. ch. (3) 32, 158)

**Arsenic trisulphide,  $As_2S_3$**

Insol. in  $H_2O$  when prepared in the dry way, but when prepared moist is very liable to go into the colloidal modification mentioned below. Insol. in  $H_2O$  containing  $H_2SO_4$ ,  $HNO_3$ ,  $HCl$ ,  $H_2C_2O_4$ ,  $HC_2H_3O_2$ ,  $H_2C_4H_4O_6$ ,  $CO_2$ ,  $NH_4Cl$ ,  $KNO_3$ ,  $(NH_4)_2SO_4$ ,  $MgSO_4$ . (Bontigny)

Insol. in  $H_2O$ . Traces are dissolved by  $H_2S + Aq$ . Sl. decomp. by boiling with  $H_2O$ , or long contact with cold  $H_2O$ . (Fresenius)

1 l  $H_2O$  dissolves  $2.1 \times 10^{-6}$  mols pptd.  $As_2S_3$  at  $18^\circ$  (Weigel, Z. phys. Ch. 1907, 58, 294)

Insol. in dil. acids. Insol. in cold, and scarcely attacked by hot conc.  $HCl + Aq$ .

Easily decomp. by  $HNO_3$  or aqua regia

Easily sol. in cold  $KOH$ ,  $NaOH$ , or  $NH_4OH + Aq$ , also in alkali carbonates, or sulphates +  $Aq$ .

Sol. in hot  $KHSO_3 + Aq$ .

Sol. in citric acid, and alkali citrates +  $Aq$ . (Spiller)

Slowly sol. in cold 2%  $Na_2B_4O_7 + Aq$ . Easily sol. on heating (Materne, C. C. 1906, II 557.)

Insol. in  $CS_2$

Min. Orpiment

$As_2S_3$  may also be obtained in a colloidal form, sol. in  $H_2O$ . Sat. solution contains 34.46%  $As_2S_3$ , it is decomp. by standing, but may be boiled without undergoing decomposition, most acids and many salts ppt.  $As_2S_3$  (Schulze, J. pr. (2) 25, 431)

The following solutions cause pptn. of  $As_2S_3$  in a solution of the colloidal modification, when added in the given state of dilution—

$HCl + Aq$	1 : 555
$HNO_3 + Aq$	1 : 276
$H_2SO_4 + Aq$	1 : 255
$H_2S_2O_7 + Aq$	1 : 138
$H_2C_2O_4 + Aq$	1 : 65
$H_3PO_4 + Aq$	1 : 26
$HC_2H_3O_2 + Aq$	1 : 0 18
$K_2SO_4 + Aq$	1 : 76
$Na_2SO_4 + Aq$	1 : 129
$(NH_4)_2SO_4 + Aq$	1 : 188
$CaSO_4 + Aq$	1 : 2780
$MgSO_4 + Aq$	1 : 2630
$ZnSO_4 + Aq$	1 : 3330
$MnSO_4 + Aq$	1 : 2860
$Na_2SO_4 + Aq$	1 : 3440
$FeSO_4 + Aq$	1 : 2380
$Al_2(SO_4)_3 + Aq$	1 : 52000
$Tl_2SO_4 + Aq$	1 : 799
$KCl + Aq$	1 : 137
$KBr + Aq$	1 : 103
$KI + Aq$	1 : 55
$LiI + Aq$	1 : 127
$NaCl + Aq$	1 : 212
$NH_4Cl + Aq$	1 : 207
$BaCl_2 + Aq$	1 : 2880
$CaCl_2 + Aq$	1 : 4370
$MgCl_2 + Aq$	1 : 10000

$\text{FeCl}_3 + \text{Aq}$	1 · 50000
$\text{AlCl}_3 + \text{Aq}$	1 · 83000
$\text{CrCl}_3 + \text{Aq}$	1 · 20000
$\text{KNO}_3 + \text{Aq}$	1 · 84
$\text{NaNO}_3 + \text{Aq}$	1 · 117
$\text{NH}_4\text{NO}_3 + \text{Aq}$	1 · 138
$\text{Ba(NO}_3)_2 + \text{Aq}$	1 · 2080
$\text{KClO}_4 + \text{Aq}$	1 · 88
$\text{CaH}_2(\text{CO}_3)_2 + \text{Aq}$	1 · 3120
$\text{K}_2\text{C}_2\text{H}_3\text{O}_5 + \text{Aq}$	1 · 85
$\text{K}_2\text{C}_2\text{O}_4 + \text{Aq}$	1 · 81
$\text{NaC}_2\text{H}_3\text{O}_5 + \text{Aq}$	1 · 78
$\text{Urea} + \text{Aq}$	1 · 25
$(\text{NH}_4)_2\text{Fe(SO}_4)_2 + \text{Aq}$	1 · 1160
$\text{K}_2\text{Al}_2(\text{SO}_4)_4 + \text{Aq}$	1 · 50000
$\text{K}_2\text{Fe}_2(\text{SO}_4)_4 + \text{Aq}$	1 · 55500
$\text{K}_2\text{Cr}_2(\text{SO}_4)_4 + \text{Aq}$	1 · 25000
$\text{K}_3\text{Fe(CN)}_6 + \text{Aq}$	1 · 67
$\text{K}_3\text{Fe(CN)}_6 + \text{Aq}$	1 · 81

Cold conc. solutions of boric, arsenous, tartaric, benzoic, and salicylic acids, also cane sugar, or chloral hydrate cause no pptn. Absolute alcohol and glycerine may also be mixed with the solutions without causing pptn. (Schulze, J. pr. (2) 25. 442.)

+6H<sub>2</sub>O, decomp. completely into As<sub>2</sub>S<sub>3</sub> under a pressure of 6000 to 7000 atmos (Spring, Z. anorg. 1895, 10. 186.)

#### Arsenic pentasulphide, As<sub>2</sub>S<sub>5</sub>

Insol. in H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH, KOH, NaOH + Aq., and solutions of alkali sulphides and carbonates. Sol. in BaO<sub>2</sub>H<sub>2</sub>, and CaO<sub>2</sub>H<sub>2</sub> + Aq.

Sol. in citric acid, and alkali citrates + Aq. (Spiller)

Alcohol dissolves out S on boiling. (Berzelius.)

Sol. in alkali arsenates + Aq (Nilson, J. pr. (2) 14. 155)

+H<sub>2</sub>O (Nilson, l.c.)

#### Arsenic trisulphide, with M<sub>2</sub>S.

See Sulpharsenites, M.

#### Arsenic pentasulphide, with M<sub>2</sub>S.

See Sulpharsenates, M.

#### Arsenic sulphobromide, AsS<sub>2</sub>Br<sub>2</sub> = AsSBr + SBr<sub>2</sub>

Decomp. by H<sub>2</sub>O. (Haunay, Chem Soc. 33. 284.)

#### Arsenic sulphochloride, As<sub>2</sub>S<sub>2</sub>Cl.

Slowly decomp. by boiling H<sub>2</sub>O. Sol. in hot AsCl<sub>3</sub> without decomp. (Ouvraud, C. R. 116. 1516.)

AsS<sub>2</sub>Cl. Decomp. by H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH, and alkali carbonates + Aq. (Ouvraud.)

AsS<sub>2</sub>Cl. Slowly decomp. by boiling H<sub>2</sub>O. Sol. in alkali carbonates and in NH<sub>4</sub>OH + Aq (Ouvraud, C. R. 1893, 116. 1517)

#### Arsenic sulphoiodide, AsSI

Insol. in alcohol, chloroform or carbon disulphide. (Schneider, J. pr. (2) 23. 486.)

Formula is probably As<sub>2</sub>S<sub>2</sub>, AsI<sub>2</sub>.

Slowly attacked by HCl + Aq., somewhat more easily by HNO<sub>3</sub> + Aq. Easily sol. in KOH, or NH<sub>4</sub>OH + Aq. (Schneider, J. pr. (2) 34. 505)

2AsI<sub>2</sub>, SI<sub>4</sub>. Decomp. on air (Schneider, J. pr. (2) 36. 509)

As<sub>2</sub>SI<sub>2</sub>. Less sol. in CS<sub>2</sub> than AsI<sub>3</sub>. (Ouvraud, C. R. 117. 107.)

As<sub>2</sub>SI<sub>4</sub> (Ouvraud)

See also Arsenyl sulphoiodide.

#### Arsenic sulphoselenide, As<sub>2</sub>SeS<sub>2</sub>

Easily sol. in cold NH<sub>4</sub>SH + Aq. Nearly completely sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq (v. Gerichten, B. 7. 29)

As<sub>2</sub>SeS<sub>2</sub>. More difficultly sol. than the preceding comp. in NH<sub>4</sub>SH + Aq. (v. Gerichten)

As<sub>2</sub>SeS<sub>2</sub>. Sp. gr. = 6.402 at ca. 75°.

Insol. in most solvents. Easily sol. in alkali hydroxides and sulphides + Aq. (Szarvasy, B. 1895, 28. 2661)

As<sub>2</sub>SeS<sub>2</sub>. Sp. gr. = 11.35 at 550-600°

Insol. in most solvents. Easily sol. in alkali hydroxides and sulphides + Aq. (Szarvasy, B. 1895, 28. 2659)

#### Arsenic telluride, As<sub>2</sub>Te.

Sol. in HNO<sub>3</sub> and HNO<sub>3</sub> + HCl + Aq. (Oppenheim, J. pr. 71. 266)

As<sub>2</sub>Te<sub>3</sub>. As above (Oppenheim.)

#### Arsenic acid, anhydrous, As<sub>2</sub>O<sub>3</sub>.

See Arsenic pentoxide.

#### Metaarsenic acid, HAsO<sub>3</sub>.

Slowly sol. in cold, quite easily sol. in hot H<sub>2</sub>O, with considerable evolution of heat, and conversion into H<sub>2</sub>AsO<sub>4</sub>. (Kopp, A. ch. (3) 48. 196)

#### Orthoarsenic acid, H<sub>2</sub>AsO<sub>4</sub>

Sol. in H<sub>2</sub>O, with absorption of heat  
1 pt. As<sub>2</sub>O<sub>3</sub> dissolves in 0.405 pt. H<sub>2</sub>O at 12.5°, or 100 pts. H<sub>2</sub>O dissolve 244.81 pts. As<sub>2</sub>O<sub>3</sub> at 12.5° (Vogel)

Sol. in 0.5 pt. H<sub>2</sub>O (Thénard.)

Sol. in 6 pts. cold H<sub>2</sub>O, and more quickly in 2 pts. hot H<sub>2</sub>O. (Bucholz)

100 pts. H<sub>2</sub>O at 15.56° dissolve 150 pts. As<sub>2</sub>O<sub>3</sub>. (Ure's Dict.)

H<sub>2</sub>AsO<sub>4</sub> + Aq sat. at 15° contains 15% As<sub>2</sub>O<sub>3</sub>

Sp. gr. of H<sub>2</sub>AsO<sub>4</sub> + Aq at 15°  $a = \text{sp. gr. if } \% \text{ is As}_2\text{O}_3, b = \text{sp. gr. if } \% \text{ is H}_2\text{AsO}_4$

%	a	b	%	a	b
5	1.042	1.0337	45	1.540	1.3973
10	1.085	1.0690	50	1.635	1.4617
15	1.134	1.1061	55	1.742	1.5320
20	1.187	1.1457	60		1.6086
25	1.245	1.1852	65		1.6919
30	1.306	1.2342	70		1.7827
35	1.378	1.2840	75		
40	1.453	1.3382			

(Schiff, A. 113. 183, calculated by Gerlach, Z. anal. 27. 303.)

Sp. gr. of  $H_3AsO_4 + Aq$  at  $15^\circ$ .  $a =$  sp. gr. if % is  $As_2O_5$ ;  $b =$  sp. gr. if % is  $H_3AsO_4$ .

%	a	b	%	a	b
1	1.008	1.006	47	1.564	1.412
2	1.016	1.013	48	1.582	1.425
3	1.023	1.019	49	1.601	1.437
4	1.031	1.026	50	1.620	1.450
5	1.039	1.032	51	1.642	1.464
6	1.048	1.039	52	1.663	1.478
7	1.057	1.046	53	1.685	1.491
8	1.065	1.052	54	1.706	1.505
9	1.074	1.059	55	1.728	1.519
10	1.083	1.066	56	1.752	1.534
11	1.092	1.073	57	1.777	1.549
12	1.102	1.081	58	1.801	1.564
13	1.111	1.088	59	1.825	1.579
14	1.121	1.096	60	1.850	1.594
15	1.130	1.103	61	1.880	1.610
16	1.140	1.111	62	1.910	1.626
17	1.150	1.119	63	1.940	1.643
18	1.160	1.126	64	1.970	1.659
19	1.170	1.134	65	2.000	1.675
20	1.180	1.142	66	2.030	1.693
21	1.191	1.150	67	2.060	1.712
22	1.203	1.158	68	2.090	1.730
23	1.214	1.167	69	2.120	1.749
24	1.226	1.175	70	2.150	1.767
25	1.237	1.183	71		1.788
26	1.249	1.192	72		1.809
27	1.261	1.201	73		1.830
28	1.274	1.210	74		1.851
29	1.286	1.219	75		1.872
30	1.298	1.228	76	..	1.897
31	1.312	1.238	77	...	1.921
32	1.325	1.248	78		1.946
33	1.339	1.257	79		1.970
34	1.352	1.267	80		1.995
35	1.366	1.277	81		2.020
36	1.381	1.288	82		2.045
37	1.396	1.299	83		2.070
38	1.411	1.309	84	...	2.095
39	1.426	1.320	85		2.120
40	1.441	1.331	86		2.149
41	1.458	1.342	87	..	2.178
42	1.475	1.353	88		2.207
43	1.492	1.366	89	..	2.236
44	1.509	1.376	90	..	2.265
45	1.526	1.387	91	...	2.295
46	1.545	1.400			

(Kopp, calculated by Gerlach, Z. anal. 27. 316)

See also Arsenic pentoxide.

### Pyroarsenic acid, $H_4As_2O_7$ .

Very deliquescent; easily sol in  $H_2O$  with evolution of much heat, and conversion into  $H_2AsO_4$ .

### Arsenates.

Arsenates of the alkali metals, and acid arsenates of the alkaline-earth metals are sol in  $H_2O$ . Neutral and basic arsenates are easily sol. in mineral acids, including  $H_2AsO_4$ ;

less sol in  $HCl + Aq$ . The neutral alkaline-earth arsenates are less sol in  $NH_4OH + Aq$  than in  $H_2O$ , but more sol. in  $NH_4Cl + Aq$  (Field). The alkali arsenates are sol. in hot glycerine (Lefèvre, C R 108. 1058.)

### Aluminum arsenate, $Al_2(AsO_4)_3$ .

Ppt Insol. in  $H_2O$ , difficultly sol. in acids. (Colman, C R 103. 273)

Insol in acetone (Naumann, B. 1904, 37. 4328.)

$2Al_2O_3, 3As_2O_5$ . Nearly unattacked by boiling  $H_2O$ ; sol in dil. acids. (Lefèvre, A. ch. (6) 27. 5.)

### Aluminum potassium arsenate, $2Al_2O_3, 3K_2O, 3As_2O_5$ .

(Lefèvre.)

### Aluminum sodium arsenate, $2Al_2O_3, 3Na_2O, 3As_2O_5$ .

(Lefèvre.)

### Ammonium arsenate, $(NH_4)_2AsO_4 + 3H_2O$ .

Difficultly sol. in  $H_2O$ . Less sol. in  $H_2O$  than  $(NH_4)_2HAsO_4$  (Mitscherlich.)

Insol in liquid  $NH_3$ . (Franklin, Am. Ch J. 1898, 20. 826.)

### Ammonium hydrogen arsenate, $(NH_4)_2HAsO_4$ .

Effloresces, giving off  $NH_3$ ; more sol. in  $H_2O$  than  $(NH_4)_2AsO_4$ . (Salkowsky, J. pr. 104. 129)

Insol in acetone (Eidmann, C. C. 1899, II. 1014)

### Ammonium dihydrogen arsenate, $NH_4H_2AsO_4$ .

Not efflorescent. Very sol. in  $H_2O$

### Ammonium barium arsenate, $NH_4BaAsO_4 + \frac{1}{2}H_2O$ .

Sol. by 10 days' contact in 1391 pts  $H_2O$ ; in 18,832 pts of a mixture of 1 pt.  $NH_4OH + Aq$  and 3 pts  $H_2O$ ; in 227 pts of a solution of 1 pt  $NH_4Cl$  in 10 pts.  $H_2O$ , and in 2169 pts of a solution of 1 pt.  $NH_4Cl$  in 10 pts.  $NH_4OH + Aq$  and 60 pts  $H_2O$ . (Lefèvre, A. ch. 1892, (6) 27. 13)

$(NH_4)_2BaH_2(AsO_4)_2$ . Efflorescent. Insol. in  $H_2O$ , easily sol. in dil.  $HNO_3 + Aq$  (Baumann, Arch. Pharm. 36. 36.)

### Ammonium calcium arsenate, $NH_4CaAsO_4 + \frac{1}{2}H_2O$ .

1000 pts. pure  $H_2O$  dissolve 0.20 pt. thus salt; 1000 pts.  $NH_4Cl + Aq$  (containing 50 pts.  $NH_4Cl$ ) dissolve 4.15 pts this salt; 900 pts.  $H_2O + 100$  pts  $NH_4OH$  (sp. gr = 0.880) dissolve 0.01 pt this salt. (Field, Chem. Soc. 11. 6)

Soluble by 10 days' contact in 2167 pts.  $H_2O$  at  $15^\circ$ ; in 381 pts.  $NH_4Cl + Aq$  (1:7); in

43478 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 : 3); in 10570 pts.  $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH} + \text{Aq}$  (1 : 10 : 60) (Lefèvre, A. ch. 1892, (6) 27. 13.)

+6 $\text{H}_2\text{O}$ . Sol. in hot, very al sol. in cold  $\text{H}_2\text{O}$ , sl. sol. in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$  (Wach, Schw. J. 12. 285)

+7 $\text{H}_2\text{O}$  (Bloxam, C. N. 54. 163)

$(\text{NH}_4)_2\text{CaH}_2(\text{AsO}_4)_2$ . Efflorescent. Insol. in  $\text{H}_2\text{O}$ , easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$  (Bau-  
mann, Arch. Pharm. 36. 36)

$(\text{NH}_4)_2\text{CaH}_2(\text{AsO}_4)_2 + 3\text{H}_2\text{O}$

$(\text{NH}_4)_2\text{CaH}_2(\text{AsO}_4)_2 + 3\text{H}_2\text{O}$ . (Bloxam, C. N. 54. 163)

Ammonium glucinum arsenate,  $\text{NH}_4\text{GlaAsO}_4$   
+4 $\frac{1}{2}\text{H}_2\text{O}$ .

More stable than the corresponding potassium salt. (Bleyer, Z. anorg. 1912, 75. 291)

Ammonium iron (ferrie) dihydrogen arsenate,  
 $\text{NH}_4\text{H}_2\text{AsO}_4$ ,  $\text{FeAsO}_4$

Hydrolyzed by  $\text{H}_2\text{O}$ .

Sol. in cold conc.  $\text{HCl}$ , hot  $\text{HNO}_3$ , hot dil.  $\text{H}_2\text{SO}_4$ , and in hot arsenic acid +  $\text{Aq}$  containing 75% arsenic pentoxide.

Sol. in hot conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . Completely hydrolyzed by caustic alkalis.

Insol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$  and in 50% acetic acid (Curtman, J. Am. Chem. Soc. 1910, 32. 628.)

Ammonium magnesium arsenate,  
 $\text{NH}_4\text{MgAsO}_4$

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in acids.

Anhydrous salt is sol. in 2784 pts.  $\text{H}_2\text{O}$  at 15°; in 15,904 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 : 3) (0.96 sp. gr.); in 1386 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 : 70); in 8867 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 : 7), in 3014 pts.  $\text{NH}_4\text{Cl}$  (1 pt.) +  $\text{NH}_4\text{OH}$  (0.96 sp. gr.) (10 pts.) +  $\text{Aq}$  (60 pts.); in 32,827 pts. magnesia mixture (Fresenius, Z. anal. 3. 206.)

Anhydrous salt is sol. in 4389 pts.  $\text{NH}_4\text{NO}_3$  +  $\text{Aq}$  (1 : 50), in 2561.5 pts.  $\text{KCl} + \text{Aq}$  (1 : 165); in 1422 pts. ammoniacal solution of 3.5 g. tartaric acid in 250 cc.  $\text{H}_2\text{O}$ , in 933.5 pts. ammoniacal solution of 2.5 g. citric acid in 250 cc.  $\text{H}_2\text{O}$ . (Pulle, Z. anal. 10. 62.)

+ $\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in 2656 pts.  $\text{H}_2\text{O}$  at 15°; in 15,038 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 : 3) (0.96 sp. gr.); in 844 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 : 7), in 1315 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 : 70); in 2871 pts.  $\text{NH}_4\text{Cl}$  (1 pt.) +  $\text{NH}_4\text{OH}$  (0.96 sp. gr.) (10 pts.) +  $\text{Aq}$  (60 pts.). (Fresenius)

1000 pts. pure  $\text{H}_2\text{O}$  dissolve 0.14 pt. salt; 1000 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (containing 100 pts.  $\text{NH}_4\text{Cl}$ ) dissolve 0.95 pt. salt; 900 pts.  $\text{H}_2\text{O}$  + 100 pts.  $\text{NH}_4\text{OH}$  (sp. gr. 0.880) dissolve 0.07 pt. salt. (Field, Chem. Soc. 11. 6.)

+6 $\text{H}_2\text{O}$ . Sl. efflorescent. Sl. sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$

Solubility of  $\text{NH}_4\text{MgAsO}_4 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  and  $\text{NH}_4$  salts +  $\text{Aq}$ .

Grams salt dissolved in 100 g. solvent

t°	$\text{H}_2\text{O}$	5% $\text{NH}_4\text{NO}_3 + \text{Aq}$	5% $\text{NH}_4\text{Cl} + \text{Aq}$	$\text{NH}_4\text{OH} + \text{Aq}$ (1 pt. $\text{NH}_4\text{OH} + \text{Aq}$ (0.96) + 4 pts. $\text{H}_2\text{O}$ )	4% $\text{NH}_4\text{OH} + \text{Aq}$ + 5% $\text{NH}_4\text{Cl} + \text{Aq}$	4% $\text{NH}_4\text{OH} + \text{Aq}$ + 10% $\text{NH}_4\text{Cl} + \text{Aq}$
0°	0.03388	0.09216	0.08397	0.00874		
20	0.02066	0.11358	0.12284	0.00958	0.01331	0.03165
30		0.11758	0.11264			
40	0.02746	0.13936	0.19016	0.01173		
50	0.02261	0.18945	0.18880	0.01005		
60	0.02103	0.21115	0.21952	0.00902	0.04691	0.05353
70	0.01564	0.18880	0.22092	0.00949		
80	0.02364	0.18945	0.23144	0.00912		

(Wenger, Dissert. 1911.)

Ammonium manganous arsenate,

$\text{NH}_4\text{MnAsO}_4 + 6\text{H}_2\text{O}$

Nearly insol. in cold  $\text{H}_2\text{O}$ ; easily sol. in dil. acids; insol. in alcohol (Otto, J. pr. 2. 414.)

Ammonium sodium arsenate,  $\text{NH}_4\text{NaHASO}_4$   
+4 $\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  (Uelsmann, Zeit. f. ges. Nat. 23. 347.)

Ammonium sodium hydrogen arsenate,

$(\text{NH}_4)_2\text{Na}_2\text{H}_2(\text{AsO}_4)_4 + 6\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Fulhol and Senderens, C. R. 94. 649)

Ammonium strontium arsenate,  $\text{NH}_4\text{SrAsO}_4$   
+ $\frac{1}{2}\text{H}_2\text{O}$

Sol. by 10 days' contact in 3229 pts.  $\text{H}_2\text{O}$ , in 11,586 pts. dil.  $\text{NH}_4\text{OH} + \text{Aq}$ , in 199 pts.

of a mixture of 1 pt.  $\text{NH}_4\text{Cl}$  in 7 pts.  $\text{H}_2\text{O}$ , and in 1519 pts. of a solution of 1 pt.  $\text{NH}_4\text{Cl}$  in 10 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  and 60 pts.  $\text{H}_2\text{O}$ . (Lefèvre, A. ch. 1892, (6) 27. 13.)

Ammonium uranyl arsenate,  $\text{NH}_4(\text{UO}_2)_2\text{AsO}_4$   
+ $x\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , and saline solutions as  $\text{NH}_4\text{Cl} + \text{Aq}$ ; sol. in mineral acids (Pulle, Z. anal. 10. 72)

Ammonium vanadium arsenate,

$\text{NH}_4(\text{VO}_2)_2\text{AsO}_4$ , and  $(\text{NH}_4)_2\text{HASO}_4 + 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4$

See Arseniovanadate, ammonium.

Ammonium arsenate tellurate.

See Arseniotellurate, ammonium.

**Antimony arsenate (?)**

Insol. in  $H_2O$ ; insol. in acids after ignition, but when fresh is sol. in conc boiling  $HCl + Aq$ , and sl sol. in  $HNO_3 + Aq$  (Dumas)

**Barium arsenate,  $Ba_3(AsO_4)_2$** 

1000 pts pure  $H_2O$  dissolve 0.55 pt.  $Ba_3(AsO_4)_2$ , 1000 pts  $NH_4Cl + Aq$  (containing 50 pts  $NH_4Cl$ ) dissolve 1.95 pts  $Ba_3(AsO_4)_2$ ; 900 pts  $H_2O + 100$  pts  $NH_4OH + Aq$  (sp gr = 0.88) dissolve 0.03 pt  $Ba_3(AsO_4)_2$  (Field, Chem. Soc. 11. 6.)

Sol in cold  $HNO_3$ , and  $HCl + Aq$  (Berzelius),  $H_2C_4H_4O_6$ , and  $HC_2H_3O_2 + Aq$  (Anthon)

Solubility in  $H_2O$  is not increased by presence of  $NH_4$ , Na, or K salts. (Laugier)

Not pptd in presence of Na citrate (Spiller)  
 $+ 1\frac{1}{2}H_2O$ . (Salkowsky, J. pt. 104. 129)

**Barium hydrogen arsenate,  $BaHAsO_4 + \frac{1}{2}H_2O$** 

Very sl. sol in  $H_2O$ , but decomp. thereby into  $Ba_3(AsO_4)_2$  and  $BaH_4(AsO_4)_2$ . (Berzelius)

Sl sol. in cold acids.  
 $+ H_2O$  Sl sol in either  $BaCl_2 + Aq$  or  $Na_2HAsO_4 + Aq$  (Maumené, J. B. 1864. 237)

**Barium tetrahydrogen arsenate,  $BaH_4(AsO_4)_2 + 2H_2O$** 

Easily sol. in  $H_2O$ . (Settenberg, Berz. J. B. 26. 206.)

Difficultly sol in little, but decomp. by much  $H_2O$ . Easily sol in  $HCl + Aq$ , less easily in  $HC_2H_3O_2 + Aq$  (Hörmann, Dissert. 1879.)

**Barium arsenate, acid,  $BaO, 2As_2O_5 + 4H_2O$** 

Very sl sol. in  $H_2O$ . (Mitscherlich)

**Barium pyroarsenate,  $Ba_2As_2O_7$** 

Insol. in  $H_2O$ , but decomp. thereby into  $BaHAsO_4 + H_2O$ . (Lefèvre, C. R. 108 1058.)

**Barium potassium arsenate,  $BaKAsO_4$** 

Sl. decomp. by cold  $H_2O$ , rapidly sol in dil. acids (Lefèvre, A. ch. (6) 27. 1)

**Barium sodium arsenate,  $BaNaAsO_4 + 9H_2O$** 

(Joly, C. R. 1887, 104. 1702)

**Barium arsenate chloride,  $3Ba_3(AsO_4)_2, BaCl_2$** 

Insol. in  $H_2O$ ; sol in dil.  $HNO_3 + Aq$  (Lechartier, C. R. 65. 172.)

**Bismuth arsenate, basic,  $BiAsO_4, 3Bi_2O_3$** 

Insol. in  $H_2O$ . Sol. in mineral acids. (Cavazzi, Gazz. ch. it. 14. 289.)  
 $5Bi_2O_3, 2As_2O_5 + 8H_2O$  Min. *Rhagite*

Easily sol. in  $HCl + Aq$ ; sl. sol. in  $HNO_3 + Aq$

**Bismuth arsenate,  $BiAsO_4 + \frac{1}{2}H_2O$** 

Insol. in  $H_2O$ . Insol. in  $HNO_3 + Aq$  in presence of  $H_2AsO_4$  or alkali arsenates  $+ Aq$ ; sol in  $HCl + Aq$  (Salkowsky, J. pr. 104. 129)

Not wholly insol. in  $HNO_3 + Aq$ . (Schneider, J. pr. (2) 20. 418.)

Very sol. in  $H_2AsO_4 + Aq$  (Dumas)

Insol. in  $Bi(NO_3)_3 + Aq$  (Dumas.)

Sol in  $Bi(NO_3)_3 + Aq$ . (Salkowsky.)

Insol. in conc.  $Bi(NO_3)_3 + Aq$  containing a small quantity of  $HNO_3$  (Schneider.)

**Bismuth copper arsenate,  $Bi_2Cu_{20}As_{10}H_{44}O_{70} = Bi_2O_3, 20CuO, 5As_2O_5 + 22H_2O$** 

Min. *Mixite* Decomp. by dil  $HNO_3 + Aq$  into insol.  $BiAsO_4$  and  $Cu_3(AsO_4)_2$ , which goes into solution. (Dana)

**Bismuth uranyl arsenate,  $Bi_2(AsO_4)_2, 8Bi_2O_3H_8, (UO_2)_2(AsO_4)_2$** 

Min *Walpurgite*.

**Cadmium arsenate,  $Cd_2(AsO_4)_2$** 

Ppt. (Salkowsky, J. pr. 104. 129)

$2CdO, As_2O_5$  (Lefèvre, C. R. 110. 405.)

$5CdO, 2As_2O_5 + 5H_2O$  Ppt. (Salkowsky.)

**Cadmium pyroarsenate,  $Cd_2As_2O_7$** 

(de Schulten)

**Cadmium hydrogen arsenate,  $CdHAsO_4 + H_2O$** 

Decomp by  $H_2O$  (Demel, B. 12. 1279)

$CdH_4(AsO_4)_2 + 2H_2O$  Decomp by excess of  $H_2O$ . (de Schulten, Bull. Soc. (3) 1. 473.)

**Cadmium potassium arsenate,  $2CdO, K_2O, As_2O_5$** 

(Lefèvre, C. R. 110. 405)

**Cadmium sodium arsenate,  $CdO, 2Na_2O, As_2O_5$** 

Slowly sol in dil. acids. (Lefèvre, C. R. 110. 405.)

$2CdO, 4Na_2O, 3As_2O_5$  (Lefèvre)

**Cadmium arsenate bromide,  $3Cd_2(AsO_4)_2, CdBr_2$** 

Sol. in very dil.  $HNO_3 + Aq$  (de Schulten, Bull Soc (3) 1. 472.)

**Cadmium arsenate chloride,  $3Cd_2(AsO_4)_2, CdCl_2$** 

Sol in very dil.  $HNO_3 + Aq$ . (de Schulten)

**Cæsium arsenate,  $Cs_2O, 2As_2O_5 + 5H_2O$** 

Ppt. (Ephraim, Z. anorg. 1910, 65. 246.)

**Calcium arsenate,  $Ca_3(AsO_4)_2 + 3H_2O$** 

Ppt. Insol. in  $H_2O$ ; sol. in  $H_2AsO_4 + Aq$ . (Kotschoubey, J. pr. 49. 182)

**Calcium pyroarsenate,  $Ca_2As_2O_7$** 

Slowly decomp by cold  $H_2O$  into  $CaHAsO_4 + 1\frac{1}{2}H_2O$  (Lefèvre.)

Calcium hydrogen arsenate,  $\text{CaHAsO}_4 + \frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ . (Debray, A. ch (3) 61. 419.)  
+  $\text{H}_2\text{O}$ . Min *Haidingerite*. Easily sol in acids

+  $2\frac{1}{2}\text{H}_2\text{O}$  Min. *Pharmacoate* Easily sol in acids.

+  $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{AsO}_4 + \text{Aq}$ ; also in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , and  $\text{NH}_4\text{Cl} + \text{Aq}$  (Pfaff)

Calcium tetrahydrogen arsenate,



Sol in  $\text{H}_2\text{O}$ . (Graham.)

+  $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  Decomp. by much hot  $\text{H}_2\text{O}$  into  $\text{H}_3\text{AsO}_4$  and  $\text{Ca}_3(\text{AsO}_4)_2$  (Hormann, Dissert. 1879.)

Calcium iron (ferric) arsenate,  $6\text{CaO}$ ,  $4\text{Fe}_2\text{O}_3$ ,  $5\text{As}_2\text{O}_5 + 15\text{H}_2\text{O}$  (?)

Min *Arseniosiderite*. Sol in acids

Calcium magnesium arsenate,  $\text{Ca}_2\text{H}_2(\text{AsO}_4)_4$ ,  $\text{Mg}_3\text{H}_2(\text{AsO}_4)_4 + 10\text{H}_2\text{O}$ .

Min *Picrophosmacolite* Easily sol in acids

$\text{Ca}_3(\text{AsO}_4)_2$ ,  $\text{Mg}_3(\text{AsO}_4)_2$  Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Kuhni.)

Min. *Berzelite*. Sol in  $\text{HNO}_3 + \text{Aq}$   
 $\text{Ca}_5\text{Mg}_5\text{H}_{14}(\text{AsO}_4)_{14} + 49\text{H}_2\text{O}$ . Min *Wapplerite*

Calcium potassium arsenate,  $\text{CaKAsO}_4$ .

(Lefèvre, A. ch. (6) 27. 5)

Calcium sodium arsenate,  $\text{CaNaAsO}_4$

(Lefèvre, A. ch. (6) 27. 1)

$4\text{CaO}$ ,  $2\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ . Not attacked by boiling  $\text{H}_2\text{O}$ ; easily sol in dil. acids. (Lefèvre.)

Calcium uranyl arsenate,  $\text{Ca}(\text{UO}_2)_2(\text{AsO}_4)_2 + 8\text{H}_2\text{O}$ .

Min. *Uranospinite*.

Calcium vanadium arsenate,  $\text{CaHAsO}_4$ ,  $2(\text{VO})_2\text{H}_2\text{AsO}_4 + 8\text{H}_2\text{O}$ .

See *Arseniovanadate*, calcium.

Calcium arsenate chloride,  $\text{Ca}_2(\text{AsO}_4)_2$ ,  $\text{CaCl}_2$ .

Insol in  $\text{H}_2\text{O}$ , sol. in dil  $\text{HNO}_3 + \text{Aq}$  (Lechartier, C. R. 65. 172.)

$3\text{Ca}_2(\text{AsO}_4)_2$ ,  $\text{CaCl}_2$ . As above (Lechartier.)

Cerous arsenate,  $\text{CeHAsO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in arsenic acid +  $\text{Aq}$ . (Berzelius.)

Ceric hydrogen arsenate,  $\text{Ce}(\text{HAsO}_4)_2 + 6\text{H}_2\text{O}$ .

Ppt Insol. in  $\text{H}_2\text{O}$  and dil acids (Barbieri, B. 1910, 43. 2216.)

Ceric dihydrogen arsenate,  $\text{Ce}(\text{H}_2\text{AsO}_4)_4 + 4\text{H}_2\text{O}$ .

Sol. in conc.  $\text{HNO}_3$ . (Barbieri l. c.)

Chromic arsenate,  $2\text{Cr}_2\text{O}_3$ ,  $3\text{As}_2\text{O}_5$

Insol in  $\text{H}_2\text{O}$  and conc. boiling acids. (Lefèvre, A. ch (6) 27. 5)

Chromic potassium arsenate,  $2\text{Cr}_2\text{O}_3$ ,  $3\text{K}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ .

(Lefèvre.)

Chromic sodium arsenate,  $2\text{Cr}_2\text{O}_3$ ,  $3\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ .

(Lefèvre)

Cobaltous arsenate, basic,  $4\text{CoO}$ ,  $\text{As}_2\text{O}_3$ .

Easily sol in acids (Gentile, J. B. 1851. 359.)

$\text{Co}(\text{CoOH})\text{AsO}_4$  Insol in  $\text{H}_2\text{O}$ , difficultly sol. in acids (Coloriano)

Cobaltous arsenate,  $\text{Co}_2(\text{AsO}_4)_2 + 8\text{H}_2\text{O}$

Ppt Insol even in boiling  $\text{H}_2\text{O}$ ; easily sol in  $\text{HNO}_3$ ,  $\text{HCl}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ ; sol. in  $\text{H}_2\text{AsO}_4 + \text{Aq}$  (Proust), sol. in dil.  $\text{FeSO}_4 + \text{Aq}$  (Karsten, Pogg. 60. 266.)

Min. *Cobalt bloom*, *Erythrite*. Easily sol. in acids.

$5\text{CoO}$ ,  $2\text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ ; difficultly sol. in acids. (Coloriano, C. R. 103. 273)

$2\text{CoO}$ ,  $\text{As}_2\text{O}_3$  Sl attacked by boiling  $\text{H}_2\text{O}$ ; easily sol. in dil. acids (Lefèvre.)

Cobaltous hydrogen arsenate,  $\text{CoH}_2(\text{AsO}_4)_2$

Sol in  $\text{H}_2\text{O}$ ;

Cobaltous potassium arsenate,  $\text{CoKAsO}_4$

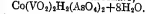
(Lefèvre.)

Cobaltous sodium arsenate,  $\text{CoNaAsO}_4$ .

(Lefèvre.)

$4\text{CoO}$ ,  $2\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ . (Lefèvre.)

Cobaltous vanadium arsenate,



See *Arseniovanadate*, cobaltous.

Cobaltous arsenate ammonia,  $\text{Co}_2(\text{AsO}_4)_2$ ,  $\text{NH}_3 + 7\text{H}_2\text{O}$ .

(Ducru, A. ch. 1901, (7) 22. 185)

$\text{Co}_2(\text{AsO}_4)_2$ ,  $2\text{NH}_3 + 6\text{H}_2\text{O}$ . (Ducru, l. c.)

$\text{Co}_2(\text{AsO}_4)_2$ ,  $3\text{NH}_3 + 5\text{H}_2\text{O}$ . (Ducru, l. c.)

Cuprous arsenate,  $2\text{Cu}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ .

(Hampe, Dissert. 1874.)

$4\text{Cu}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ . (Hampe, l. c.)

Cuprous pyroarsenate,  $\text{Cu}_4\text{As}_2\text{O}_7$ .

Ppt. Sol. in  $\text{NH}_4\text{OH}$  or  $\text{KOH} + \text{Aq}$ . (Reichard, B. 1898, 31. 2166.)

Cupric arsenate, basic,  $8\text{CuO}$ ,  $\text{As}_2\text{O}_5 + 12\text{H}_2\text{O}$

Min. *Chalcophyllite* Easily sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq}$ .

$6\text{CuO}$ ,  $\text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$  Min *Aphanesite*, *Choclaite*. Sol. in acids and ammonia.

$5\text{CuO}$ ,  $\text{As}_2\text{O}_5 + 2\text{H}_2\text{O}$ . Min. *Erimite*. Sol in  $\text{HNO}_3 + \text{Aq}$ .

+5H<sub>2</sub>O. Min. *Cornwallite* Sol. in acids, and NH<sub>4</sub>OH + Aq.  
 +9H<sub>2</sub>O. Min. *Tyrolite*.  
 4CuO, As<sub>2</sub>O<sub>3</sub> + H<sub>2</sub>O Insol in H<sub>2</sub>O (Debray, A. ch. (3) 61, 423)  
 Min. *Okunite* Sol in acids, and NH<sub>4</sub>OH + Aq, decomp by hot KOH + Aq  
 +7H<sub>2</sub>O. Min. *Euchroite*. Sol in HNO<sub>3</sub> + Aq  
 +4½H<sub>2</sub>O. (Hirsch, C. C. 1891, I. 15)

#### Cupric arsenate, Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>

Insol in H<sub>2</sub>O. Easily sol. in HCl + Aq, sl. sol. in other acids; sol in NH<sub>4</sub>OH + Aq (Colomano, C. R. 103, 273)  
 Insol in methyl acetate. (Naumann, B. 1909, 42, 3790)  
 Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20, 827)  
 +4H<sub>2</sub>O Decomp by hot H<sub>2</sub>O. (Debray)  
 +5H<sub>2</sub>O Min. *Trichalite* Easily sol. in cold HCl + Aq

#### Cupric arsenate, acid, 5CuO, 2As<sub>2</sub>O<sub>3</sub>

Sol in H<sub>2</sub>SO<sub>4</sub> + Aq (Vogel.)  
 +3H<sub>2</sub>O. (Salkowsky)  
 +8, 9½, and 12½H<sub>2</sub>O (Hirsch)  
 CuHAsO<sub>4</sub> + H<sub>2</sub>O. Insol in H<sub>2</sub>O. (Colomano)  
 +1½H<sub>2</sub>O. Insol. in H<sub>2</sub>O (Debray, A. ch. (3) 61, 419.)  
 8CuO, 3As<sub>2</sub>O<sub>3</sub> + 12H<sub>2</sub>O. (Hirsch.)

#### Cupric lead arsenate, 3CuO, PbO, As<sub>2</sub>O<sub>3</sub> + 2H<sub>2</sub>O

Min. *Bayldonite*. Nearly insol in HNO<sub>3</sub> + Aq.

#### Cupric potassium arsenate, CuKAsO<sub>4</sub>

Slowly sol in NH<sub>4</sub>OH + Aq, easily sol in acids. (Lefèvre, A. ch. (6) 27, 5.)  
 8CuO, K<sub>2</sub>O, As<sub>2</sub>O<sub>3</sub>. Easily sol. in dil. acids. (Lefèvre.)

#### Cupric sodium arsenate, CuNaAsO<sub>4</sub>

(Lefèvre.)  
 3CuO, Na<sub>2</sub>O, 2As<sub>2</sub>O<sub>3</sub> Very sol in dil. acids. (Lefèvre)  
 2Cu<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, NaH<sub>2</sub>AsO<sub>4</sub> + 5H<sub>2</sub>O Ppt (Hirsch, C. C. 1891, I. 15.)  
 6Cu<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, 2NaH<sub>2</sub>AsO<sub>4</sub>, Na<sub>2</sub>HAsO<sub>4</sub> + 13½H<sub>2</sub>O, or 16H<sub>2</sub>O. Ppt. (Hirsch.)  
 3Cu<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, Na<sub>2</sub>HAsO<sub>4</sub> + 9½H<sub>2</sub>O Ppt. (Hirsch.)  
 4Cu<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, Na<sub>2</sub>HAsO<sub>4</sub> + 11H<sub>2</sub>O. Ppt (Hirsch.)

#### Cupric uranyl arsenate, Cu(UO<sub>2</sub>)<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub> + 8H<sub>2</sub>O.

(Werther, A. 68, 312.)  
 Min. *Zeunerite*.

#### Cupric vanadium arsenate,

Cu(VO<sub>2</sub>)<sub>2</sub>H<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub> + 3H<sub>2</sub>O

See Arseniovanadate, cupric.

#### Cupric arsenate ammonia, Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, 3NH<sub>3</sub> + 4H<sub>2</sub>O

Insol. in cold or hot H<sub>2</sub>O (Damour, J. pr 37, 485)  
 2CuO, As<sub>2</sub>O<sub>3</sub>, 4NH<sub>3</sub> + 3H<sub>2</sub>O. Decomp by H<sub>2</sub>O (Schiff, A. 123, 42.)

#### Cupric arsenate calcium carbonate, 5CuO, As<sub>2</sub>O<sub>3</sub>, CaCO<sub>3</sub> + 4H<sub>2</sub>O, or 9H<sub>2</sub>O.

Min. *Tyrolite*. Easily sol. in acids, and NH<sub>4</sub>OH + Aq

#### Cupric arsenate sodium chloride, 2Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, NaCl + 7½H<sub>2</sub>O.

Decomp by hot H<sub>2</sub>O. (Hirsch, Dissert. 1891.)  
 3Cu<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, 2NaCl + 13½H<sub>2</sub>O.  
 +17½H<sub>2</sub>O. (Hirsch, l.c.)  
 5Cu<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, 3NaCl + 23H<sub>2</sub>O. (Hirsch.)

#### Didymium arsenate, D<sub>2</sub>H<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>.

Ppt Insol. in H<sub>2</sub>O; sl. sol. in weak acids (Maugnac, A. ch. (3) 38, 164)  
 5D<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, As<sub>2</sub>O<sub>3</sub> + 3H<sub>2</sub>O Ppt.

#### Glucinum arsenate, Gl<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>

Insol. in H<sub>2</sub>O, sol. in H<sub>3</sub>AsO<sub>4</sub> + Aq. (Berzelius)

#### Glucinum hydrogen arsenate, GlHAsO<sub>4</sub>.

Obtained in impure state by heating As<sub>2</sub>O<sub>3</sub> with Gl(OH)<sub>3</sub> in a sealed tube at 220°. (Bleyer, Z. anorg 1912, 75, 287.)

#### Glucinum tetrahydrogen arsenate,

GlH<sub>4</sub>(AsO<sub>4</sub>)<sub>2</sub>  
 Very hygroscopic. (Bleyer, Z. anorg. 1912, 75, 287)

#### Glucinum potassium arsenate, KGlAsO<sub>4</sub>, ½GlO + 5H<sub>2</sub>O.

Unstable. Amorphous Easily hydrolyzed, giving more basic salts. (Bleyer, Z. anorg. 1912, 75, 289.)

#### Glucinum sodium arsenate, NaGlAsO<sub>4</sub>, ½GlO + 6H<sub>2</sub>O

Unstable Easily hydrolyzed. (Bleyer, Z. anorg. 1912, 75, 290.)

#### Iron (ferrous) arsenate, Fe<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub> + 6H<sub>2</sub>O (?)

Ppt. Sl. sol in NH<sub>4</sub>OH + Aq. Insol in (NH<sub>4</sub>)<sub>2</sub>AsO<sub>4</sub> + Aq or other NH<sub>4</sub> salts + Aq. (Wittstein)  
 +8H<sub>2</sub>O Min. *Symplectite*. Sol in HCl + Aq

#### Iron (ferric) arsenate, basic, 16Fe<sub>2</sub>O<sub>3</sub>, As<sub>2</sub>O<sub>3</sub> + 24H<sub>2</sub>O.

Insol. in NH<sub>4</sub>OH + Aq (Berzelius.)  
 2Fe<sub>2</sub>O<sub>3</sub>, As<sub>2</sub>O<sub>3</sub> + 12H<sub>2</sub>O. Insol. in NH<sub>4</sub>OH + Aq  
 3Fe<sub>2</sub>O<sub>3</sub>, 2As<sub>2</sub>O<sub>3</sub>.  
 3Fe<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>H<sub>4</sub> + 12H<sub>2</sub>O. Min. *Pharmacosiderite*. Easily sol in acids; decomp. by KOH + Aq

**Iron (ferric) arsenate,  $\text{Fe}_2\text{O}_3, \text{As}_2\text{O}_5$** 

Ppt Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ .  
Sol in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  (Metszke, Z. anorg. 1898, 19. 473.)  
+  $4\text{H}_2\text{O}$  Min. *Scorodite*. Easily sol. in  $\text{HCl}$ +Aq; insol in  $\text{HNO}_3$ +Aq  
+  $8\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$ . When freshly pptd., sol in  $\text{NH}_4\text{OH}$ +Aq. Sol. in  $\text{HCl}$  or  $\text{HNO}_3$ +Aq. Insol in  $\text{HC}_2\text{H}_3\text{O}_2$  or  $\text{NH}_4$  salts+Aq (Wittstein)  
Sol. in warm  $\text{H}_2\text{SO}_4$ +Aq or  $(\text{NH}_4)_2\text{SO}_4$ +Aq. (Berthier, A. ch. (3) 7. 79)

**Iron (ferric) arsenate, acid,  $\text{Fe}_2\text{O}_3, 3\text{As}_2\text{O}_5$** 

+  $16.7\text{H}_2\text{O}$   
Ppt; sl sol. in acids with a yellow color, and in  $\text{NH}_4\text{OH}$ +Aq with a red color. (Metszke, Z. anorg. 1898, 19. 476.)  
 $2\text{Fe}_2\text{O}_3, 3\text{As}_2\text{O}_5 + 12\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq  
Sol in mineral acids  
Sol. only in conc.  $\text{H}_2\text{AsO}_4$ +Aq.  
Sol. in  $(\text{NH}_4)_2\text{AsO}_4$  and other  $\text{NH}_4$  salts+Aq (Wittstein)  
Sol. in  $\text{NH}_4\text{OH}$ +Aq.  
+  $22\frac{1}{2}\text{H}_2\text{O}$  Ppt. Sl. sol. in acids with a yellow color, and in  $\text{NH}_4\text{OH}$ +Aq with a red color. (Metszke, Z. anorg. 1898, 19. 475.)

**Iron (ferroferric) arsenate,  $6\text{FeO}, 3\text{Fe}_2\text{O}_3, 4\text{As}_2\text{O}_5 + 32\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ +Aq. Decomp. by  $\text{KOH}$ +Aq (Wittstein, J. B. 1866. 243)

**Iron (ferric) lead arsenate,  $5\text{Pb}_2(\text{AsO}_4)_3, \text{Pb}_3(\text{AsO}_4)_2$** 

Min. *Carmine Spar. Carminite*. Sol. in acids,  $\text{KOH}$ +Aq dissolves out  $\text{As}_2\text{O}_5$ . (Sandberger.)

**Iron (ferric) potassium arsenate,  $2\text{Fe}_2\text{O}_3, 3\text{K}_2\text{O}, 3\text{As}_2\text{O}_5$** 

Not attacked by boiling  $\text{H}_2\text{O}$ ; easily sol in dil. acids (Lefèvre)  
 $\text{Fe}_2\text{C}_2, \text{K}_2\text{O}, 2\text{As}_2\text{O}_5$ . (Lefèvre.)

**Iron (ferric) sodium arsenate,  $\text{Fe}_2\text{O}_3, \text{Na}_2\text{O}, 2\text{As}_2\text{O}_5$** 

(Lefèvre.)  
 $2\text{Fe}_2\text{O}_3, 3\text{Na}_2\text{O}, 3\text{As}_2\text{O}_5$ . (Lefèvre.)

**Lanthanum arsenate,  $\text{La}_2\text{H}_3(\text{AsO}_4)_3$** 

(Frerichs and Smith.)  
Doubtful (Cleve, B. 11. 910.)

**Lead arsenate, basic,  $15\text{PbO}, 2\text{As}_2\text{O}_5$  (?)**

Ppt (Stroinholm, Z. anorg. 1904, 38. 446.)

**Lead arsenate,  $\text{Pb}_3(\text{AsO}_4)_2$** 

Insol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts+Aq. (Wittstein)

Sol. in 2703.5 pts  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq containing 38.94%  $\text{HC}_2\text{H}_3\text{O}_2$ . (Bertrand, Monit. Scient. (3) 10. 477.)

Sol in sat.  $\text{NaCl}$ +Aq. (Bequerel, C. R. 20. 1523.)

Not pptd. in presence of  $\text{Na}$  citrate. (Spiller.)

**Lead pyroarsenate,  $\text{Pb}_2\text{As}_2\text{O}_7$** 

Insol. in  $\text{H}_2\text{O}$  or  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq Sol. in  $\text{HCl}$  or  $\text{HNO}_3$ +Aq (Rose)  
Decomp. by cold  $\text{H}_2\text{O}$  (Lefèvre.)  
+  $\text{H}_2\text{O} = \text{PbHAsO}_4$  Ppt. (Salkowsky, J. pr. 104. 109.)

**Lead potassium arsenate,  $\text{PbKAsO}_4$** 

(Lefèvre, A. ch. (6) 27. 5.)

**Lead sodium arsenate,  $\text{PbNaAsO}_4$** 

(Lefèvre.)

$4\text{PbO}, 2\text{Na}_2\text{O}, 3\text{As}_2\text{O}_5$ . Superficially decomp. by cold  $\text{H}_2\text{O}$  (Lefèvre.)

**Lead arsenate chloride,  $3\text{Pb}_2(\text{AsO}_4)_2, \text{PbCl}_2$** 

Sol. in dil  $\text{HNO}_3$ +Aq. (Lechartier.)  
Min *Mimetite*. Sol in  $\text{HNO}_3$ , and  $\text{KOH}$ +Aq

**Lithium arsenate,  $\text{Li}_3\text{AsO}_4$** 

Ppt. Sol. in dil acids and in  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq. (de Schulten, Bull. Soc (3) 1. 479.)  
 $\text{LiH}_2\text{AsO}_4 + \frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into  $\text{H}_2\text{AsO}_4$  and  $\text{Li}_4\text{AsO}_4$ . (Rammelsberg, Pogg. 128. 311.)

**Magnesium arsenate,  $\text{Mg}_3(\text{AsO}_4)_2$** 

Ppt  
Insol in methyl acetate. (Naumann, B. 1909. 42. 3790.)  
+  $7\text{H}_2\text{O}$ , +  $8\text{H}_2\text{O}$ , +  $10\text{H}_2\text{O}$ , and +  $22\text{H}_2\text{O}$ . (Gruhl, Dissert. 1897.)  
+  $8\text{H}_2\text{O}$  Min. *Hörnæsile*. Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids.

**Magnesium hydrogen arsenate,  $\text{MgHAsO}_4$** 

+  $\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (de Schulten, C. R. 100. 263.)

+  $5\text{H}_2\text{O}$ . (Schiefer)  
+  $6\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . 1000 pts. boiling  $\text{H}_2\text{O}$  dissolve 1.5 pts. (Thompson.)

Sol. in  $\text{HNO}_3$ +Aq before ignition, but insol. in acids after ignition. (Graham, A. 29. 29.)

+  $7\text{H}_2\text{O}$ . Min *Roesslerite*. Sol. in  $\text{HCl}$ +Aq.

**Magnesium tetrahydrogen arsenate,  $\text{MgH}_4(\text{AsO}_4)_2$** 

Very deliquescent; sol. in  $\text{H}_2\text{O}$ . (Schiefer.)

**Magnesium potassium arsenate,  $\text{MgKAsO}_4$** 

Insol. in, but decomp. by cold  $\text{H}_2\text{O}$ . (Rose.)

Easily sol. in dil. acids (Lefèvre.)

+  $7\text{H}_2\text{O}$ . (Kinkelin, Dissert. 1893.)

$4\text{MgO}, 2\text{K}_2\text{O}, 3\text{As}_2\text{O}_5$ . Not attacked by boiling  $\text{H}_2\text{O}$ ; slowly sol. in dil. acids. (Lefèvre.)

**Magnesium potassium hydrogen arsenate,  $\text{KMgH}(\text{AsO}_4)_2 + x\text{H}_2\text{O}$** 

Decomp. by  $\text{H}_2\text{O}$  (Kinkelin, Dissert. 1893.)

$Mg_3KH_2(AsO_4)_2 + 5H_2O$ . (Chevron and Drouche, J. B. 1888, 523.)

**Magnesium potassium sodium arsenate**,  $Mg_3KNa(AsO_4)_2 + 10H_2O$ .  
(Kinkelin, Dissert. 1883.)

**Magnesium sodium arsenate**,  $MgNaAsO_4$ .  
Insol. in  $H_2O$ . Very sl. sol. in dil. acids. (Lefèvre.)  
 $4MgO, 2Na_2O, 3As_2O_5$ . (Lefèvre.)

**Magnesium vanadium arsenate**,  
 $MgH_2(VO_2)_2(AsO_4)_2 + 9H_2O$  and  
 $MgHAsO_4, 2(VO_2)_2H_2AsO_4 + 9H_2O$ .  
See Arseniovanadate, magnesium.

**Magnesium arsenate chloride**,  $Mg_3(AsO_4)_2, MgCl_2$

Insol. in  $H_2O$ ; sol. in dil.  $HNO_3 + Aq$  (Lechartier, C. R. 65. 172.)

**Magnesium arsenate fluoride**,  $Mg_3(AsO_4)_2, MgF_2$ .

Insol. in  $H_2O$ ; sol. in dil.  $HNO_3 + Aq$ . (Lechartier.)

**Manganous arsenate, basic**,  $6MnO, As_2O_3 + 3H_2O$  (?).

Min. *Chondroarsenite*. Easily and completely sol. in dil.  $HCl$  and  $HNO_3 + Aq$ .

**Manganous arsenate**,  $Mn_3(AsO_4)_2 + H_2O$ .  
Insol. in  $H_2O$ , sl. sol. in acids. (Coloriano, C. R. 103. 273.)  
 $5MnO, 2As_2O_3 + 5H_2O$ . Insol. in  $H_2O$ . (Coloriano.)

$2MnO, As_2O_3$ . Sl. decomp. by cold  $H_2O$ , but rapidly on heating (Lefèvre)  
 $MnHAsO_4 + H_2O$ . Decomp. by boiling  $H_2O$  into  $5MnO, 2As_2O_3 + 5H_2O$ . Sol. in  $HNO_3, H_2SO_4$ , or  $H_2AsO_4 + Aq$ .

**Manganous tetrahydrogen arsenate**,  
 $MnH_4(AsO_4)_2$ .

Deliquescent. Easily sol. in  $H_2O$ . (Schiefer.)

**Manganous potassium arsenate**,  $MnKAsO_4$ .  
(Lefèvre, A. ch. (6) 27. 5.)

**Manganous sodium arsenate**,  $MnNaAsO_4$ .  
Very sol. in dil. acids (Lefèvre.)  
 $2MnO, 4Na_2O, 3As_2O_5$ . Not attacked by boiling  $H_2O$ ; very sol. in dil. acids (Lefèvre.)

**Manganous arsenate chloride**,  $Mn_3(AsO_4)_2, MnCl_2$

Insol. in  $H_2O$ ; sol. in dil.  $HNO_3 + Aq$ . (Lechartier, A. 68. 259)

**Manganic arsenate**,  $Mn_2(AsO_4)_3 + 2H_2O$ .  
Insol. in  $H_2O$ ; sol. in acids.

**Mercurous arsenate**,  $(Hg_2)_2(AsO_4)_2$ .

Insol. in  $H_2O$ ; difficultly sol. in acids. (Coloriano, C. R. 103. 273.) Ppt (Haack, C. C. 1890, II. 736.)

$Hg_2(AsO_4)_2$ . Insol. in  $H_2O, HC_2H_3O_2$ , or alcohol. Decomp. by cold  $HCl + Aq$ . Sl. sol. in cold  $HNO_3 + Aq$ , from which it is precipitated by  $NH_4OH$  as  $Hg_2HAsO_4$  (Simon, Pogg. 41. 424.)

**Mercurous hydrogen arsenate**,  $Hg_2HASO_4$ .

Insol. in  $H_2O, HC_2H_3O_2$ , or  $NH_4OH + Aq$ . Decomp. by cold  $HCl + Aq$ , sol. in cold  $HNO_3 + Aq$  without decomp; very sl. sol. without decomp. in  $NH_4NO_3 + Aq$  (Simon, Pogg. 41. 424.)

**Mercuric arsenate**,  $Hg_3(AsO_4)_2$ .

Ppt. Sol. in  $H_2AsO_4$  or  $HNO_3 + Aq$ . (Bergman) Very sl. sol. in  $H_2O$ . Easily sol. in  $HCl + Aq$ . Sl. sol. in  $HNO_3 + Aq$ . Insol. in  $H_2AsO_4 + Aq$  (Haack, C. C. 1890, II. 736.)

**Mercurous silver arsenate**,  $Hg_2AgAsO_4$ .

Sol. in hot conc.  $HNO_3$ . (Jacobsen, Bull. Soc. 1909, (4) 5. 948)

**Mercurous arsenate nitrate**,  $Hg_3AsO_4, HgNO_3 + H_2O$

Insol. in  $H_2O$  or  $HC_2H_3O_2$ , sol. in  $HNO_3 + Aq$  (Simon, Pogg. 41. 424.)  
 $3Hg_3AsO_4, 2HgNO_3, 2Hg_2O$  Ppt. (Haack.)

**Molybdenum arsenate**.

Ppt.

**Nickel arsenate, basic**,  $5NiO, As_2O_3$

Min. — (Bergemann.)  
 $Ni(NiOH)AsO_4$ . Difficultly attacked by acids or alkalis. (Coloriano, Bull. Soc. (2) 45. 241.)  
 $5NiO, 2As_2O_3 + 3H_2O$ . As above.

**Nickel arsenate**,  $Ni_2(AsO_4)_2$ .

Min. — (Bergemann)  
 $+ xH_2O$ . Insol. in  $H_2O$ . Sol. in  $H_2AsO_4$ , and conc. mineral acids. Easily sol. in  $NH_4OH + Aq$ .

$+ 2H_2O$ . Insol. in  $H_2O$ ; difficultly sol. in acids. (Coloriano, Bull. Soc. 45. 241)  
 $+ 8H_2O$ . Min. *Nickel-bloom, Annabergite*.

Easily sol. in acids.  
 $NiHASO_4 + H_2O$ . Sol. in  $H_2O$ . Difficultly attacked by acids. (Coloriano, C. R. 103. 274.)

**Nickel potassium arsenate**,  $12NiO, 3K_2O, 5As_2O_3$

(Lefèvre)  
 $2NiO, K_2O, As_2O_5$ . Rapidly sol. in dil. acids. (Lefèvre.)

**Nickel sodium arsenate**,  $NiNaAsO_4$ .

Very slowly sol. in dil. acids (Lefèvre.)  
 $4NiO, 2Na_2O, 3As_2O_5$ . (Lefèvre.)

**Nickel arsenate ammonia**,

$Ni_2(AsO_4)_2 \cdot NH_3 + 7H_2O$ .  
 $Ni_2(AsO_4)_2 \cdot 2NH_3 + 6H_2O$ .  
 $Ni_3(AsO_4)_2 \cdot 3NH_3 + 5H_2O$ . (Ducru, C. R. 1900, 131. 703.)

Palladium arsenate (?).

Ppt

Platinum arsenate (?)

Ppt. Sol in  $\text{HNO}_3 + \text{Aq}$

Potassium arsenate,  $\text{K}_3\text{AsO}_4$ .

Deliquescent Very sol. in  $\text{H}_2\text{O}$  (Graham, Pogg. 32. 47)

Insol. in ethyl acetate (Naumann, B 1904, 37. 3601.)

Potassium hydrogen arsenate,  $\text{K}_2\text{HASO}_4$ .

Sol. in  $\text{H}_2\text{O}$

Potassium dihydrogen arsenate,  $\text{KH}_2\text{AsO}_4$

Sol in 5.3 pts  $\text{H}_2\text{O}$  at  $6^\circ$ , forming a solution of sp. gr. 1.1134. Much more sol. in hot  $\text{H}_2\text{O}$ . Insol in alcohol

Sol. in 28,666 pts boiling cone alcohol. (Wenzel)

Potassium sodium hydrogen arsenate,  $\text{KNaHASO}_4 + 16\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ .

$\text{K}_2\text{Na}_2\text{H}_2(\text{AsO}_4)_4 + 9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , and not easily decomp. thereby into its constituents (Filhol and Sendeuens, C R 95. 343.)

Potassium strontium arsenate,  $\text{K}_2\text{SrAsO}_4$

(Lefèvre, C. R. 108. 1058)

Potassium vanadium arsenate,  $\text{K}(\text{VO}_2)_2\text{AsO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ .

See Arsenovanadate, potassium.

Potassium zinc arsenate,  $\text{KZnAsO}_4$ .

(Lefèvre)

Potassium arsenate sulphate.

See Arseniosulphate, potassium.

Rhodium arsenate (?)

Ppt.

Rubidium metaarsenate,  $\text{RbAsO}_3$ .

Sol. in  $\text{H}_2\text{O}$  (Bouchonnet, C R 1907, 144. 642.)

Rubidium arsenate,  $\text{Rb}_3\text{AsO}_4 + 2\text{H}_2\text{O}$

Very hygroscopic; sol. in  $\text{H}_2\text{O}$  to give an alkaline solution. Absorbs  $\text{CO}_2$  from the air. (Bouchonnet, l.c.)

Rubidium pyroarsenate,  $\text{Rb}_4\text{As}_2\text{O}_7$

(Bouchonnet, l.c.)

Rubidium hydrogen arsenate,  $\text{Rb}_2\text{HASO}_4 + \text{H}_2\text{O}$

Absorbs  $\text{CO}_2$  from the air. Very hygroscopic, sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Bouchonnet, l.c.)

Rubidium dihydrogen arsenate,  $\text{RbH}_2\text{AsO}_4$ .

Not hygroscopic. Very sol. in  $\text{H}_2\text{O}$ , aq solution is acid to litmus (Bouchonnet, l.c.)

Silver arsenate,  $\text{Ag}_3\text{AsO}_4$ .

Insol in  $\text{H}_2\text{O}$ . Sol. in acids; easily sol. in  $\text{H}_2\text{AsO}_4 + \text{Aq}$ . (Joly, C. R. 103. 1071.)

11  $\text{H}_2\text{O}$  dissolves 0.0085 g  $\text{Ag}_3\text{AsO}_4$  at  $20^\circ$ . (Whitby, Z. anorg. 1910, 67. 108)

Much less sol. in  $\text{H}_2\text{AsO}_4$  than  $\text{Ag}_3\text{PO}_4$  (Graham.)

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Scheele.)

Sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Insol. in  $\text{NH}_4$  sulphate, nitrate, or succinate +  $\text{Aq}$  (Wittstein)

Very sl. sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ , more easily in  $\text{HCl} + \text{H}_2\text{O}_2 + \text{Aq}$ . (Graham)

Sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , but not so easily as  $\text{Ag}_3\text{PO}_4$

Not pptd. in presence of Na citrate. (Spiller)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch J 1898, 20. 829)

Silver hydrogen arsenate,  $\text{Ag}_2\text{HASO}_4$ .

Decomp by  $\text{H}_2\text{O}$ , with formation of  $\text{Ag}_3\text{AsO}_4$  (Settberg, Berz J. B. 26. 208)

$\text{Ag}_2\text{HASO}_4$ . Decomp. by  $\text{H}_2\text{O}$  (Joly, C. R. 103. 1071.)

$\text{Ag}_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ . Decomp by  $\text{H}_2\text{O}$  Rather sl. sol in  $\text{HNO}_3 + \text{Aq}$  Very easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Hurtzig and Geuther, A 111. 168).

Silver arsenate ammonia,  $\text{Ag}_3\text{AsO}_4 \cdot 4\text{NH}_3$

Easily sol. in  $\text{H}_2\text{O}$  (Widmann, Bull. Soc. (2) 20. 64)

Silver arsenate sulphate,  $3\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{SO}_3$

Decomp by  $\text{H}_2\text{O}$ , with separation of  $\text{Ag}_3\text{AsO}_4$ ; decomp. by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Settberg, Berz J. B. 26. 209)

Sodium arsenate,  $\text{Na}_3\text{AsO}_4 + 12\text{H}_2\text{O}$

Permanent in dry air. Sol. in 3.57 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$ . (Graham) 100 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 28 pts  $\text{Na}_3\text{AsO}_4 + 12\text{H}_2\text{O}$ . (Berzelius) Sol in 3.75 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ , or 100 pts.  $\text{H}_2\text{O}$  at  $17^\circ$  dissolve 26.7 pts; or sat.  $\text{Na}_3\text{AsO}_4 + \text{Aq}$  at  $17^\circ$  contains 21.1%  $\text{Na}_3\text{AsO}_4 + 12\text{H}_2\text{O}$  or 10.4%  $\text{Na}_3\text{AsO}_4$ , and has sp. gr. 1.1186. (Schiff, A. 113. 350.)

Melts in crystal  $\text{H}_2\text{O}$  at  $85.5^\circ$

Sp. gr. of  $\text{Na}_3\text{AsO}_4 + \text{Aq}$  at  $17^\circ$

% = %  $\text{Na}_3\text{AsO}_4 + 12\text{H}_2\text{O}$

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0063	9	1.0490	17	1.0945
2	1.0107	10	1.0517	18	1.1003
3	1.0161	11	1.0603	19	1.1061
4	1.0215	12	1.0659	20	1.1121
5	1.0270	13	1.0716	21	1.1179
6	1.0325	14	1.0773	22	1.1238
7	1.0380	15	1.0830		
8	1.0435	16	1.0887		

(Schiff, calculated by Gerlach, Z. anal. 8. 286.)

"Arsenate of soda" dissolves in 60 pts. boiling alcohol (Wenzel.)

$+4\frac{1}{2}\text{H}_2\text{O}$ . (Hall, Chem. Soc. 51. 93)

$+10\text{H}_2\text{O}$ . Efflorescent. (Hall.)

Sodium hydrogen arsenate,  $\text{Na}_2\text{HASO}_4 + 7\text{H}_2\text{O}$ .

Not efflorescent (Schiff).

Solubility in  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ . A table is given which records the g. of  $\text{As}_2\text{O}_3$  in 100 cc of the filtrate. (Curry, J. Am. Chem. Soc. 1915, 37, 1685.)

+  $7\frac{1}{2}\text{H}_2\text{O}$  (Lescœur, C. R. 104, 1171).

+  $12\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$ ; sol. in 1.79 pts  $\text{H}_2\text{O}$  at  $14^\circ$ ; or 100 pts  $\text{H}_2\text{O}$  at  $14^\circ$  dissolve 56 pts  $\text{Na}_2\text{HASO}_4 + 12\text{H}_2\text{O}$ . Sat.  $\text{Na}_2\text{HASO}_4 + \text{Aq}$  contains 35.9%  $\text{Na}_2\text{HASO}_4 + 12\text{H}_2\text{O}$ , or 16.5%  $\text{Na}_2\text{HASO}_4$ , and has sp. gr. = 1.1722 (Schiff, A. 113, 350.)

100 pts  $\text{H}_2\text{O}$  at  $72^\circ$  dissolve 22.268 pts. (Thompson.)

100 pts  $\text{H}_2\text{O}$  dissolve 17.2 pts.  $\text{Na}_2\text{HASO}_4 + 12\text{H}_2\text{O}$  at  $0^\circ$ , and 140.7 pts at  $30^\circ$ . (Tilden, Chem. Soc. 45, 409.)

Melts in crystal  $\text{H}_2\text{O}$  at  $28^\circ$ . (Tilden.)

Sp. gr. of  $\text{Na}_2\text{HASO}_4 + \text{Aq}$  at  $14^\circ$ .

% = %  $\text{Na}_2\text{HASO}_4 + 12\text{H}_2\text{O}$

%	Sp gr	%	Sp gr	%	Sp gr
1	1.0042	15	1.0665	29	1.1358
2	1.0084	16	1.0712	30	1.1410
3	1.0126	17	1.0759	31	1.1463
4	1.0168	18	1.0807	32	1.1516
5	1.0212	19	1.0855	33	1.1569
6	1.0256	20	1.0904	34	1.1623
7	1.0300	21	1.0953	35	1.1677
8	1.0344	22	1.1003	36	1.1731
9	1.0389	23	1.1052	37	1.1786
10	1.0434	24	1.1103	38	1.1841
11	1.0479	25	1.1153	39	1.1896
12	1.0525	26	1.1204	40	1.1952
13	1.0571	27	1.1255		
14	1.0618	28	1.1306		

(Schiff, calculated by Gerlach, Z. anal. 8, 280.)

Insol. in alcohol.

+  $13\frac{1}{2}\text{H}_2\text{O}$  (Setterberg.)

Sodium dihydrogen arsenate,  $\text{NaH}_2\text{AsO}_4 + \text{H}_2\text{O}$

More sol. in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{AsO}_4$  or  $\text{Na}_2\text{HASO}_4$ . (Schiff.)

+  $2\text{H}_2\text{O}$ . Efflorescent. (Joly and Duffet, C. R. 102, 1391.)

Sodium trihydrogen arsenate,

$\text{NaH}_2(\text{AsO}_4)_2 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Fihol and Senderens, C. R. 95, 343.)

Sodium strontium arsenate,  $\text{NaSrAsO}_4$ .

Not attacked by boiling  $\text{H}_2\text{O}$ . (Lefèvre.) +  $9\text{H}_2\text{O}$ . Scarcely sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 104, 905.)

+  $18\text{H}_2\text{O}$ . (Joly.)

Sodium uranyl arsenate,  $\text{Na}(\text{UO}_2)\text{AsO}_4$

Ppt. (Werther, A. 68, 312.)

Sodium zinc arsenate,  $\text{NaZnAsO}_4$ .

Slowly sol. in dil. acids. (Lefèvre.)

$\text{Na}_2\text{ZnAs}_2\text{O}_7$ . As above. (Lefèvre.)

Sodium arsenate fluoride,  $\text{Na}_2\text{AsO}_4, \text{NaF} + 12\text{H}_2\text{O}$ .

Sol. in 9.5 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ , and 2 pts at  $75^\circ$ . (Briegleb, A. 97, 95.)

Sodium arsenate stannate,  $6\text{Na}_2\text{O}, 2\text{As}_2\text{O}_5, \text{SnO}_2 + 50\text{H}_2\text{O}$ .

More difficultly sol. than sodium stannate. (Haeffely, Phil. Mag. (4) 10, 290.)

$5\text{Na}_2\text{AsO}_4, \text{Na}_2\text{SnO}_3 + 60\text{H}_2\text{O}$  (Prandtl, B. 1907, 40, 2133.)

Sodium arsenate sulphate,  $\text{Na}_4\text{As}_2\text{O}_{10}, 2\text{Na}_2\text{SO}_4$ .

Sol. in  $\text{H}_2\text{O}$  (Mitscherlich.)

$\text{Na}_4\text{As}_2\text{O}_7, \text{Na}_2\text{SO}_4$ . (Setterberg.)

Sodium arsenate tungstate,  $\text{Na}_4\text{As}_2\text{O}_7, \text{Na}_2\text{W}_2\text{O}_{10} + 20\text{H}_2\text{O}$ .

See Arseniotungstate, sodium.

Strontium arsenate,  $\text{Sr}_3(\text{AsO}_4)_2$

Not attacked by boiling  $\text{H}_2\text{O}$ ; easily sol. in dil. acids (Lefèvre, A. ch. (6) 27, 5.)

Strontium pyroarsenate,  $\text{Sr}_2\text{As}_2\text{O}_7$

Decomp. by cold  $\text{H}_2\text{O}$  into  $\text{SrHASO}_4 + \frac{1}{2}\text{H}_2\text{O}$ . (Lefèvre.)

Strontium hydrogen arsenate,  $\text{SrHASO}_4 + \frac{1}{2}\text{H}_2\text{O}$

Insol. in cold, but decomp. by hot  $\text{H}_2\text{O}$  into a basic, and a sol. acid salt. 100 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 0.284 pt. (Thompson, 1831.)

Sol. in  $\text{HCl}$ , and very easily in  $\text{HCl} + \text{Aq}$ . (Kotschoubey, J. pr. 49, 182.)

Sol. in  $\text{HNO}_3 + \text{Aq}$ .  $\text{SrH}_4(\text{AsO}_4)_2 + 2\text{H}_2\text{O}$ . Partly sol. in  $\text{H}_2\text{O}$ . (Hormann, Dissert. 1879.)

Strontium vanadium arsenate,  $\text{SrHASO}_4, 2(\text{VO})_2\text{H}_2\text{AsO}_4 + 7\frac{1}{2}\text{H}_2\text{O}$ .

See Arseniovanadate, strontium.

Strontium arsenate chloride,  $3\text{Sr}_3(\text{AsO}_4)_2, \text{SrCl}_2$ .

Insol. in  $\text{H}_2\text{O}$ , easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Lechartier, C. R. 65, 172.)

Thallos arsenate,  $\text{Ti}_2\text{AsO}_4$

Sol. in  $\text{H}_2\text{O}$ . (Willm, A. ch. (4) 5, 5.)

Thallos hydrogen arsenate,  $\text{Ti}_2\text{HASO}_4$

Very easily sol. in  $\text{H}_2\text{O}$ . (Willm.)

Thallos dihydrogen arsenate,  $\text{TiH}_2\text{AsO}_4$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Willm.)

Thallic arsenate,  $\text{TiAsO}_4 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ ; decomp. by  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . (Willm.)

Thorium hydrogen arsenate,  $\text{Th}(\text{HAsO}_4)_2 + 6\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_3\text{AsO}_4 + \text{Aq}$  (Berzelius).  
Ppt.; insol. in  $\text{H}_2\text{O}$  (Barbieri, C. A. 1911. 3385)

$\text{Th}(\text{H}_2\text{AsO}_4)_4 + 4\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$  (Barbieri, l. c.)

Tin (stannous) arsenate,  $\text{SnHAsO}_4 + \frac{1}{2}\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$ . (Lewissen, A. 114. 113)

Tin (stannic) arsenate,  $2\text{SnO}_3, \text{As}_2\text{O}_3$

Ppt. Insol. in  $\text{H}_2\text{O}$  and dil.  $\text{HNO}_3 + \text{Aq}$  (Haeffely, Phil. Mag. (4) 10. 290.)

$\text{Sn}_2(\text{AsO}_4)_4 + 6\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ , sol. in conc.  $\text{HCl} + \text{Aq}$ , and in aqua regia; insol. in  $\text{HNO}_3 + \text{Aq}$  or  $\text{H}_2\text{SO}_4$  (Williams, Proc. Soc. Manchester, 15. 67.)

*Colloidal.* Very slowly sol. in  $\text{H}_2\text{O}$ , from which it is pptd. by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , also by  $\text{BaCl}_2$ ,  $\text{CaCl}_2$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{FeCl}_3 + \text{Aq}$ , and by  $\text{AgNO}_3$ , or  $\text{KI} + \text{Aq}$ . Not pptd. by alcohol,  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$ ,  $\text{HgCl}_2$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . The pptd. jelly is readily sol. in conc. acids, and  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ . (Williams, l. c.)

Tin (stannous) arsenate chloride,  $\text{Sn}_2(\text{AsO}_4)_2, \text{SnCl}_2 + 2\text{H}_2\text{O}$ .

Decomp. on air (Lewissen, A. 114. 113.)

Titanium arsenate (?)

Insol. in  $\text{H}_2\text{O}$ . Sol. in titanio acid, arsenic acid, or  $\text{HCl} + \text{Aq}$ . Sol. in Ti salts +  $\text{Aq}$  (Rose)

Titanyl arsenate,  $5\text{TiO}_3, 2\text{As}_2\text{O}_5$ .

Sol. in acids without decomp. Scarcely attacked by  $\text{KOH}$  or by  $\text{NH}_4\text{OH} + \text{Aq}$ . (Reichard, B. 1894. 27. 1026)

Uranous arsenate,  $\text{U}_3(\text{AsO}_4)_2$ .

Ppt

Uranous hydrogen arsenate,  $\text{UH}_2(\text{AsO}_4)_2 + 3\text{H}_2\text{O}$

Ppt. Sol. in  $\text{HCl} + \text{Aq}$ .

Uranyl arsenate,  $(\text{UO}_2)_2\text{HAsO}_4 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$ , and saline solutions, as  $\text{NH}_4\text{Cl} + \text{Aq}$ , sol. in the mineral acids; sol. in  $\text{K}_2\text{CO}_3 + \text{Aq}$  (Werther, A. 68. 313)

$(\text{UO}_2)_4\text{H}_4(\text{AsO}_4)_3 + 3\text{H}_2\text{O}$ . (Werther)

$(\text{UO}_2)_2\text{As}_2\text{O}_7$  Insol. in  $\text{H}_2\text{O}$ , sol. in acids.

$(\text{UO}_2)_2(\text{AsO}_4)_2 + 12\text{H}_2\text{O}$ .

Min. *Troegerite*.

Vanadium dihydrogen arsenate,  $(\text{VO})_2\text{H}_2\text{AsO}_4 + 4\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Friedheim, B. 23. 2600)

See Arseniovanadic acid.

Vanadium zinc arsenate,  $(\text{VO})_2\text{ZnH}_2(\text{AsO}_4)_2 + 5\frac{1}{2}\text{H}_2\text{O}$ , and  $2(\text{VO})_2\text{H}_2\text{AsO}_4 + 6\frac{1}{2}\text{H}_2\text{O}$ .

See Arseniovanadate, zinc.

Vanadyl arsenate,  $(\text{VO})_2\text{HAsO}_4 + \text{H}_2\text{O}$ .

Very slowly sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol; easily sol. in  $\text{HCl} + \text{Aq}$  (Berzelius.)

Composition given by Friedheim (B. 23. 2600).

Yttrium arsenate,  $\text{YHAsO}_4$ .

Ppt. Insol. in acetic, easily sol. in mineral acids.

Zinc arsenate, basic,  $4\text{ZnO}, \text{As}_2\text{O}_5 + \text{H}_2\text{O}$

(Friedel, J. B. 1866. 949.)

Min. *Adamite*. Easily sol. in dil.  $\text{HCl} + \text{Aq}$ , and is attacked by  $\text{HC}_2\text{H}_3\text{O}_2$

Zinc arsenate,  $\text{Zn}_3(\text{AsO}_4)_2$ .

(deSchulten, Bull. Soc. (3) 2. 300.)

$+ 3\text{H}_2\text{O}$ . Ppt. Sol. in  $\text{HNO}_3$ , and  $\text{H}_3\text{AsO}_4 + \text{Aq}$ . (Köttig, J. pr. 48. 182.)

$+ 8\text{H}_2\text{O}$

Min. *Köttigite*.

Zinc arsenate, acid,  $\text{Zn}_2\text{H}_2(\text{AsO}_4)_4$

Easily sol. in cold  $\text{HCl} + \text{Aq}$ , less easily in cold  $\text{HNO}_3$ . Sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  (Gorgeul, Dissert, 1894.)

$+ 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_3\text{AsO}_4$ , or  $\text{HNO}_3 + \text{Aq}$  (Mitscherlich)

$+ 5\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{Aq}$  (Demel, B. 12. 1279.) Could not be obtained, (Colorano, Bull. Soc. (2) 45. 709.)

$2\text{ZnO}, \text{As}_2\text{O}_5$ . Very slowly decomp. by cold, rapidly by boiling  $\text{H}_2\text{O}$ . (Lefèvre.)

$\text{ZnHAsO}_4 + \text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  (Debray, Bull. Soc. (2) 2. 14.)

Decomp. by hot  $\text{H}_2\text{O}$  into  $4\text{ZnO}, \text{As}_2\text{O}_5 + \text{H}_2\text{O}$  (Colorano, C. R. 103. 273.)

$\text{Zn}(\text{ZnOH})_2, \text{As}_2\text{O}_5 + 7\text{H}_2\text{O}$  (Gorgeul.)

Zinc arsenate ammonia,  $\text{Zn}_2(\text{AsO}_4)_2, 2\text{NH}_3 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids,  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . (Bette, A. 15. 141.)

Zirconium arsenate,  $2\text{ZrO}_3, \text{As}_2\text{O}_5 + \frac{1}{2}\text{H}_2\text{O} = (\text{ZrO})\text{HAsO}_4 + \frac{1}{2}\text{H}_2\text{O}$

Ppt. Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ . (Paykull, B. 6. 1467.)

Perarsenic acid.

See Perarsenic acid.

Arsenicotungstic Acid.

Ammonium vanadium arsenicotungstate.

See Arseniovanadicotungstate, ammonium.

Arseniovanadicotungstic acid.

Ammonium arseniovanadicotungstate,

$16(\text{NH}_4)_2\text{O}, 5\text{As}_2\text{O}_5, 15\text{V}_2\text{O}_5, 26\text{WO}_3 + 101\text{H}_2\text{O}$ .

Sl. sol. in cold, readily sol. in hot  $\text{H}_2\text{O}$ . (Rogers, J. Am. Chem. Soc. 1903. 25. 308.)

Arsenimide,  $\text{As}_2(\text{NH})_2$

Decomp. by  $\text{H}_2\text{O}$ . (Hugot, C. R. 1904. 139. 56)

**Arsenioarsenic acid,  $3As_2O_3, 2As_2O_5 + 3H_2O$** 

Decomp. by  $H_2O$ . (Joly, C. R. 100. 1231)  
 $3As_2O_3, As_2O_5 + H_2O$  Decomp. by  $H_2O$  (Joly)  
 $As_2O_3, As_2O_5 + H_2O$  Decomp. by  $H_2O$  (Joly)

See also Arsenic trioxide pentoxide.

**Arseniochromic acid.****Ammonium arseniochromate,  $2(NH_4)_2O, As_2O_3, 4CrO_3 + H_2O$** 

Insol in  $H_2O$ . (Friedheim and Mozkin, Z. anorg. 1894, 6. 280)

$3(NH_4)_2O, As_2O_3, 8CrO_3$  Decomp. by recryst. from  $H_2O$ . (Friedheim and Mozkin, Z. anorg. 1894, 6. 281)

**Potassium arseniochromate,  $2K_2O, As_2O_3, 4CrO_3$** 

Decomp. by recryst. from  $H_2O$  (Friedheim and Mozkin, Z. anorg. 1894, 6. 275)

$2K_2O, As_2O_3, 4CrO_3 + H_2O$  Decomp. by recryst. from  $H_2O$ . (Friedheim and Mozkin, l. c.)

**Arseniomolybdic acid,  $As_2O_3, 6MoO_3 + 10H_2O$** 

By recryst. from  $H_2O$  the comp. with  $18H_2O$  is formed (Pufahl, Dissert. 1888.)

+  $16H_2O$ . Sol. in  $H_2O$  (Debray.)  
 +  $18H_2O$  Completely sol. in  $H_2O$  Sp. gr. of sat. solution at  $18^\circ$  is 2.21 Easily sol. in abs. alcohol. Insol. in  $CS_2$ , liq. hydrocarbons and  $CHCl_3$ . (Pufahl, l. c.)

$As_2O_3, 7MoO_3 + 14H_2O$  (Seyberth, B. 7. 391.)

$As_2O_3, 18MoO_3 + 28H_2O$  Very sol. in  $H_2O$  Sp. gr. of sat. solution at  $18.3^\circ$  = 2.45 and 1 cc contains 2.16 g. acid Easily sol. in absolute alcohol; insol. in  $CS_2$ , liquid hydrocarbons and  $CHCl_3$  (Pufahl, l. c.)

Sol. in ether with subsequent separation into two layers See Phosphotungstic acid. (Drechsel, B. 20. 1452.)

+  $38H_2O$  Efflorescent When recryst. comp. with  $28H_2O$  is formed. (Pufahl, l. c.)

$As_2O_3, 30MoO_3 + 27H_2O$ . Sl. sol. in  $HNO_3 + Aq$ . (Debray, C. R. 78. 1408)

**Ammonium arseniomolybdate,  $(NH_4)_2O, As_2O_3, 2MoO_3 + 3H_2O$** 

(Friedheim, Z. anorg. 1894, 6. 28.)  
 +  $4H_2O$ . (Friedheim, l. c.)

$(NH_4)_2O, As_2O_3, 6MoO_3 + 2H_2O$  Sl. sol. in cold  $H_2O$ , sol. in acids (Debray.)

+  $4H_2O$ . Sl. sol. in cold, very easily sol. in hot  $H_2O$ . (Pufahl, l. c.)

$2(NH_4)_2O, As_2O_3, 6MoO_3 + 6H_2O$ . Sl. sol. in  $H_2O$ . Cannot be recryst. therefrom (Pufahl.)

+  $12H_2O$  (Friedheim, Z. anorg. 1894, 6. 31)

$3(NH_4)_2O, As_2O_3, 6MoO_3 + 4H_2O$ . (Friedheim, l. c.)

+  $8H_2O$ . (Friedheim, l. c.)

$(NH_4)_2O, 2H_2O, 7MoO_3, As_2O_3 + 4H_2O$ . Sol. in hot  $H_2O$  (Seyberth, B. 7. 391)

Not obtained. (Pufahl)

$7(NH_4)_2O, 2As_2O_3, 14MoO_3 + 28H_2O$ . (Friedheim, l. c.)

$5(NH_4)_2O, As_2O_3, 16MoO_3 + 5H_2O$  (Friedheim, Z. anorg. 1894, 6. 31)

$5(NH_4)_2O, As_2O_3, 16MoO_3 + 9H_2O$ . Nearly insol. in cold, sol. in boiling  $H_2O$ . Easily sol. in  $NH_4OH + Aq$  (Gibbs, Am. Ch. J. 3. 402.)

+  $12H_2O$  (Pufahl, l. c.)  
 $2(NH_4)_2O, As_2O_3, 18MoO_3 + 17H_2O$ . (Pufahl, l. c.)

$3(NH_4)_2O, As_2O_3, 18MoO_3 + 14H_2O$  Very sol. in  $H_2O$  and alcohol (Kehrmann, Z. anorg. 1894, 7. 421.)

$3(NH_4)_2O, As_2O_3, 20MoO_3$ . Easily sol. in  $H_2O$  (Debray, C. R. 78. 1408.)

$3(NH_4)_2O, As_2O_3, 24MoO_3 + 12H_2O$ . Decomposed by  $H_2O$ , especially when boiling

Easily sol. in  $NH_4OH + Aq$ , less easily sol. in warm  $H_2SO_4$  and boiling  $H_2AsO_4 + Aq$ . Sl. sol. in molybdic acid +  $Aq$ ,  $HNO_3$ , and conc.  $NH_4NO_3 + Aq$  (Pufahl, l. c.)

**Barium arseniomolybdate,  $BaO, As_2O_3, 6MoO_3 + 10H_2O$**

Sl. sol. in  $H_2O$ . Partially decomp. by boiling (Pufahl, l. c.)

$3BaO, As_2O_3, 6MoO_3$ . Sl. sol. in  $H_2O$ . (Pufahl, l. c.)

$3BaO, As_2O_3, 7MoO_3$  Ppt. (Seyberth.)

$3BaO, As_2O_3, 18MoO_3$ . Decomp. by  $H_2O$ . (Pufahl, l. c.)

**Cadmium arseniomolybdate,  $CdO, 2H_2O, As_2O_3, 6MoO_3 + 11H_2O$**

(Pufahl.)  
 $3CdO, 3H_2O, As_2O_3, 18MoO_3 + 33H_2O$ . (Pufahl)

**Cesium arseniomolybdate,  $Cs_2O, As_2O_3, 6MoO_3$**

Sl. sol. in  $H_2O$  (Pufahl, l. c.)  
 $4Cs_2O, As_2O_3, 26MoO_3 + 15H_2O$ . Ppt. (Ephraim, Z. anorg. 1910, 65. 246)

**Calcium arseniomolybdate,  $CaO, As_2O_3, 6MoO_3 + 10H_2O$**

Rather difficultly sol. in cold  $H_2O$ . (Pufahl, l. c.)

$3CaO, As_2O_3, 6MoO_3$  As Ba salt. (Pufahl, l. c.)

$3CaO, As_2O_3, 18MoO_3 + 32H_2O$ . Very sol. in  $H_2O$ . Solution sat. at  $18^\circ$  has sp. gr. = 2.163. (Pufahl, l. c.)

**Cobalt arseniomolybdate,  $CoO, 2H_2O, As_2O_3, 6MoO_3 + 11H_2O$**

(Pufahl.)  
 $3CoO, 3H_2O, As_2O_3, 18MoO_3 + 33H_2O$ . (Pufahl.)

**Cupric arseniomolybdate,  $CuO, 2H_2O, As_2O_3, 6MoO_3 + 15H_2O$**

(Pufahl.)  
 $3CuO, 3H_2O, As_2O_3, 18MoO_3 + 34H_2O$ . (Pufahl.)

Lithium arseniomolybdate,  $\text{Li}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 14\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$3\text{Li}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 34\text{H}_2\text{O}$ . Solution sat at  $15^\circ$  has sp. gr. of 2.481. (Pufahl, l.c.)

Magnesium arseniomolybdate,  $\text{MgO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 13\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$3\text{MgO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 36\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

Manganese arseniomolybdate,  $\text{MnO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$ .

(Pufahl)

$3\text{MnO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 33\text{H}_2\text{O}$  (Pufahl.)

Nickel arseniomolybdate,  $\text{NiO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$

(Pufahl)

$3\text{NiO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 34\text{H}_2\text{O}$  (Pufahl.)

Potassium arseniomolybdate,  $\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{MoO}_3 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Friedheim, Z. anorg. 2. 314.)

$\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 5\text{H}_2\text{O}$ . Sol. in hot  $\text{H}_2\text{O}$  without decom. (Friedheim, Z. anorg. 1892, 2. 330.)

$\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 25\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ . Decom. on dilution. (Pufahl, l.c.)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 26\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $20\text{MoO}_3$ . Insol. in  $\text{H}_2\text{O}$  (Debray, C. R. 78. 1408.)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $24\text{MoO}_3 + 12\text{H}_2\text{O}$ . Somewhat sol. in  $\text{H}_2\text{O}$  acidified with  $\text{HNO}_3$ . (Pufahl, l.c.)

Rubidium arseniomolybdate,  $3\text{Rb}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ ,  $5\text{MoO}_3 + 9\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1910, 65. 241)

$\text{Rb}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$4\text{Rb}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 40\text{H}_2\text{O}$ . Pptd (Ephraim, Z. anorg. 1910, 65. 241-4.)

Silver arseniomolybdate,  $3\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 2\text{H}_2\text{O}$

(Pufahl, Leipzig, 1888.)

$6\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 22\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Very sol. in  $\text{NH}_4\text{OH}$  and in dil.  $\text{HNO}_3$ . (Pufahl, l.c.)

$7\text{Ag}_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $36\text{MoO}_3 + 30\text{H}_2\text{O}$ . Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$  strongly acidified with  $\text{HNO}_3$ . (Pufahl, l.c.)

Sodium arseniomolybdate,  $\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{MoO}_3 + 8\text{H}_2\text{O}$ .

(Friedheim, Z. anorg. 1892, 2. 357.)

$\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 12\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Solution sat. at  $19.8^\circ$  has sp. gr. = 1.678. (Friedheim, l.c.)

$3\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$ ,  $+ 12\text{H}_2\text{O}$ , and  $+ 13\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$3\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 24\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$+ 30\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

Strontium arseniomolybdate,  $\text{SrO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 10\text{H}_2\text{O}$ .

As Ba salt. (Pufahl, l.c.)

$3\text{SrO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$ . As Ba salt. (Pufahl, l.c.)

$3\text{SrO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 32\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

Thallium arseniomolybdate,  $6\text{Tl}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 2\text{H}_2\text{O}$

Ppt. (Pufahl.)

$8\text{Tl}_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 3\text{H}_2\text{O}$ . Ppt. (Pufahl.)

Zinc arseniomolybdate,  $\text{ZnO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$ .

(Pufahl.)

$3\text{ZnO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 37\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Pufahl.)

### Arseniophosphovanadicotungstic acid.

Ammonium arseniophosphovanadicotungstate,  $88(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $12\text{P}_2\text{O}_5$ ,  $69\text{V}_2\text{O}_5$ ,  $148\text{WO}_3 + 484\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and ether. (Rogers, J. Am. Chem. Soc. 1903, 25. 313.)

### Arseniophosphovanadicovanadiotungstic acid.

Ammonium arseniophosphovanadicovanadiotungstate,  $99(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $12\text{P}_2\text{O}_5$ ,  $6\text{V}_2\text{O}_5$ ,  $66\text{V}_2\text{O}_5$ ,  $191\text{WO}_3 + 522\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ . (Rogers, J. Am. Chem. Soc. 1903, 25. 314.)

### Arseniophosphovanadiotungstic acid.

Ammonium arseniophosphovanadiotungstate,  $82(\text{NH}_4)_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ ,  $12\text{P}_2\text{O}_5$ ,  $52\text{V}_2\text{O}_5$ ,  $201\text{WO}_3 + 567\text{H}_2\text{O}$ .

Very sol. in warm  $\text{H}_2\text{O}$ . Insol. in organic solvents (Rogers, J. Am. Chem. Soc. 1903, 25. 312.)

### Arseniosulphuric acid.

Ammonium arseniosulphate,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{SO}_3 + 3\text{H}_2\text{O}$

Can be recryst. from  $\text{H}_2\text{O}$ . (Friedheim and Moskin, Z. anorg. 1894, 6. 290.)

Potassium arseniosulphate,  $2\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{SO}_3 + 3\text{H}_2\text{O}$

(Friedheim and Moskin, Z. anorg. 1894, 6. 289.)

$5\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{SSO}_3 + 6\text{H}_2\text{O}$ . (Friedheim and Moskin, Z. anorg. 1894, 6. 291.)

Sodium arseniosulphate,  $2\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $2\text{SO}_3 + 3\text{H}_2\text{O}$ .  
(Friedheim and Mozkin, Z. anorg. 1894, 6. 290.)

### Arseniotelluric acid.

Ammonium arseniotellurate,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $\text{TeO}_3 + 4\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1901, 28. 65.)  
 $4(\text{NH}_4)_2\text{O}$ ,  $3\text{As}_2\text{O}_3$ ,  $2\text{TeO}_3 + 11\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (Weinland.)

Sodium arseniotellurate,  $2\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $2\text{TeO}_3 + 9\text{H}_2\text{O}$   
Ppt. (Weinland, l.c.)

Arseniotungstic acid,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $16\text{WO}_3 + 32\text{H}_2\text{O} = \text{H}_3\text{AsW}_3\text{O}_{28} + 16\text{H}_2\text{O}$  ( $\alpha$ -anhydroarseniotungstic acid)

Sol in  $\text{H}_2\text{O}$  (Kehrmann, A. 245. 45)  
 $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $19\text{WO}_3$  (?). Sp. gr of sat. solution in  $\text{H}_2\text{O}$  is 3.279. (Fremery, B. 17. 296.)

Is a mixture containing principally  $\text{H}_3\text{AsW}_3\text{O}_{28} + 16\text{H}_2\text{O}$  (Kehrmann.)  
 $\text{As}_2\text{O}_3$ ,  $18\text{WO}_3 + x\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1899, 22. 292.)

### Aluminum ammonium arseniotungstate.

See Aluminumcoarseniotungstate, ammonium.

Ammonium arseniotungstate,  $4(\text{NH}_4)_2\text{O}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{WO}_3 + 3\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ ; easily sol. in boiling  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 16. 135.)

$7(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $14\text{WO}_3 + 17\text{H}_2\text{O}$ . Very sl. sol. even in boiling  $\text{H}_2\text{O}$ . (Fremery, l.c.)  
 $3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $16\text{WO}_3 + 16\text{H}_2\text{O} = (\text{NH}_4)_3\text{AsW}_3\text{O}_{28} + 8\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$  (Kehrmann)

$5(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $17\text{WO}_3 + 8\text{H}_2\text{O}$ . Can be recryst. from  $\text{H}_2\text{O}$  without decomp. Decomp. by long boiling with  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1899, 22. 294.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{WO}_3 + 14$ , or  $18\text{H}_2\text{O}$ . Very sol. in cold  $\text{H}_2\text{O}$ . Can be recryst. from  $\text{H}_2\text{O}$ . (Kehrmann, l.c.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $21\text{WO}_3 + x\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Easily decomp. on recryst. (Kehrmann, l.c.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $24\text{WO}_3 + 12\text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{O}$  than corresponding phosphotungstate. (Kehrmann, l.c.)

Barium arseniotungstate,  $2\text{BaO}$ ,  $\text{As}_2\text{O}_3$ ,  $16\text{WO}_3 + x\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Péchar, A. ch. (6) 22. 262.)  
 $7\text{BaO}$ ,  $\text{As}_2\text{O}_3$ ,  $22\text{WO}_3 + 54\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ : Can be recryst. therefrom. (Kehrmann, l.c.)

Potassium arseniotungstate,  $3\text{K}_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{WO}_3$ .

Insol in  $\text{H}_2\text{O}$ . Readily sol. in alkali hydroxides + Aq. (Gibbs)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $16\text{WO}_3 + 16\text{H}_2\text{O} = \text{K}_2\text{AsW}_3\text{O}_{28} + 8\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (Kehrmann)

$5\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $17\text{WO}_3 + 22\text{H}_2\text{O}$ . Scarcely sol. in cold  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1899, 22. 295.)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{WO}_3 + 14\text{H}_2\text{O}$ . Efflorescent. (Kehrmann, l.c.)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $19\text{WO}_3 + 16\text{H}_2\text{O}$  (?). Sol. in  $\text{H}_2\text{O}$ . (Fremery.)

Silver arseniotungstate,  $\text{Ag}_3\text{AsW}_3\text{O}_{28}$ .

Insol in  $\text{H}_2\text{O}$  (Kehrmann, A. 245. 55); perhaps identical with—

$6\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $16\text{WO}_3 + 11\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$ . (Gibbs.)

Sodium arseniotungstate,  $3\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $3\text{WO}_3 + 20\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Lefort, C. R. 92. 1461)

### Arsenious acid, $\text{HAsO}_3$ .

Solubility of  $\text{HAsO}_3$  in amyl alcohol + Aq. at  $25^\circ$ .

$a_w$  = mol of  $\text{HAsO}_3$  in 1 l. of  $\text{H}_2\text{O}$ .

$a_a$  = mol. of  $\text{HAsO}_3$  in 1 l. of amyl alcohol.

$h$  = partition coefficient

$a_w$	$a_a$	$h$
0.0449	0.0082	5.48
0.0446	0.0083	5.38
0.0887	0.0184	5.41
0.0892	0.0161	5.53
0.1800	0.0324	5.55

(Auerbach, Z. anorg. 1903, 37. 356.)

Solubility of  $\text{HAsO}_3$  in sat.  $\text{H}_3\text{BO}_3 + \text{Aq}$  and amyl alcohol.

$a_w$  = mol. of  $\text{HAsO}_3$  in 1 l. of  $\text{H}_2\text{O}$ .

$a_a$  = mol. of  $\text{HAsO}_3$  in 1 l. of amyl alcohol.

$h$  = partition coefficient

$a_w$	$a_a$	$h$
0.0859	0.0161	5.33
0.1720	0.0321	5.35

(Auerbach, l.c.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

See Arsenic trioxide.

### Arsenites.

All arsenites, except those of the alkali metals, are partially or wholly insol in  $\text{H}_2\text{O}$ , but easily sol. in acids; several are sol. in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4\text{Cl} + \text{Aq}$ .

All basic arsenites are sol. in acids except those that give an insol. salt with the bases. Many are sol. in excess of  $\text{As}_2\text{O}_3 + \text{Aq}$

**Aluminum arsenite,  $Al_2O_3, As_2O_3$** 

Sl sol in boiling  $H_2O$ . Easily sol in  $NaOH + Aq$  and in acids (Reichard, B 1894, 27. 1729)

**Aluminum arsenite iodide,  $AlI_3, 6As_2O_3 + 16H_2O$ .**

(Gruhl, Dissert 1897.)

**Ammonium arsenite,  $NH_4AsO_3$** 

Very sol in  $H_2O$ . (Luyne, A. pr. 72. 180.)  
Insol. in acetone. (Eidmann, C. C 1899, II. 1014); (Naumann, B. 1904, 37. 4328.)  
( $NH_4$ )<sub>3</sub> $AsO_3$  (?) Sol. in  $H_2O$ . (Stavenhagen, J. pr. 1895, (2) 51. 11.)  
( $NH_4$ )<sub>4</sub> $AsO_4$ . Very sol in  $H_2O$ . Insol in alcohol or ether. (Stein, A. 74. 218.)  
Could not be obtained. (Stavenhagen.)

**Ammonium arsenite bromide,  $2As_2O_3, NH_4Br$ .**

Sl sol in  $H_2O$ . (Rudorff, B. 19. 2679.)

**Ammonium arsenite chloride,  $As_2O_3, NH_4Cl$** 

Sl sol in  $H_2O$ . Sol. in warm dil.  $NH_4OH + Aq$  (Rudorff)

**Ammonium arsenite iodide,  $2As_2O_3, NH_4I$ .**

Sl sol in boiling  $H_2O$ . Sol in warm dil.  $NH_4OH + Aq$ . (Rudorff.)

**Antimony arsenite (?).**

Ppt Sol in a small amount  $H_2O$ , but insol. in a large quantity. (Berzelius.)  
Completely sol. in  $KOH + Aq$  (Reynolds)

**Barium arsenite,  $Ba(AsO_3)_2$ .**

Easily sol. in  $H_2O$  when recently pptd., but insol. after being dried. Pptd. from aqueous solution by boiling. (Filhol, A. 68. 308)

Only sl. sol. in  $H_2O$ . (Stavenhagen, J. pr. 1895, (2) 51. 18.)

$Ba_3(AsO_3)_2$ . Sl sol in cold  $H_2O$ ; sol. in hot  $H_2O$  and dil. acids. (Stavenhagen, J. pr. 1895, (2) 51. 17.)

$BaH_2(AsO_3)_2$ . Ppt. (Bloxam, Chem. Soc. 15. 281.)

+34 $H_2O$ . Moderately sol. in cold, more easily sol. in hot  $H_2O$ . Insol. in alcohol. (Perper, Dissert. 1894)

$Ba_2As_2O_5 + 2H_2O$ . Easily sol. in  $H_2O$  (Stavenhagen, J. pr. 1895, (2) 51. 18.)

+4 $H_2O$ . Sl. sol. in  $H_2O$ ; also somewhat sol. in alcohol. (Stein, A. 74. 218.)

Sl. sol. in  $H_2AsO_4 + Aq$  and  $BaO_2H_2 + Aq$ . (Dumas.)

Sol. in  $NH_4Cl + Aq$ . (Wackenroder, A. 41. 316.)

Not pptd. from solutions containing Na citrate (Spiller.)

$BaAs_4O_7$ . Sol. in  $H_2O$ . Less sol. in alcohol. (Reichard, B. 1894, 27. 1033.)

**Bismuth arsenite,  $BiAsO_3 + 5H_2O$  (?).**

Easily sol. in  $HNO_3 + Aq$ . (Schnneider, J. p. (2) 20. 419.)

Sl sol in  $H_2O$  (Stavenhagen, J. pr. 1895, (2) 51. 35.)

**Cadmium arsenite,  $Cd_3(AsO_3)_2$** 

Sl. sol. in  $H_2O$ ; easily sol. in  $NH_4OH + Aq$  and dil. acids. (Stavenhagen, l.c.)

$Cd_2As_2O_5$ . Ppt (Reichard, B 1898, 31. 2168)

Sol in acids without decomp; insol. in alkalis. (Reichard, B 1894, 27. 1033)

5 $CdO, As_2O_3 + 12H_2O$  Not attacked by  $KOH, Ba(OH)_2$  or alkali carbonates +  $Aq$ . Insol in  $KCN + Aq$ . (Reichard, Ch. Z. 1902, 26. 1145)

**Cæsium arsenite bromide,  $As_2O_3, CsBr$ .**

Sol. in  $H_2O$ . (Wheeler, Z. anorg. 4. 451.)

**Cæsium arsenite chloride,  $As_2O_3, CsCl$ .**

As above.

**Cæsium arsenite iodide,  $As_2O_3, CsI$ .**

As above.

**Calcium arsenite,  $Ca(AsO_3)_2$** 

Somewhat sol. in  $H_2O$ , sol. in  $Ca(OH)_2 + Aq$  or  $As_2O_3 + Aq$ . (Simon, Pogg. 47. 417.)

$Ca_3(AsO_3)_2$ . Ppt (Kühn, J. B. 1862. 379)

Only sl. sol.  $H_2O$ ; readily sol. in dil. acids (Stavenhagen, l.c.)

Sol. in  $H_2O$ , insol. in alcohol (Reichard, B 1894, 27. 1036.)

3 $CaO, 2As_2O_3 + 3H_2O$ . Sl. sol. in  $H_2O$ ; easily sol. in  $NH_4Cl + Aq$ ; sol. in  $As_2O_3 + Aq$ . (Stein.)

$CaH_2(AsO_3)_2 + xH_2O$  Moderately sol. in  $H_2O$ . Insol in abs. alcohol. (Perper, Dissert. 1894.)

$Ca_2As_2O_5$ . Sl. sol. in  $H_2O$ ; 1 pt. in 3000-4000 pts  $H_2O$ . Alkali chlorides increase solubility slightly. (Stavenhagen, l.c.)

Sl. sol. in  $H_2O$ ; insol in  $H_2O$  containing  $CaO_2H_2$ . (Berzelius)

Not pptd. in presence of 4000-5000 pts  $H_2O$ . (Harting, Leansigne)

Not pptd. from solutions containing  $NH_4$  salts; and when pptd. in sol. in  $(NH_4)SO_4, NH_4NO_3, NH_4C_2H_3O_2$ , and  $NH_4Cl + Aq$ . (Gesenius and Schweigger.)

Sol in  $NH_4(AsO_3)_2 + Aq$  (Schwauenger)

Sol in  $CaCl_2 + Aq$  (Ordway)

Easily sol. in dil. acids. Not pptd. from solutions containing sodium citrate (Spiller)

**Calcium arsenite iodide,  $CaI_2, 3As_2O_3 + 12H_2O$** 

Sl. sol in  $H_2O$ . Decomp. on heating. (Gruhl, Dissert 1897.)

**Chromic arsenite,  $CrAsO_3$ .**

Sol. in  $H_2O$ , but slowly decomp. by boiling. (Neville, C. N. 34. 220.)

Sol. in  $HCl$ ; repptd. by  $NH_4OH + Aq$ ; sol. in  $KOH + Aq$ . (Reichard, B. 1894, 27. 1028.)

**Cobaltous arsenite basic,  $7CoO, As_2O_3$ .**

Very sol. in dil. difficultly sol. in conc.  $H_2SO_4$ . Sol. in conc.  $NaOH$  and in conc.  $NH_4OH + Aq$ . (Reichard, Z. anal. 1903, 42. 19.)

**Cobaltous arsenite,  $3\text{CoO} \cdot \text{As}_2\text{O}_3$ .**

Sol  $\text{KOH} + \text{Aq}$  with decomp. (Identical with salt of Guard) (Reichard, B. 1894, 27. 1031)

+  $4\text{H}_2\text{O}$ . Sl sol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Stavenhagen, J. pr. 1895, (2) 51. 39)

$3\text{CoO}$ ,  $2\text{As}_2\text{O}_3 + 4\text{H}_2\text{O}$ . Sol in  $\text{HNO}_3$  (Girard, C. R. 1852, 34. 918.)

$\text{Co}_3\text{H}_2(\text{AsO}_3)_4$ . Insol in  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Proust)

Only sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  when formed in a solution containing an excess of those reagents. (Reynoso, C. R. 31. 68)

$\text{Co}_2\text{As}_2\text{O}_5$ . Ppt (Reichard, B. 1898, 31. 2165.)

Sol. in  $\text{HNO}_3$  and  $\text{HCl} + \text{Aq}$ . (Proust)

**Cupric arsenite,  $\text{Cu}(\text{AsO}_3)_2$ .**

(Avery, J. Am. Chem. Soc. 1906, 28. 1161.)

Insol in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

+  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Stavenhagen, l.c.)

+  $2\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ , insol. in alcohol. (Stavenhagen, l.c.)

$3\text{CuO}$ ,  $\text{As}_2\text{O}_3$ . Ppt (Stavenhagen, l.c.)

$2\text{CuO}$ ,  $\text{As}_2\text{O}_3$  (Scheele's green) Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{KOH} + \text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , and in most acids. Formula is  $\text{Cu}_2(\text{AsO}_3)_2 + 2\text{H}_2\text{O}$ . (Sharples, C. N. 35. 89)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp. Sol in  $\text{KOH} + \text{Aq}$  with decomp (Reichard, B. 1894, 27. 1026)

Insol in pyridine. (Schroeder, Dissert. 1901.)

$5\text{CuO}$ ,  $\text{As}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ , sol in acids,  $\text{NH}_4\text{OH} + \text{Aq}$  and conc  $\text{MOH} + \text{Aq}$  (Reichard, Ch. Z. 1902, 26. 1142)

$x\text{CuO}$ ,  $y\text{As}_2\text{O}_3$ . Min. *Trippskate*. Easily sol in  $\text{HNO}_3$  and in  $\text{HCl} + \text{Aq}$

**Didymium arsenite,  $\text{Dy}_2\text{H}_2(\text{AsO}_3)_4$ .**

Ppt. (Frenche and Smith, A. 191. 355.)

Does not exist (Cleve, B. 11. 910)

**Glucinum arsenite iodide,  $\text{GlH}_2$ ,  $3\text{As}_2\text{O}_3 + 8\text{H}_2\text{O}$** 

Decomp. by  $\text{H}_2\text{O}$  (Gruhl, Dissert. 1897.)

**Gold (aurous) arsenite,  $3\text{Au}_2\text{O}_3 \cdot \text{As}_2\text{O}_3$** 

Decomp by light. (Reichard, B. 1894, 27. 1027)

**Gold (auric) arsenite,  $\text{AuAsO}_3 + \text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  and dil acids (Stavenhagen, J. pr. 1895, (2) 51. 28.)

**Iron (ferrous) arsenite,  $\text{FeO} \cdot \text{As}_2\text{O}_3$** 

Decomp. in the air when moist; sol in  $\text{NH}_4\text{OH} + \text{Aq}$  when freshly pptd. (Reichard, B. 1894, 27. 1029-30.)

$\text{Fe}_2\text{As}_2\text{O}_6$ . Ppt Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in  $\text{NH}_3$  arsenite, or other  $\text{NH}_4$  salts +  $\text{Aq}$ . (Wittstein)

**Iron (ferric) arsenite, basic,  $4\text{Fe}_2\text{O}_3 \cdot \text{As}_2\text{O}_3 + 5\text{H}_2\text{O}$ .**

Ppt.  $\text{H}_2\text{O}$  extracts  $\text{As}_2\text{O}_3$ . Sol. in conc acids with separation of  $\text{As}_2\text{O}_3$ . Acetic acid is without action. (Bunsen and Berthold, 1834.)

Sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ .

**Iron (ferric) arsenite,  $\text{Fe}_2\text{O}_3 \cdot \text{As}_2\text{O}_3$** 

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  when freshly pptd. (Reichard, B. 1894, 27. 1030)

$\text{Fe}_4\text{As}_2\text{O}_9$ . Ppt. (Reichard, B. 1898, 31. 2170)

+  $7\text{H}_2\text{O}$ . Sol. in  $\text{NaOH}$ , and  $\text{KOH} + \text{Aq}$ .

"Ferric arsenite" is sl. sol. in  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$ . (Kynaston, Dmg. 235. 326.)

**Lanthanum arsenite,  $\text{La}_2\text{H}_2(\text{AsO}_3)_4$ .**

Ppt. (Frenche and Smith, A. 191. 355)

Does not exist. (Cleve, B. 11. 910.)

**Lead arsenite,  $\text{Pb}(\text{AsO}_3)_2 + x\text{H}_2\text{O}$** 

Sl sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{KOH}$ , but sol in  $\text{NaOH} + \text{Aq}$  (Berzelius.)

$\text{Pb}_2\text{As}_2\text{O}_6$ . Insol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ ,  $\text{NH}_3$  arsenite, or other  $\text{NH}_4$  salts +  $\text{Aq}$  (Wittstein)

$\text{Pb}_3(\text{AsO}_3)_5$ . Scarcely sol in  $\text{H}_2\text{O}$ , easily sol in  $\text{HNO}_3$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Boiling  $\text{H}_2\text{O}$  dissolves some  $\text{As}_2\text{O}_3$ . Not completely insol. in  $\text{KOH} + \text{Aq}$ . (Streng, A. 129. 238)

Sol. in acetic acid; insol. in  $\text{H}_2\text{O}$  in the presence of ammonium salts; sol in  $\text{NaOH} + \text{Aq}$ , sl sol. in  $\text{KOH} + \text{Aq}$  (Reichard, B. 1894, 27. 1024.)

+  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Stavenhagen, J. pr. 1895, (2) 51. 33.)

**Lead arsenite chloride,  $\text{Pb}_3\text{As}_2\text{O}_6 \cdot 3\text{PbCl}_2$ .**

Min. *Ekdemite*. Easily sol in  $\text{HNO}_3 + \text{Aq}$ , and warm  $\text{HCl} + \text{Aq}$ .

**Magnesium arsenite,  $\text{Mg}_3(\text{AsO}_3)_4$** 

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$ , but sol. in a large excess of  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose.)

Very sol in boiling  $\text{H}_2\text{O}$  and in dil. acids. Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Reichard, B. 1894, 27. 1032.)

Very sol in  $\text{H}_2\text{O}$  and dil acids. (Stavenhagen, l.c.)

$\text{Mg}_3\text{As}_2\text{O}_6 + 4\text{H}_2\text{O}$  Hydroscopic. Very sol in  $\text{H}_2\text{O}$  and acids. (Stavenhagen, l.c.)

$3\text{MgO} \cdot 2\text{As}_2\text{O}_3 + 3\text{H}_2\text{O} + 15\text{H}_2\text{O}$ , and +  $18\text{H}_2\text{O}$ . (Perper, Dissert. 1894.)

**Magnesium arsenite iodide,  $\text{MgI}_2 \cdot 3\text{As}_2\text{O}_3 + 12\text{H}_2\text{O}$** 

Moderately sol in  $\text{H}_2\text{O}$ . (Gruhl, Dissert. 1897.)

**Manganous arsenite,  $\text{Mn}_2(\text{AsO}_3)_2 + 3\text{H}_2\text{O}$ .**

Sol in  $\text{H}_2\text{O}$ ; insol in alcohol; easily oxidized by moist air. (Stavenhagen, l.c.)

$3\text{MnO} \cdot 2\text{As}_2\text{O}_3$ . (Reichard, B. 1894, 27. 1032.)

$Mn_3H_2As_2O_{10} + 4H_2O$ . Sl sol in  $H_2O$ . Very sol in acids and alkali (Stavenhagen, *l.c.*)  
 $Mn_3As_2O_8$  Ppt (Reichard, B 1898, 31. 2165.)

Mercurous arsenite,  $Hg_2O_3As_2O_3$ .

Decomp by light. Decomp by  $H_2O$  (Reichard, B 1894, 27. 1022)  
 $Hg_2As_2O_3$ . Only sl sol in  $H_2O$ . sol. in dil acids (Stavenhagen, J p 1895, (2) 51. 24.)

Gradually and completely decomposed by  $H_2O$  (Reichard, Ch. Z. 1902, 26. 1143)

Mercuric arsenite,  $Hg_2(AsO_3)_2$ .

Sl sol. in  $H_2O$  (Stavenhagen, *l.c.*)  
 Decomp more easily by  $H_2O$  than is the mercurous comp. (Reichard, Ch. Z. 1902, 26. 1143)

$2HgO, As_2O_3$  Not decomp. by boiling with  $H_2O$  Undecomp. by boiling acids  
 Decomp by  $KOH + Aq$ ,  $K_2CO_3 + Aq$  and  $NH_4OH + Aq$  (Reichard, B 1894, 27. 1021)  
 $Hg_2As_2O_3$  Ppt. Decomp. by boiling  $H_2O$ . Very sl. sol. in  $H_2SO_4 + HCl$ . (Reichard, B 1898, 31. 2170)

Nickel arsenite,  $Ni_2(AsO_3)_2$

Insol. in  $H_2O$ ; easily sol. in  $NH_4OH + Aq$  (Proust.)

Ppt. (Reichard, B. 1898, 31. 2165)  
 $3NiO, 2As_2O_3$ . Sol. in  $NH_4OH + Aq$  (identical with salt of Girard) (Reichard, B 1894, 27. 1031.)

$+ 4H_2O$ . Insol. in  $H_2O$ , sol. in  $NH_4OH + Aq$ . (Proust.)

Sol. in  $KOH + Aq$  (Girard, C R 34. 918)

$2NiO, As_2O_3$  Insol. in  $H_2O$ ; sol. in  $NH_4OH + Aq$ , sol. in  $KOH + Aq$  (Reynoso, C. R. 31. 68)

Platinum arsenite,  $Pt_3(AsO_3)_4$ .

Sol. in  $H_2O$  and alcohol; very unstable (Stavenhagen, *l.c.*)

Potassium arsenite,  $KAsO_2$ .

Sol. in  $H_2O$ ; sl sol. in alcohol (Pasteur, A 68. 309.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601)

Does not exist. (Stavenhagen, *l.c.*)

$K_3AsO_3$  Very sol. in  $H_2O$ , sol. in alcohol. (Stavenhagen, *l.c.*)

$K_4As_2O_6 + 6H_2O$ . Very sol. in  $H_2O$ ; sol. in alcohol. (Stavenhagen, *l.c.*)

$K_2As_4O_7 + 2H_2O$ . Sol. in  $H_2O$ ; sl sol. in alcohol. (Pasteur, A. 68. 309)

Potassium arsenite bromide,  $4As_2O_3, 2KBr$

More sol. in  $H_2O$  than iodide. (Schiff and Sestini, A. 228. 72.)

$2As_2O_3, KBr$ . (Rudorff, B 19. 2675.)

Potassium arsenite chloride,  $2As_2O_3, KCl$

Much more quickly sol. in hot  $H_2O$  than bromide or iodide. (Rudorff, B 19. 2675.)

$As_2O_3, KCl$ . Decomp by  $H_2O$

Potassium arsenite iodide,  $3As_2O_3, 2KI + H_2O$

Sl. sol. in cold  $H_2O$ ; sol. in 20 pts. boiling, and 40 pts. cold  $H_2O$ . (Limmel, Sil. Am. J (2) 18. 583.)

$6KAsO_2, 2KI + 3H_2O$ . Sol. in  $H_2O$  and alcohol. Decomp. by acids. (Harms)

$2KH(AsO_3)_2, As_2O_3, 2KI$ . Sl. sol. in  $H_2O$ . (Harms, A. 91. 371)

$2As_2O_3, KI$ . Very difficultly sol. even in boiling  $H_2O$  Very easily sol. in  $KOH + Aq$ , but much less so in  $K_2CO_3 + Aq$  (Rudorff, B. 19. 2670)

Sol. in 40 pts. cold, 20 pts. hot  $H_2O$ ; sol. in alkalis. (Schiff and Sestini, A. 228. 72)

Potassium arsenite sulphate,  $K_3AsO_3, 10K_2SO_4$ .

(Stavenhagen, Zeit. angew. ch 1894, 8. 166.)

Rubidium arsenite,  $RbAsO_3$ .

Sol. in  $H_2O$ , aq. solution is alkaline to litmus. Insol. in alcohol (Bouchonnet, C. R. 1907, 144. 641.)

Rubidium arsenite bromide,  $As_2O_3, RbBr$

Decomp by  $H_2O$ . (Wheeler, Z. anorg. 4. 451.)

Rubidium arsenite chloride,  $As_2O_3, RbCl$ .

As above

Rubidium arsenite iodide,  $As_2O_3, RbI$

As above.

Silver arsenite,  $Ag_3AsO_3$ .

Insol. in  $H_2O$  Not pptd. in presence of 20,000 pts.  $H_2O$  (Hartnag.)

11  $H_2O$  dissolves 0.0115 g  $Ag_3AsO_3$  at 20° (Whitby, Z. anorg 1910, 67. 108.)

Only sl. sol. in  $H_2O$  and in dil. acids; readily sol. in  $NH_4OH + Aq$  and conc. acids. (Stavenhagen, *l.c.*)

Decomp by light, by  $KOH + Aq$  and by  $NH_4OH + Aq$  (Reichard, B. 1894, 27. 1022-23)

Easily sol. in  $HNO_3 + Aq$  and other acids. (Marcet)

More easily sol. in  $HC_2H_3O_2 + Aq$  than  $Ag_3PO_4$ ; sl. sol. in  $HC_2H_3O_2 + Aq$  (Santos, C. N. 38. 94.)

Insol. in  $KOH + Aq$ . (Kuhn, Arch. Pharm. (2) 69. 267)

Easily sol. in  $NH_4OH + Aq$ . (Marcet.)

Insol. in  $NH_4OH + Aq$ , but sol. therein in presence of alkali nitrates. (Santos, *l.c.*)

Incompletely sol. in  $(NH_4)_2CO_3$ ,  $(NH_4)_2SO_4$ , or  $NH_4NO_3 + Aq$  (Wittstein, Report. 51. 41.)

Decomp. by  $\text{NH}_4\text{Cl} + \text{Aq}$  Sol. in  $\text{KAsO}_4 + \text{Aq.}$  (Kuhn, *l.c.*)

Not pptd. in solutions containing sol citrates (Spiller.)

Sol. in methyl acetate (Naumann, B 1909, 42, 3790)

Sl. sol. in methyl acetate (Bezold, Dissert 1908.)

Insol. in ethyl acetate. (Hamers, Dissert 1906); (Naumann, B 1910, 43, 314.)

+  $\text{H}_2\text{O}$  Very sol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  and in dil acids (Stavenhagen, J. pr. 1895, (2) 51, 29.)

$2\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ . Ppt. (Pasteur, J. Pharm (3) 13, 395)

Could not be obtained (Stavenhagen, *l.c.*)

$3\text{Ag}_2\text{O}$ ,  $2\text{As}_2\text{O}_3$ . Sol. in cold  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  (Santos)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  and in potassium arsenite +  $\text{Aq}$  (Girard, C. R. 34, 918)

Ppt. (Reichard, B. 1898, 31, 2167)

Could not be obtained. (Stavenhagen, *l.c.*)

Silver arsenite ammonia,  $2\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $4\text{NH}_3$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol. (Girard.)

### Sodium arsenites.

Correspond to potassium arsenites, but have not been obtained in crystalline form. All are very sol. in  $\text{H}_2\text{O}$  (Pasteur, A. 68, 308.)

$\text{Na}_3\text{AsO}_3$ . Very sol. in  $\text{H}_2\text{O}$ . (Stavenhagen, *l.c.*)

Insol. in ethyl acetate (Naumann, B 1904, 37, 3802)

Sodium arsenite bromide,  $2\text{As}_2\text{O}_3$ ,  $\text{NaBr}$

Decomp. by warm  $\text{H}_2\text{O}$ . (Rudorff, B 21, 3052.)

Sodium arsenite iodide,  $2\text{As}_2\text{O}_3$ ,  $\text{NaI}$ .

Decomp. by hot  $\text{H}_2\text{O}$ . (Rudorff.)

Strontium arsenite,  $\text{Sr}_2(\text{AsO}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Stavenhagen, *l.c.*)

Sol. in  $\text{H}_2\text{O}$ , insol. in alcohol (identical with Stein.) (Reichard, B. 1894, 27, 1036)

$\text{Sr}_2\text{As}_2\text{O}_6 + 2\text{H}_2\text{O}$ . Quite easily sol. in  $\text{H}_2\text{O}$  (Stein.)

Sl. sol. in  $\text{H}_2\text{C}$ ,  $\text{SrO}_2\text{H}_2 + \text{Aq.}$  or  $\text{H}_3\text{AsO}_4 + \text{Aq}$  (Dumas)

Very sl. sol. in alcohol (Stein.)

Easily sol. in  $\text{H}_2\text{O}$  and in acids. (Stavenhagen, J. pr. 1895, (2) 51, 17)

$\text{Sr}_2\text{As}_2\text{O}_6$ . Moderately sol. in  $\text{H}_2\text{O}$ . (Reichard, B. 1894, 27, 1036)

Strontium arsenite iodide,  $\text{SrI}_2$ ,  $3\text{As}_2\text{O}_3 + 12\text{H}_2\text{O}$ .

As Ba comp. (Grühl, Dissert. 1897.)

Thallium arsenite,  $\text{Tl}_3\text{AsO}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$  and alcohol, easily sol. in acids, especially in dil  $\text{H}_2\text{SO}_4$ . (Stavenhager, *l.c.*)

Tin (stannous) arsenite,  $\text{Sn}_2(\text{AsO}_3)_2$ .

Ppt., decomp. by acids and alkali. (Reichard, B. 1898, 31, 2169)

+  $2\text{H}_2\text{O}$  Sl. sol. in  $\text{H}_2\text{O}$  Easily sol. in dil. acids and alkalis (Stavenhagen, *l.c.*)

Tin (stannic) arsenite,  $\text{Sn}_2(\text{AsO}_4)_2 + 5\frac{1}{2}\text{H}_2\text{O}$

Sl. sol. in  $\text{H}_2\text{O}$ . (Stavenhagen, *l.c.*)

$5\text{SnO}_2$ ,  $2\text{As}_2\text{O}_3$  Ppt. Sol. in acids without decomp. (Reichard, B. 1894, 27, 1025)

$\text{Sn}_2\text{As}_2\text{O}_{17}$ . Ppt (Reichard, B. 1898, 31, 2169)

Uranium arsenite,  $\text{UO}_2$ ,  $\text{As}_2\text{O}_3$ .

Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; only sl. sol.  $\text{KOH} + \text{Aq.}$  Sol. in acids. (Reichard, B. 1894, 27, 1029)

Zinc arsenite,  $\text{ZnO}$ ,  $\text{As}_2\text{O}_3$ .

Ppt. (Avery, J. Am. Chem. Soc. 1906, 28, 1163)

$3\text{ZnO}$ ,  $\text{As}_2\text{O}_3$  Sol. in acids without decomp. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Reichard, B. 1894, 27, 1033.)

Arseniovandic acid,  $\text{As}_2\text{O}_3$ ,  $\text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ , but solution easily decomposes; crystallizes from  $\text{H}_2\text{O}$  with  $10\text{H}_2\text{O}$ . Composition is vanadium dihydrogen arsenate  $(\text{VO})_2\text{H}_2\text{AsO}_4$ . (Friedheim, B. 23, 2600.)

+14, and +18  $\text{H}_2\text{O}$ . (Ditte, C. R. 102, 757.) Could not be obtained (Friedheim.)

$3\text{As}_2\text{O}_3$ ,  $2\text{V}_2\text{O}_5$ . (Berzelius.) Correct formula is as above. (Friedheim)

$3\text{H}_2\text{O}$ ,  $7\text{As}_2\text{O}_6$ ,  $6\text{V}_2\text{O}_5$ . (Gibbs, Am. Ch. J. 7, 209.) Could not be obtained. (Friedheim.)

$3\text{H}_2\text{O}$ ,  $5\text{As}_2\text{O}_3$ ,  $8\text{V}_2\text{O}_5 + 24\text{H}_2\text{O}$ . (Gibbs.) Could not be obtained (Friedheim.)

### Arseniovandates.

According to Friedheim (Z. anorg. 1892, 2, 319) the arseniovandates are double arsenates of  $\text{VO}_2$  and  $\text{NH}_4$ .

Ammonium arseniovandate,  $(\text{NH}_4)_2\text{O}$ ,

$\text{As}_2\text{O}_3$ ,  $2\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$

Efflorescent in dry air, sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Composition is ammonium divanadium arsenate

$= (\text{VO})_2(\text{NH}_4)\text{AsO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ . (Friedheim, B. 23, 2600.)

Sl. sol. in cold  $\text{H}_2\text{O}$  Somewhat more easily sol. in hot  $\text{H}_2\text{O}$  with separation of  $\text{V}_2\text{O}_5$ .

(Schmitz-Dumont, Dissert 1891.)

$2(\text{NH}_4)_2\text{O}$ ,  $3\text{As}_2\text{O}_3$ ,  $2\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$  Cannot be crystallized from  $\text{H}_2\text{O}$ . Composition is  $(\text{NH}_4)_2\text{HAsO}_4 + 2(\text{VO})_2\text{HAsO}_4$ . (Friedheim.)

Decomp. under  $\text{H}_2\text{O}$  to  $(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $\text{As}_2\text{O}_3 + 5\text{H}_2\text{O}$ . (Schmitz-Dumont, *l.c.*)

$5(\text{NH}_4)_2\text{O}$ ,  $4\text{As}_2\text{O}_3$ ,  $2\text{V}_2\text{O}_5 + 18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102, 1019.) Does not exist (Friedheim, B. 23, 2605.)

Calcium arseniovanadate,  $2\text{CaO}, 3\text{As}_2\text{O}_5, 2\text{V}_2\text{O}_5 + 2\text{H}_2\text{O} = \text{CaHAsO}_4 + 2(\text{VO}_3)\text{H}_2\text{AsO}_4 + 8\text{H}_2\text{O}$

Can be crystallized in presence of vanadic acid without decomp (Friedheim)  
Efflorescent. Sol in  $\text{H}_2\text{O}$  (Schmitz-Dumont, l.c.)

Cobalt arseniovanadate,  $\text{CoO}, \text{As}_2\text{O}_5, \text{V}_2\text{O}_5 + 9\text{H}_2\text{O} = \text{Co}(\text{VO}_3)_2\text{H}_2(\text{AsO}_4)_2 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Friedheim.)

Copper arseniovanadate,  $\text{CuO}, \text{As}_2\text{O}_5, \text{V}_2\text{O}_5 + 4\text{H}_2\text{O} = \text{Cu}(\text{VO}_3)_2\text{H}_2(\text{AsO}_4)_2 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Friedheim.)

Magnesium arseniovanadate,  $\text{MgO}, \text{As}_2\text{O}_5, \text{V}_2\text{O}_5 + 10\text{H}_2\text{O} = (\text{VO}_3)_2\text{MgH}_2(\text{AsO}_4)_2 + 9\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  (Friedheim.)

Moderately sol. in  $\text{H}_2\text{O}$ . Solution decomp. on standing. (Schmitz-Dumont, l.c.)  
 $2\text{MgO}, 3\text{As}_2\text{O}_5, 2\text{V}_2\text{O}_5 + 23\text{H}_2\text{O} = \text{MgHAsO}_4 + 2(\text{VO}_3)_2\text{H}_2\text{AsO}_4 + 9\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

Sol. in  $\text{H}_2\text{O}$  but solution decomp. on evaporation. (Schmitz-Dumont, l.c.)

Potassium arseniovanadate,  $\text{K}_2\text{O}, \text{As}_2\text{O}_5, 2\text{V}_2\text{O}_5 + 5\text{H}_2\text{O} = (\text{VO}_3)_2\text{KAsO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Friedheim.)

Sl. sol. in cold  $\text{H}_2\text{O}$  Partially decomp. on heating. (Schmitz-Dumont.)

Strontium arseniovanadate,  $2\text{SrO}, 3\text{As}_2\text{O}_5, 2\text{V}_2\text{O}_5 + 20\text{H}_2\text{O} = \text{SrHAsO}_4 + 2(\text{VO}_3)_2\text{H}_2\text{AsO}_4 + 7\frac{1}{2}\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Friedheim.)

+  $21\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Schmitz-Dumont.)

Zinc arseniovanadate,  $\text{ZnO}, \text{As}_2\text{O}_5, \text{V}_2\text{O}_5 + 6\frac{1}{2}\text{H}_2\text{O} = \text{Zn}(\text{VO}_3)_2\text{H}_2(\text{AsO}_4)_2 + 5\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Friedheim.)

$2\text{ZnO}, 3\text{As}_2\text{O}_5, 2\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ , and  $+18\text{H}_2\text{O} = \text{ZnHAsO}_4 + 2(\text{VO}_3)_2\text{H}_2\text{AsO}_4$ , and  $+6\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

### Arseniovanadicotungstic acid.

Ammonium arseniovanadicotungstate,  $17(\text{NH}_4)_2\text{O}, 2\text{As}_2\text{O}_5, 14\frac{1}{2}\text{V}_2\text{O}_5, 29\text{WO}_3 + 98\text{H}_2\text{O}$

Sl. sol. in cold  $\text{H}_2\text{O}$ . Readily sol. in boiling  $\text{H}_2\text{O}$ . Insol. in alcohol, ether, benzene,  $\text{CS}_2$ ,  $\text{CHCl}_3$ , acetone, nitrobenzene, aniline and acetic anhydride. (Rogers, J. Am. Chem. Soc. 1903, 25, 307.)

### Arseniovanadicovanadic acid.

Ammonium arseniovanadicovanadate,  $5(\text{NH}_4)_2\text{O}, 12\text{As}_2\text{O}_5, 12\text{VO}_3, 6\text{V}_2\text{O}_5 + 7\text{H}_2\text{O}$ .

Sl. sol. in cold, sol. in hot  $\text{H}_2\text{O}$ , from which crystallizes—

$4(\text{NH}_4)_2\text{O}, 9\text{As}_2\text{O}_5, 9\text{VO}_3, 8\text{V}_2\text{O}_5 + 11\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7, 209.)

### Arseniovanadicovanadiotungstic acid.

Ammonium arseniovanadicovanadiotungstate,  $17(\text{NH}_4)_2\text{O}, 2\text{As}_2\text{O}_5, 7\text{V}_2\text{O}_5, 4\text{V}_2\text{O}_3, 32\text{WO}_3 + 73\text{H}_2\text{O}$ .

Sl. sol. in cold, readily sol. in boiling  $\text{H}_2\text{O}$ . (Rogers, J. Am. Chem. Soc. 1903, 25, 310.)

### Arseniovanadiotungstic acid.

Ammonium arsenovanadiotungstate,  $18(\text{NH}_4)_2\text{O}, 2\text{As}_2\text{O}_5, 13\text{V}_2\text{O}_5, 39\text{WO}_3 + 88\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in organic solvents. (Rogers, J. Am. Chem. Soc. 1903, 25, 306.)

### Arseniuretted hydrogen, $\text{AsH}_3$ .

See Arsenic hydride.

### Arsenochromic acid.

Potassium arsenochromate,  $\text{K}_4\text{Cr}_2\text{As}_2\text{O}_{16} + 12\text{H}_2\text{O}$ .

Sol. in moderately conc. mineral acids. (Tarugi, C. C. 1897, II, 724.)

$\text{K}_7\text{Cr}_2\text{As}_2\text{O}_{23} + 24\text{H}_2\text{O}$ . Ppt. Sol. in dil. warm acids (Tarugi.)

Potassium hydrogen arsenochromate,  $\text{K}_4\text{H}_4\text{Cr}_2\text{As}_2\text{O}_{16}$ .

(Tarugi, C. C. 1897, II, 724.)

### Arsenosarseniotungstic acid.

Potassium arsenosarseniotungstate,  $10\text{K}_2\text{O}, 4\text{As}_2\text{O}_5, \text{As}_2\text{O}_3, 21\text{WO}_3 + 26\text{H}_2\text{O}$ .

Precipitate. Sol. in a large amount of hot  $\text{H}_2\text{O}$  (Gibbs, Am. Ch. J. 7, 313.)

### Arsenosomolybdic acid.

Ammonium arsenosomolybdate,  $3(\text{NH}_4)_2\text{O}, 5\text{As}_2\text{O}_5, 12\text{MoO}_3 + 24\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7, 313.)

Ammonium barium arsenosomolybdate,  $3(\text{NH}_4)_2\text{O}, 2\text{BaO}, 5\text{As}_2\text{O}_5, 10\text{MoO}_3 + 50\text{H}_2\text{O}$ .

Ppt. (Ephraim, Z. anorg. 1910, 66, 57.)

Ammonium cupric arsenosomolybdate,  $(\text{NH}_4)_2\text{O}, \text{CuO}, 2\text{As}_2\text{O}_5, 4\text{MoO}_3 + 2\text{H}_2\text{O}$ , and  $2(\text{NH}_4)_2\text{O}, \text{CuO}, 3\text{As}_2\text{O}_5, 6\text{MoO}_3 + 13\text{H}_2\text{O}$ .

Ppts. (Ephraim, Z. anorg. 1910, 66, 58.)

Barium arsenosomolybdate,  $3\text{BaO}, 2\text{As}_2\text{O}_5, 8\text{MoO}_3 + 13\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$  (Gibbs.)

Copper arsenosomolybdate,  $2\text{CuO}, 3\text{As}_2\text{O}_5, 6\text{MoO}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

Manganese arsenosomolybdate,  $2\text{MnO}, 3\text{As}_2\text{O}_5, 6\text{MoO}_3 + 6\text{H}_2\text{O}$ , and  $+15\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Potassium arsenosomolybdate**,  $3K_2O, As_2O_3, 5MoO_3 + 3H_2O$ .

Easily sol. in  $H_2O$ . (Ephraim, Z. anorg. 1910, 66, 54.)

$3K_2O, As_2O_3, 8MoO_3 + 18H_2O$ . Easily sol in  $H_2O$ . (Ephraim.)

**Sodium arsenosomolybdate**,  $Na_2O, As_2O_3, 2MoO_3 + 6H_2O$ .

Easily sol. in  $H_2O$ . (Ephraim, Z. anorg. 1910, 66, 56.)

$2Na_2O, As_2O_3, 4MoO_3 + 13H_2O$ . Ppt. (Ephraim.)

**Zinc arsenosomolybdate**,  $2ZnO, 3As_2O_3, 6MoO_3 + 6H_2O$ .

Sol. in  $H_2O$ . (Gibbs.)

**Arsenosophosphotungstic acid.**

**Potassium arsenosophosphotungstate**,  $10K_2O, 14As_2O_3, 3P_2O_5, 32WO_3 + 28H_2O$ .

Moderately sol. in cold, very easily in hot  $H_2O$ . (Gibbs.)

$7K_2O, 2As_2O_3, 4P_2O_5, 60WO_3 + 55H_2O$ . Sol in hot  $H_2O$  with decomp. (Gibbs.)

**Potassium sodium arsenosophosphotungstate**,  $5K_2O, Na_2O, 2As_2O_3, 2P_2O_5, 12WO_3 + 15H_2O$ .

(Gibbs, Am. Ch. J. 7, 313.)

**Arsenosotungstic acid.**

**Ammonium arsenosotungstate**,  $7(NH_4)_2O, 2As_2O_3, 18WO_3 + 18H_2O$ .

Sol. in  $H_2O$ . (Gibbs.)

**Barium arsenosotungstate**,  $4BaO, As_2O_3, 9WO_3 + 21H_2O$ .

Precipitate. Nearly insol in  $H_2O$ . (Gibbs.)

**Sodium arsenosotungstate**,  $9Na_2O, 8As_2O_3, 16WO_3 + 55H_2O$ .

Very sol. in  $H_2O$ . (Gibbs, Am. Ch. J. 7, 313.)

**Arsenyl bromide**,  $AsOBr$ .

$H_2O$  dissolves out  $As_2O_3$ ; insol. in alcohol (Sérullas.)

$+H_2O$ . (Wallace, Phil. Mag. (4) 17, 122.)  $As_2O_3Br_2 \approx 2AsBr_3, 3As_2O_3 + 12H_2O$ .

**Arsenyl bromide with MBr.**

See Arsenite bromide, M.

**Arsenyl chloride**,  $AsOCl$ .

Sol. in  $H_2O$  with decomp  $+H_2O$ . (Wallace, Phil. Mag. (4) 16, 358.)

$As_2O_3Cl$ . (Wallace.)

**Arsenyl chloride with MCl.**

See Arsenite chloride, M.

**Arsenyl potassium fluoride**,  $AsOF_2, KF + H_2O$ .

(Marignac, A. 145, 237.)

**Arsenyl iodide**,  $As_2I_2O_{11} = 2AsOI, 3As_2O_3 + 12H_2O$

Decomp. by  $H_2O$ . (Wallace, Phil. Mag. (4) 17, 122.)

Sl. sol. in cold  $H_2O$ , less sol. in alcohol. (Plisson, J. Pharm. 14, 46.)

**Arsenyl iodide with MI.**

See Arsenite iodide, M.

**Arsenyl sulphatiodide**,  $As_{12}I_2S_8O_9$

Scarcely attacked by cold  $H_2O$ . Boiling  $H_2O$  extracts  $AsI_3$ . Decomp. by hot  $HNO_3$  or  $H_2SO_4$ . Easily sol. in  $KOH$ , or  $NH_4OH + Aq$ . (Schneider, J. pr. (2) 36, 513.)

**Arsine.**

See Arsenic hydride.

**Atmospheric air.**

See Air, atmospheric.

**Auriamine**,  $Au(OH)_2NH_2$

(Jacobsen, C. R. 1908, 146, 1214.)

**Diauriamine**,  $Au_2(OH)_4NH_2$ .

(Jacobsen, C. R. 1908, 146, 1214.)

**Sesquiauriamine**,  $NAu_3, NH_3$ .

Decomp. by  $H_2O$  into  $NAu_3$ . (Raschig, A. 235, 341.)

**Auric acid**,  $HAuO_4$ .

Sol. in  $HBr$ , or  $HCl + Aq$ . (Kruss, B. 19, 2546.)

**Ammonium aurate.**

See Auroamidoimide.

**Barium aurate**,  $BaAuO_4 + 5H_2O$ .

Sl. sol. in  $H_2O$ . (Weigand, Zeit. angew. Ch. 1905, 19, 139.)

$+6H_2O$ . Sl. sol. in  $H_2O$ . Sol. in dil.  $H_2SO_4$  and in dil.  $HNO_3$ . Sol. in  $HCl$ . Decomp. by alcohol. (Meyer, C. R. 1907, 145, 806.)

**Calcium aurate (?)**.

Insol. in  $H_2O$ ; sol. in  $CaCl_2 + Aq$ . (Fremy, A. ch. (3) 31, 485.)

$CaAu_2O_4 + 6H_2O$ . As Ba salt. (Meyer, C. R. 1907, 145, 806.)

**Magnesium aurate (?)**.

Ppt. Insol. in  $H_2O$ ; sol. in  $MgCl_2 + Aq$ . (Pelletier.)

**Potassium aurate**,  $KAuO_4 + 3H_2O$ .

Very sol. in  $H_2O$ , and easily decomp. (Fremy, A. ch. (3) 31, 483.)

Sol. in alcohol; the solution in alcohol does not decomp. below  $50^\circ$ . (Figuer, A. ch. (3) 11, 364.)

**Potassium aurate sulphite**,  $KAuO_4, 2K_2SO_3 + 5H_2O$

Sol. in  $H_2O$  with decomp. Nearly insol. in alkaline solutions. (Fremy, A. ch. (3) 31, 485.)

Sodium aurate,  $\text{Na}_3\text{Au}_2\text{O}_4 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4$ , dil.  $\text{HNO}_3$ , and  $\text{HCl}$  with decomp. Decomp. by alcohol. (Meyer, C. R. 1907, 145. 806.)

Strontium aurate,  $\text{SrAu}_2\text{O}_4 + 6\text{H}_2\text{O}$ .

As Ba salt (Meyer.)

Auriumide chloride,  $\text{Au}(\text{NH})\text{Cl}$ .

(Raschig)

Auriumide nitrate,  $\text{Au}_3\text{N}_2\text{H}_2\text{O}$ ,  $2\text{HNO}_3$ , or  $\text{AuN}$ ,  $\text{HNO}_3 + \frac{1}{2}\text{H}_2\text{O}$ , or  $\text{Au}_2\text{O}(\text{NH})_2$ ,  $2\text{HNO}_3$ .

Not deliquescent. Decomp. by hot  $\text{H}_2\text{O}$  into  $\text{Au}_2\text{O}(\text{NH})_2$ . (Schottlander, J. B. 1884. 453.)

Auroamidoimide,  $\text{Au}(\text{HN})\text{NH}_2 + 3\text{H}_2\text{O}$ .

(Fulminating gold.) Insol. in  $\text{H}_2\text{O}$ , not attacked by dil. acids; sol. in conc. acids, and in moderately dil. acids, when freshly precipitated. Insol. in alkalis or alcohol. Sol. in  $\text{KCN} + \text{Aq}$ .

Triauroamine,  $\text{Au}_3\text{N} + 5\text{H}_2\text{O}$ .

Not decomp. by boiling dil. acetic acid,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$ . (Raschig, A. 1886, 235. 349.)

Auricyanhydric acid,  $\text{HAu}(\text{CN})_4 + 1\frac{1}{2}\text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$ , alcohol, or ether.

See also Bromauricyanides.

Chlorauricyanides.

Iodauricyanides.

Ammonium auricyanide,  $\text{NH}_4\text{Au}(\text{CN})_4$ .

Easily sol. in  $\text{H}_2\text{O}$  or alcohol. Insol. in ether.

Cobaltous auricyanide,  $\text{Co}[\text{Au}(\text{CN})_4]_2 + 9\text{H}_2\text{O}$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Sl. sol. in alcohol (Lindbom.)

Potassium auricyanide,  $\text{KAu}(\text{CN})_4 + 1\frac{1}{2}\text{H}_2\text{O}$

Efflorescent. Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Easily sol. in alcohol.

Silver auricyanide,  $\text{AgAuCN}_4$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Diaurodiamine nitrate.

See Auriumide nitrate.

Aurobromhydric acid.

See Bromauric acid.

Aurobromic acid.

See Bromauric acid.

Aurochlorhydric acid.

See Chlorauric acid.

Aurochloric acid.

See Chlorauric acid.

Aurocyanhydric acid.

Aurocyanides with  $\text{MCN}$ .

See Cyanide, aurous with  $\text{MCN}$ .

Azinosulphonic acid.

Ammonium azinosulphonate,  $\text{N}_2\text{SO}_2\text{NH}_4$ .

(Traube, B. 1914, 47. 944.)

Barium azinosulphonate,  $(\text{N}_2\text{SO}_2)_2\text{Ba}$

(Traube, B. 1914, 47. 944.)

Potassium azinosulphonate,  $\text{N}_2\text{SO}_2\text{K}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Can be cryst. from boiling abs. alcohol. (Traube, B. 1914, 47. 943.)

Sodium azinosulphonate,  $\text{N}_2\text{SO}_2\text{Na}$ .

(Traube, B. 1914, 47. 944.)

Azoimide,  $\text{HN}_3$ .

Miscible with  $\text{H}_2\text{O}$  and alcohol (Curtius and Radershausen, J. pr. (2) 43. 207.)

Stable in aq. solution; decomp. slowly by dil. boiling  $\text{HCl}$ . (Curtius, J. pr. 1898, (2) 58. 265.)

For salts of  $\text{HN}_3$ , see azoimide of metal under metal.

Azoimide, hydroxylamine,  $\text{N}_2\text{H}_4\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Gradually volatilizes at ord. temp. (Dennis, J. Am. Chem. Soc. 1907, 29. 22.)

Azophosphoric acid.

See Pyrophosphamic acid.

Deutazophosphoric acid.

See Pyrophosphodamic acid.

Barium, Ba.

Decomp. by  $\text{H}_2\text{O}$  and abs. alcohol. (Guntz, C. R. 1901, 133. 874.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 327.)

Barium amalgam,  $\text{BaHg}_{12}$ .

Stable in contact with liquid amalgam up to  $30^\circ$ . Can be cryst. from  $\text{Hg}$  without decomp. if temp. does not exceed  $30^\circ$ . (Kerp, Z. anorg. 1900, 25. 68.)

$\text{BaHg}_{12}$ . Stable in contact with liquid amalgam from  $30^\circ$ – $100^\circ$ . Can be cryst. from  $\text{Hg}$  without decomp. at any temp. within these limits. (Kerp.)

Barium amide,  $\text{Ba}(\text{NH}_2)_2$ .

B.-pt  $280^\circ$ . (Mentrel, C. C. 1903, I. 276.)

Decomp. by  $\text{H}_2\text{O}$  (Guntz and Mentrel, Bull. Soc. 1903, (3) 29. 578.)

Barium potassium amide.

See Potassium ammonobarate.

Barium ammonia,  $\text{Ba}(\text{NH}_3)_6$ .

Takes fire in the air. Only sl. sol. in liquid  $\text{NH}_3$ . Violently decomp. by  $\text{H}_2\text{O}$ . (Mentrel, C. R. 1902, 135. 740.)

**Barium arsenide,  $\text{Ba}_3\text{As}_2$** Decomp. by  $\text{H}_2\text{O}$ . (Lebeau, C. R. 1899, 129. 48.)**Barium azoimide,  $\text{Ba}(\text{N}_3)_2$** 

Very sl. hygroscopic, explosive

12.5 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$   
 16 2 " " " 100 "  $\text{H}_2\text{O}$  " 10  $5^\circ$   
 16 7 " " " 100 "  $\text{H}_2\text{O}$  " 15"  
 17 3 " " " 100 "  $\text{H}_2\text{O}$  " 17"

0.0172 pts are sol. in 100 pts. abs alcohol at  $16^\circ$ .

Insol. in ether. (Curtius, J. pr. 1898, (2) 58. 290)

See also Barium nitride.

**Barium boride,  $\text{BaB}_2$** Sol. in fused oxidizing agents, not decomp. by  $\text{H}_2\text{O}$ ; insol. in aq acids; sl sol. in conc.  $\text{H}_2\text{SO}_4$ , sol. in dil and conc.  $\text{HNO}_3$ . (Moissan, C. R. 1897, 125, 634.)**Barium subbromide sodium bromide,  $\text{BaBr}$ ,  $\text{NaBr}$** Decomp. by  $\text{H}_2\text{O}$ . (Guntz, C. R. 1903, 136. 750.)**Barium bromide,  $\text{BaBr}_2$ , and  $+2\text{H}_2\text{O}$** 100 pts.  $\text{H}_2\text{O}$  dissolve—

at  $0^\circ$  20° 40° 60° 80° 100°  
 98 104 114 123 135 149 pts.  $\text{BaBr}_2$

Sat  $\text{BaBr}_2 + \text{Aq}$  contains at.

$-20^\circ$   $-9^\circ$   $+7^\circ$   $16^\circ$   $19^\circ$   $40^\circ$   
 45 7 46 5 48 5 48 8 49 3 50 9%  $\text{BaBr}_2$   
 71° 76° 77° 104° 145° 160° 175°  
 55 1 55 5 55.6 56.6 60 5 59 4 60.3%  $\text{BaBr}_2$

(Étard, A. ch. 1894, (7) 2. 540.)

Sp gr. of  $\text{BaBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing:

5 10 15 20 25 30%  $\text{BaBr}_2$   
 1 045 1 092 1 114 1 201 1 262 1.329

35 40 45 50 55%  $\text{BaBr}_2$ .  
 1.405 1 485 1.580 1.685 1 800

(Kremers, Pogg. 99. 444, calculated by Gerlach, Z. anal. 8. 285.)

 $\text{BaBr}_2 + \text{Aq}$  containing 7.74%  $\text{BaBr}_2$  has sp. gr.  $20^\circ/20^\circ = 1.0716$ . $\text{BaBr}_2 + \text{Aq}$  containing 16.76%  $\text{BaBr}_2$  has sp. gr.  $20^\circ/20^\circ = 1.1674$ .

(Le Blanc and Rohland, Z. phys. Ch. 1890, 19. 279.)

Sat.  $\text{BaBr}_2 + \text{Aq}$  boils at  $113^\circ$ . (Kremers, Pogg. 99. 43)**Solubility in  $\text{BaI}_2 + \text{Aq}$  at  $t^\circ$ .**

$t^\circ$	Sat. solution contains	
	% $\text{BaBr}_2$	% $\text{BaI}_2$
-16	4.7	57.9
-16	5.0	59.0
+60	5.5	66.0
135	9.3	67.3
135	9.0	67.2
170	11.0	67.4
210	14.9	67.7

(Étard, A. ch. 1894, (7) 3. 287.)

Very sol in absolute alcohol (Hunefeld.)

100 pts. absolute methyl alcohol dissolve 50 pts  $\text{BaBr}_2$  at  $22.5^\circ$ .100 pts absolute ethyl alcohol dissolve 3 pts  $\text{BaBr}_2$  at  $22.5^\circ$  (de Bruyn, Z. phys. Ch. 10. 783)Sat solution in 87% alcohol contains 6%  $\text{BaBr}_2$ . (Richards, Z. anorg. 3. 455.)100 pts. absolute methyl alcohol dissolve 45.8 pts.  $\text{BaBr}_2 + 2\text{H}_2\text{O}$  at  $15^\circ$ 100 pts. 93.5% methyl alcohol dissolve 27.3 pts  $\text{BaBr}_2 + 2\text{H}_2\text{O}$  at  $15^\circ$ 100 pts. 50% methyl alcohol dissolve 4 pts.  $\text{BaBr}_2 + 2\text{H}_2\text{O}$  at  $15^\circ$  (de Bruyn, Z. phys. Ch. 10. 787)100 g.  $\text{BaBr}_2 + \text{CH}_3\text{OH}$  contain 0.4 g.  $\text{BaBr}_2$  at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, 72. 437)At  $15^\circ$ , 1 pt. by weight is sol in:

36 pts. methyl alcohol, sp. gr. 0.709  
 207 " ethyl " " 0.8035  
 652 " propyl " " 0.8085

(Rohland, Z. anorg. 1897, 15. 413.)

Nearly insol in boiling amyl alcohol, 10 cem dissolving only an amt. equal to 1.3 mg  $\text{BaO}$  (Browning, Sill. Am J. 144. 459)

Sol. in acetone. (Naumann, B. 1904, 37. 4328; Eidmann, C. C. 1899, II 1014)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Difficultly sol. in methyl acetate (Naumann, B. 1909, 42. 3789)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Barium cadmium bromide,  $\text{BaBr}_2$ ,  $\text{CdBr}_2 + 4\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (v. Hauer, W. A. B. 20. 40.)**Barium rhodium bromide.**

See Bromorhodite, barium.

**Barium bromide ammonia,  $\text{BaBr}_2 \cdot 8\text{NH}_3$ .**Decomp. by  $\text{H}_2\text{O}$ . (Joannis, C. R. 1905, 140. 1244.)**Barium bromide hydrazine,  $\text{BaBr}_2 \cdot 2\text{N}_2\text{H}_4$ .**Hydroscopic. Very sol. in  $\text{H}_2\text{O}$ . Insol in alcohol. (Franzen, Z. anorg 1908, 60. 291.)**Barium bromofluoride,  $\text{BaBr}_2 \cdot \text{BaF}_2$ .**Insol. in and undecomp. by boiling alcohol. Sol. in  $\text{HBr}$  and in  $\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$ , hot  $\text{H}_2\text{SO}_4$ , dil.  $\text{HCl}$ , dil.  $\text{HNO}_3$ , or dil. acetic acid. (Defacqz, C. R. 1904, 138. 199)**Barium carbide,  $\text{BaC}_2$ .**Decomp. by  $\text{H}_2\text{O}$ . (Maquenne, C. R. 144. 360.)Sp. gr. 3.75. Easily decomp. by  $\text{H}_2\text{O}$  and dil. acids (Moissan, Bull. Soc. 1894, (3) 11. 1008.)

Barium carbonyl, Ba(CO)<sub>2</sub>.

Sol. in H<sub>2</sub>O. (Guntz and Mentrel, Bull. Soc. 1903, (3) 29. 586.)

Barium subchloride, BaCl

Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1903, 136. 751.)

Barium subchloride sodium chloride, BaCl, NaCl

Decomp. by H<sub>2</sub>O (Guntz, C. R. 1903, 136. 750)

Barium chloride, BaCl<sub>2</sub>, and +2H<sub>2</sub>O.

Permanent in dry air.

100 pts H<sub>2</sub>O at t° dissolves (a) pts BaCl<sub>2</sub> and (b) pts BaCl<sub>2</sub>+2H<sub>2</sub>O

t°	a	b	t°	a	b
15 04	34 80	43 50	74 89	59 94	65 51
40 31	43 84	55 63	105 48	59 58	77 80

(Gay-Lussac, A. ch. (2) 11. 309)

100 pts H<sub>2</sub>O at t° dissolves 32 62 + 0.2711 pts. BaCl<sub>2</sub> (Kopp)

100 pts H<sub>2</sub>O dissolves pts. BaCl<sub>2</sub>+2H<sub>2</sub>O at t°.

t°	Pts. BaCl <sub>2</sub> +2H <sub>2</sub> O	t°	Pts. BaCl <sub>2</sub> +2H <sub>2</sub> O
16 25	30.66	62 50	48 0
20 00	42 22	75 00	63 0
22 50	43 7	87 00	65 0
37 50	51 0	100	72 0
50 00	65 0		

(Brandes.)

Sol. in 2.67 pts H<sub>2</sub>O at 18.75° (Abl)  
1 pt BaCl<sub>2</sub> is sol. in 2.86 pts H<sub>2</sub>O at 15.5°, and 1.07 pts at boiling temp (M. K. and P)  
100 pts H<sub>2</sub>O at 15.5° dissolves 20 pts. BaCl<sub>2</sub>, and 43 pts at 87.7°. (Ure's Diet)

Solubility in 100 pts. H<sub>2</sub>O at t°

t°	Pts. BaCl <sub>2</sub>	t°	Pts. BaCl <sub>2</sub>
0	31.1	77 5	51 9
12 2	33.9	95 65	57 7
38 4	41.2	102 5	58 9
62 75	47.7	105	59 7

(Nordenskiöld, Pogg 136 316)

100 pts H<sub>2</sub>O dissolve pts BaCl<sub>2</sub> at t°.

t°	Pts. BaCl <sub>2</sub>	t°	Pts. BaCl <sub>2</sub>
0	33.2	50	43 7
30	38.1	58	45 9
37	40.0		

(Gusardian, A. ch. (4) 5. 143.)

1 pt BaCl<sub>2</sub>+2H<sub>2</sub>O is sol. in 2.18 pts. H<sub>2</sub>O at 21.5°, and the solution has sp. gr. = 1.2878. (Schuff, A. 109. 326.)

1 pt anhydrous BaCl<sub>2</sub> is sol. in 2.86 pts. H<sub>2</sub>O at 15°. (Gerlach.)

Solubility in 100 pts H<sub>2</sub>O at t°.

t°	Pts. BaCl <sub>2</sub>	t°	Pts. BaCl <sub>2</sub>	t°	Pts. BaCl <sub>2</sub>
0	30 9	36	39.7	71	49.7
1	31 2	37	40.0	72	50 0
2	31.5	38	40.2	73	50 3
3	31 7	39	40 5	74	50.6
4	31.9	40	40 7	75	50 9
5	32.2	41	41 0	76	51.2
6	32 4	42	41 3	77	51 5
7	32 6	43	41 6	78	51 8
8	32.8	44	41 9	79	52 1
9	33.1	45	42 2	80	52 4
10	33.3	46	42 5	81	52.7
11	33 5	47	42.7	82	53 0
12	33 8	48	43.0	83	53 3
13	34 0	49	43.3	84	53.6
14	34 2	50	43.6	85	54.0
15	34.5	51	43 9	86	54 3
16	34.7	52	44 2	87	54.6
17	35 0	53	44 4	88	55.0
18	35.2	54	44 7	89	55.3
19	35.5	55	45 0	90	55.6
20	35.7	56	45 3	91	55.9
21	36.0	57	45 6	92	56.2
22	36 2	58	45 9	93	56.6
23	36.5	59	46 2	94	56 9
24	36.7	60	46 4	95	57.2
25	37 0	61	46.7	96	57.6
26	37 2	62	47 0	97	57.9
27	37 5	63	47.3	98	58 2
28	37 7	64	47.6	99	58.5
29	38 0	65	47 9	100	58 8
30	38 2	66	48.2	101	59.2
31	38.5	67	48 5	102	59.5
32	38.7	68	48 8	103	59.8
33	39.0	69	49 1	104	60 2
34	39.2	70	49 4	104.1	60 3
35	39 5				

(Mulder, calculated from his own and other observations. Scheik. Verhandel. 1864. 45.)

The saturated solution contains—

60.3 pts. BaCl<sub>2</sub> to 100 pts. H<sub>2</sub>O, and boils at 104.1°. (Mulder.)

60.1 pts. BaCl<sub>2</sub> to 100 pts. H<sub>2</sub>O, and boils at 104.4°. (Legrand.)

61.8 pts. BaCl<sub>2</sub> to 100 pts. H<sub>2</sub>O, and boils at 104.5°. (Griffith.)

59.58 pts BaCl<sub>2</sub> to 100 pts. H<sub>2</sub>O, and boils at 105.48° (Gay-Lussac); at 106° (Kremers).

54.1 pts BaCl<sub>2</sub> to 100 pts. H<sub>2</sub>O, and forms crust at 104.4°; highest temperature observed, 104.9°. (Gerlach, Z anal. 26. 426.)

Sat. BaCl<sub>2</sub>+Aq contains at:

100° 130° 144° 160° 180° 215°  
36 37 3 37 5 38.9 40.7 43.1% BaCl<sub>2</sub>

(Étard, A. ch. 1894, (7) 2. 535.)

Aq. solution contains 27.6% BaCl<sub>2</sub> at 30°. (Shreinemakers, C. C. 1910, I. 9.)

Solubility of  $\text{BaCl}_2 + 2\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  equals 1.745 mol.-litre at  $30^\circ$ . (Masson, Chem. Soc. 1911, 99, 1136.)

$\text{BaCl}_2 + \text{Aq}$  sat. at  $8^\circ$  has sp gr 1.27 (Anthon)  
 $\text{BaCl}_2 + \text{Aq}$  sat at  $15^\circ$  has sp gr 1.282 (Michel and Krafft.)

$\text{BaCl}_2 + \text{Aq}$  sat at  $18.1^\circ$  has sp gr 1.285, and contains 44.31 pts  $\text{BaCl}_2 + 2\text{H}_2\text{O}$  to 100 pts  $\text{H}_2\text{O}$ . (Karsten.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $19.5^\circ$

% $\text{BaCl}_2$	Sp. gr.	% $\text{BaCl}_2$	Sp. gr.
8.88	1.0760	27.53	1.2245
18.24	1.1521	35.44	1.2837

(Kremer, Pogg. 99, 444.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $15^\circ$ .

% $\text{BaCl}_2$	Sp. gr.	% $\text{BaCl}_2$	Sp. gr.
1	1.00917	14	1.13778
2	1.01834	15	1.14846
3	1.02750	16	1.15999
4	1.03667	17	1.17152
5	1.04584	18	1.18305
6	1.05509	19	1.19458
7	1.06554	20	1.20631
8	1.07538	21	1.21892
9	1.08523	22	1.23173
10	1.09508	23	1.24455
11	1.10576	24	1.25736
12	1.11643	25	1.27017
13	1.12711		

(Gerlach, Z. anal. 8, 283.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $21.5^\circ$

% $\text{BaCl}_2 + 2\text{H}_2\text{O}$	Sp. gr.	% $\text{BaCl}_2 + 2\text{H}_2\text{O}$	Sp. gr.
1	1.0073	16	1.1302
2	1.0147	17	1.1394
3	1.0222	18	1.1488
4	1.0298	19	1.1584
5	1.0374	20	1.1683
6	1.0452	21	1.1783
7	1.0530	22	1.1884
8	1.0610	23	1.1986
9	1.0692	24	1.2090
10	1.0776	25	1.2197
11	1.0861	26	1.2304
12	1.0947	27	1.2413
13	1.1034	28	1.2523
14	1.1122	29	1.2636
15	1.1211	30	1.2750

(Schiff, calculated by Gerlach, *l.c.*)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $18^\circ$ .

% $\text{BaCl}_2$	Sp. gr.	% $\text{BaCl}_2$	Sp. gr.
5	1.0445	20	1.2047
10	1.0939	24	1.2559
15	1.1473		...

(Kohlrausch, W. Ann. 1879, 1.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $20^\circ$ .

g mole $\text{BaCl}_2$ per l	Sp. gr.
0.01	1.001878
0.025	1.00475
0.05	1.00929
0.075	1.01369
0.10	1.01766
0.25	1.0456
0.40	1.0726

(Jones and Pedree, Am. Ch. J. 1907, 38, 701.)

$\text{BaCl}_2 + \text{Aq}$  containing 6.94%  $\text{BaCl}_2$  has sp. gr  $20^\circ/20^\circ = 1.0640$

$\text{BaCl}_2 + \text{Aq}$  containing 11.38%  $\text{BaCl}_2$  has sp. gr.  $20^\circ/20^\circ = 1.1086$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 279.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $25^\circ$ .

$\text{BaCl}_2 + \text{Aq}$	Sp. gr.
1-normal	1.0884
$\frac{1}{2}$ "	1.0441
$\frac{1}{4}$ "	1.0226
$\frac{1}{8}$ "	1.0114

(Wagner, Z. phys. Ch. 1890, 5, 35.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$ .

$t^\circ$	Concentration of $\text{BaCl}_2 + \text{Aq}$	Sp. gr.
$25^\circ$	1 pt. $\text{BaCl}_2$ in 3.684 pts. $\text{H}_2\text{O}$	1.2194
$22.8$	1 " " " 52.597 " "	1.0145

(Hittorf, Z. phys. Ch. 1902, 39, 628.)

Temp. of Maximum Density

Weight of $\text{BaCl}_2$ in 1000 grams $\text{H}_2\text{O}$	Temp. of maximum density	Molecular reduction of temp. of M. D.
0	$3.982^\circ$	
6.73	$3.207^\circ$	23.94
10.42	$2.783^\circ$	23.88
20.83	$1.572^\circ$	24.04
41.72	$-0.843^\circ$	24.04

(De Coppet, C. R. 1897, 125, 533.)

$\text{BaCl}_2 + \text{Aq}$  containing 10%  $\text{BaCl}_2$  boils at  $100.6^\circ$ . (Gerlach.)

$\text{BaCl}_2 + \text{Aq}$  containing 20%  $\text{BaCl}_2$  boils at  $101.9^\circ$ . (Gerlach.)

B.-pt of  $\text{BaCl}_2 + \text{Aq}$  containing pts.  $\text{BaCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ . G=according to Gerlach (Z. anal. 26, 443), L=according to Legrand (A. ch. (2) 59, 452).

B.-pt	G	L
100.5	6.4	11.0
101.0	12.7	19.6
101.5	19.0	26.2
102.0	25.3	32.5
102.5	31.6	38.6
103.0	37.7	44.6
103.5	43.7	50.3
104.0	49.5	56.0
104.4		60.1
104.5	55.2	

Less sol in  $H_2O$  containing  $HCl$  than in pure  $H_2O$ , and scarcely sol. in conc.  $HCl + Aq$ . (Berzelius.)

Solubility of  $BaCl_2$  in  $HCl + Aq$  at  $0^\circ$ .  
 $BaCl_2 = no.$   $\frac{1}{2}$  mols. (in milligrammes) dissolved in 10 cc of the liquid,  $HCl = no.$  mols. (in milligrammes) contained in the same quantity of liquid.

$BaCl_2$	$HCl$	Sum of mole	Sp gr
29.45	0	29.45	1.250
27.8	1.1	28.9	1.242
26.075	2.8	28.875	1.228
23.4	5.0	28.4	1.210
14.0	14.36	28.36	1.143
10.2	18.775	28.975	1.118
6.67	22.75	29.42	1.099
2.74	32.0	34.74	1.079
0.29	50.5	50.79	1.088

(Engel, Bull. Soc. (2) 45. 653.)

Sol. in about 8000 pts. conc  $HCl + Aq$   
 Sol. in about 20,000 pts conc  $HCl + Aq$  through which  $HCl$  gas was passed.

Practically insol in conc.  $HCl + Aq$  containing  $\frac{1}{2}$  vol ether. (Mar, Sill Am. J 143.

Solubility in  $HCl + Aq$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt $HCl$	% by wt $BaCl_2$	
0	27.6	$BaCl_2 \cdot 2H_2O$
5.94	12.97	"
11.55	3.85	"
18.11	0.46	"
32.35	0.00	"
37.34	0.00	$BaCl_2 \cdot 2H_2O + BaCl_2 \cdot H_2O$
38.63	0.00	$BaCl_2 \cdot H_2O$

(Schreinemakers, Z. phys. Ch. 1909, 68. 89.)

Much less sol in  $HNO_3 + Aq$  than in  $H_2O$ , because  $Ba(NO_3)_2$  is nearly insol. therein. (Wurtz.)

$BaCl_2$  is sol in about—

4.00 pts.  $H_2O$ .

5.00 pts.  $NH_4OH + Aq$  (conc.).

5.33 pts.  $NH_4OH + Aq$  (1 vol. conc.. 3 vols  $H_2O$ ).

5.33 pts.  $HCl + Aq$  (1 vol conc.: 4 vols  $H_2O$ ).

8.00 pts.  $HC_2H_3O_2 + Aq$  (1 vol commercial acid: 1 vol  $H_2O$ ).

6.00 pts.  $NH_4Cl + Aq$  (1 pt.  $NH_4Cl$  : 10 pts  $H_2O$ ).

6.00 pts.  $NH_4C_2H_3O_2 + Aq$  (dil  $NH_4OH + Aq$  neutralized by dil.  $HC_2H_3O_2 + Aq$ )

6.67 pts.  $Na_2C_2H_3O_2 + Aq$  (commercial  $HC_2H_3O_2$  neutralized by  $Na_2CO_3$ , and dil. with 4 vols.  $H_2O$ ).

6.33 pts.  $Cu(C_2H_3O_2)_2 + Aq$ . See Stolba (Z. anal. 2. 390).

5.67 pts. grape sugar (1 pt grape sugar: 10 pts  $H_2O$ ). (Pearson, Zeit. Chem 1869. 662.)

$BaCl_2 + NH_4Cl$ . Solubility of  $BaCl_2$  in  $NH_4Cl + Aq$  at  $30^\circ$

Composition of the solution		Solid phase
% $NH_4Cl$	% $BaCl_2$	
0	27.6	$BaCl_2 \cdot 2H_2O$
5.71	22.16	"
10.06	18.36	"
13.84	15.42	"
20.00	10.89	"
24.69	8.33	"
25.79	7.95	$BaCl_2 \cdot 2H_2O + NH_4Cl$
26.06	7.99	"
27.47	3.56	$NH_4Cl$
29.5	0	"

(Schreinemakers, Z. phys. Ch. 1909, 68. 688.)

See also under Ammonium chloride.

$BaCl_2 + Ba(OH)_2$ . Solubility of  $BaCl_2$  in  $BaO + Aq$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt $BaO$	% by wt $BaCl_2$	
0	27.6	$BaCl_2 \cdot 2H_2O$
1.78	27.42	"
1.79	27.31	$BaCl_2 \cdot 2H_2O + BaCl(OH) \cdot 2H_2O$
1.75	27.41	"
2.33	24.98	$BaCl(OH) \cdot 2H_2O$
2.50	24.20	"
3.27	21.46	"
4.67	19.18	"
4.86	18.97	$BaCl(OH) \cdot 2H_2O + BaO \cdot 9H_2O$
4.29	18.83	"
4.64	18.77	"
4.65	18.10	"
4.62	18.04	$BaO \cdot 9H_2O$
4.60	17.08	"
4.58	12.81	"
4.45	10.77	"
4.99	0	"

(Schreinemakers, Z. phys. Ch. 1909, 68. 88.)

Sol. in  $CuCl_2 \cdot NH_4Cl + Aq$  at  $30^\circ$ . (Schreinemakers, Z. phys. Ch. 1909, 68. 688.)

The solubility data for the system  $BaCl_2 + CuCl_2 + KCl + Aq$  have been determined at  $40^\circ$  and  $60^\circ$ . (Schreinemakers, C. C. 1915, I 933.)

$BaCl_2 + HgCl_2$ . Solubility of  $BaCl_2$  in  $HgCl_2$  in  $H_2O$

$t^\circ$	Gms per 100 g solution		Solid phase
	$BaCl_2$	$HgCl_2$	
10.4°	23.58	50.54	$BaCl_2 \cdot 2H_2O + HgCl_2$
10.4	23.44	50.74	$BaCl_2 \cdot 3HgCl_2 \cdot 6H_2O$
10.4	22.58	51.23	
10.4	22.48	51.41	
10.4	22.10	51.66	
10.4	21.64	51.74	$BaCl_2 \cdot 2H_2O + HgCl_2$
25.0	23.02	54.83	

(Foote and Bristol, Am. Ch. J. 32. 248)

Solubility of  $\text{BaCl}_2 + \text{HgCl}_2$  in  $\text{H}_2\text{O}$ 

Temp. = 30°			Temp. = 0°		
% $\text{HgCl}_2$	% $\text{BaCl}_2$	Solid phase	% $\text{HgCl}_2$	% $\text{BaCl}_2$	Solid phase
0	27.77	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$	0	23.70	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
2.90	27.56	"	14.25	24.0	"
7.00	27.47	"	36.20	24.89	"
12.98	26.99	"	46.12	24.07	$\text{BaCl}_2, 3\text{HgCl}_2, 6\text{H}_2\text{O} +$
22.61	26.89	"	46.05	24.03	" $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
34.57	26.69	"	46.07	24.05	"
46.50	25.22	"	46.59	23.28	$\text{BaCl}_2, 3\text{HgCl}_2, 6\text{H}_2\text{O}$
55.16	23.46	$\text{HgCl}_2 + \text{BaCl}_2 \cdot 2\text{H}_2\text{O}$	47.78	21.05	"
55.32	23.08	"	48.43	20.64	$\text{BaCl}_2, 3\text{HgCl}_2, 6\text{H}_2\text{O} + \text{HgCl}_2$
55.19	22.98	"	48.49	20.71	"
48.97	17.87	$\text{HgCl}_2$	44.33	18.50	$\text{HgCl}_2$
41.30	14.26	"	29.0	11.59	"
27.62	8.41	"	16.36	6.11	"
14.19	2.65	"	3.95	0	"
7.67	0	"			
Temp. = 40°			Temp. = 40°		
56.57	22.98	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O} + \text{HgCl}_2$			

(Schreinemakers, Ch. Weekbl. 1911, 7. 202.)

$\text{BaCl}_2 + \text{KCl}$ . Sol. in sat.  $\text{KCl} + \text{Aq.}$  at first without pptn. The  $\text{KCl}$  is pptd. after a time until a state of equilibrium is reached.

100 pts.  $\text{H}_2\text{O}$  at 16.8° dissolve 33.8–27.2 pts  $\text{KCl}$  and 18.2–34.9 pts.  $\text{BaCl}_2$ . (Kopp, A. 34. 267.)

100 g. sat. solution of  $\text{BaCl}_2 + \text{KCl}$  contain 13.83 g.  $\text{BaCl}_2$  and 18.97 g.  $\text{KCl}$  at 25° (Foote, Am. Ch. J. 32. 253.)

$\text{BaCl}_2 + \text{Ba}(\text{NO}_3)_2$ .  $\text{BaCl}_2$  is sol. in sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq.}$

Solubility of  $\text{BaCl}_2 + \text{Ba}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$ . Both salts present in solid phase.

t°	Gms. per 100 gms. solution		t°	Gms. per 100 gms. solution	
	$\text{BaCl}_2$	$\text{Ba}(\text{NO}_3)_2$		$\text{BaCl}_2$	$\text{Ba}(\text{NO}_3)_2$
0	22.5	4.3	100	31	14
20	24.5	6.0	140	32	20
40	26.5	7.5	180	33	26
60	28.5	9.5	210	32	

(Etard, A. Ch. (7) 2. 535.)

Very slowly sol. in sat.  $\text{NaNO}_3 + \text{Aq.}$  with separation of  $\text{Ba}(\text{NO}_3)_2$ .

Rapidly sol. in sat.  $\text{KNO}_3 + \text{Aq.}$  forming  $\text{Ba}(\text{NO}_3)_2$ , which separates out. (Karsten.)

$\text{BaCl}_2 + \text{NaCl}$ .  $\text{BaCl}_2$  is sol. in  $\text{NaCl} + \text{Aq.}$  at first without separation of  $\text{NaCl}$ , which, however, finally separates.

100 pts.  $\text{H}_2\text{O}$  dissolve, when both salts are in excess—

	1	2	3	4	5	6
$\text{NaCl}$ . . .	35.9	4.1		40.4	35.3	
$\text{BaCl}_2$ . .		34.5	35.0		19.4	60.3
		38.6			54.7	

1, 2, and 3 are at 17°. (Kopp, A. 34. 268.)  
4, 5, and 6 are at b-pt. (Mulder.)

Solubility of  $\text{BaCl}_2 + \text{NaCl}$ .  
100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{BaCl}_2$  and  $\text{NaCl}$  at t°.

t°	Pts. $\text{BaCl}_2$	Pts. $\text{NaCl}$	t°	Pts. $\text{BaCl}_2$	Pts. $\text{NaCl}$
10	4.1	33.9	60	9.7	33.5
20	4.1	33.8	70	11.7	33.6
30	5.0	33.7	80	13.9	33.6
40	6.3	33.6	90	15.9	33.6
50	7.9	33.5	100	17.9	33.6

(Precht and Wittgen, B. 14. 1667.)

Solubility of  $\text{BaCl}_2 + \text{NaCl}$  in  $\text{HCl} + \text{Aq.}$  at 30°.

Solid phase, $\text{NaCl}$			Solid phase, $\text{BaCl}_2 + 2\text{H}_2\text{O}$		
Sp. gr. of sat. solution	G. mol. litre		Sp. gr. of sat. solution	G. mol. litre	
	$\text{HCl}$	$\text{NaCl}$		$\text{HCl}$	$\text{BaCl}_2$
1.2018	0.0000	5.400	1.3066	0.0000	1.745
1.1906	0.4575	4.932	1.2651	0.4709	1.468
1.1801	0.969	4.386	1.2147	1.107	1.122
1.1633	1.786	3.589	1.1789	1.622	0.861
1.1512	2.412	2.978	1.1419	2.234	0.592
1.1427	3.052	2.463	1.1068	3.041	0.307
1.1289	4.152	1.628	1.0880	3.953	0.124
1.1188	5.950	0.630	1.0695	3.059	0.020
1.1258	7.305	0.268	1.1024	6.234	0.00
			1.1609	10.25	0.00

(Masson, Chem. Soc. 1911, 99. 1136.)

Solubility of  $\text{BaCl}_2 + \text{NaCl}$  in  $\text{HCl} + \text{Aq}$  at  $30^\circ$ .

$^\circ\text{HCl}$	$\% \text{NaCl}$	$\% \text{BaCl}_2$	Solid phase
0	23.85	3.8	$\text{NaCl}$ , $\text{BaCl}_2$ , $2\text{H}_2\text{O}$
4.84	18.07	2.27	"
12.02	9.55	0.82	"
17.20	4.65	0.29	"
23.16	1.54	0.00	"
28.66	0.47	0.00	"
36.51	0.12	0.00	$\text{NaCl}$ , $\text{BaCl}_2$ , $\text{H}_2\text{O}$

(Schreinemakers, Arch. Néer. Sc. ex. nat. (2) 16. 91.)

Insol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 827.)

Solubility in alcohol 100 pts. alcohol of given sp. gr. dissolves pts. of the anhydrous, and crystallized salt.

Sp. gr.	Pts. $\text{BaCl}_2$	Pts. $\text{BaCl}_2 + 2\text{H}_2\text{O}$
0.900	1.00	1.56
0.848	0.29	0.43
0.834	0.185	0.32
0.817	0.09	0.06

(Kirwan)

Insol. in abs. alcohol, or below  $19^\circ$  in alcohol of over 91%. Dil. alcohol dissolves less  $\text{BaCl}_2$  than corresponds to the amount of  $\text{H}_2\text{O}$  present. (Gerardin, A. ch. (4) 5. 142.)

Solubility in 100 pts. alcohol at  $t^\circ$ .  $D = \text{sp. gr.}$  of alcohol;  $S = \text{solubility}$ .

$D = 0.9904$		$D = 0.9848$		$D = 0.9793$		$D = 0.9726$	
$t^\circ$	$S$	$t^\circ$	$S$	$t^\circ$	$S$	$t^\circ$	$S$
14	29.1	14	25.0	11	19.6	15	15.6
25	32.0	32	29.1	15	20.4	23	17.0
32	33.5	39	30.9	20	21.7	23	19.1
47	37.4	50	33.2	35	24.6	50	22.0
60	39.8	53	37.0	45	26.8		

$D = 0.9578$		$D = 0.9390$		$D = 0.9167$		$D = 0.8429$	
$t^\circ$	$S$	$t^\circ$	$S$	$t^\circ$	$S$	$t^\circ$	$S$
13	10	12	6.5	12	0.1	12	0.00
24	11.4	23	7.2	30	4.3	19	0.00
34	12.9	31	8.3	47	4.9	25	0.01
39	13.8	37	9.0			50	0.28
60	16.2	47	10.1			67	0.377

(Gerardin, A. ch. (4) 5. 142.)

Solubility in dil. alcohol of  $x\%$  by weight at  $15^\circ$ .

$^\circ\text{alcohol}$	0	10	20	30	40	60	80
Pts. $\text{BaCl}_2, 2\text{H}_2\text{O}$	30.25	23.7	18.0	12.8	9.3	3.4	0.5

(Schiff, A. 118. 365.)

Sol. in 6885-8108 pts. 99.3% alcohol at  $14.5^\circ$ , and in 1857 pts. at ebullition. (Fresenius.)

Solubility of  $\text{BaCl}_2$  in alcohol + Aq.

$t^\circ$	$^\circ\text{alcohol}$	$\% \text{BaCl}_2$	Solid phase
30	0	27.95	$\text{BaCl}_2, 2\text{H}_2\text{O}$
"	32.67	10.63	"
"	50.16	5.68	"
"	66.72	2.23	"
"	92.53	0.05	"
"	94.83	0.07	$\text{BaCl}_2, 2\text{H}_2\text{O} + \text{BaCl}_2, \text{H}_2\text{O}$
"	94.75	0.05	"
"	94.60	0.07	"
"	97.14		$\text{BaCl}_2, \text{H}_2\text{O}$
"	98.17	0.08	$\text{BaCl}_2, \text{H}_2\text{O} + \text{BaCl}_2$
"	99.41		$\text{BaCl}_2$
60	0	31.57	$\text{BaCl}_2, 2\text{H}_2\text{O}$
"	16.68	20.16	"
"	34.10	13.21	"
"	66.02	2.83	"
"	88.55	0.25	"
"	90.11	0.09	$\text{BaCl}_2, 2\text{H}_2\text{O} + \text{BaCl}_2, \text{H}_2\text{O}$
"	90.39		"
"	93.95		$\text{BaCl}_2, \text{H}_2\text{O}$

(Schreinemakers and Massink, Chem. Weekbl. 1910, 7. 213.)

100 pts. absolute methyl alcohol dissolve 2.18 pts.  $\text{BaCl}_2$  at  $15.5^\circ$ , and 7.3 pts.  $\text{BaCl}_2, 2\text{H}_2\text{O}$  at  $6^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

At  $15^\circ \text{C}$ . 1 pt. by weight is sol. in:—  
78 pts. methyl alcohol of sp. gr. 0.790  
7,000 " ethyl " " " " 0.8035  
100,000 " propyl " " " " 0.8085  
(Rohland, Z. anorg. 1897, 15. 413.)

Absolutely insol. in boiling amyl alcohol. (Browning, Sill. Am. J. 144. 459.)  
Absolutely insol. in acetic ether. (Cann, C. R. 102. 363.)

Very sl. sol. in acetone (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

100 pts. by weight of glycerine dissolve 10 pts.  $\text{BaCl}_2$  at  $15.5^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.) (Eidmann, C. C. 1899, II. 1014.)

Insol. in benzonitrile (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in anhydrous pyridine, 97% pyridine + Aq. and 95% pyridine + Aq. Sl. sol. in 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1903, 30. 1107.)

+  $\text{H}_2\text{O}$  Solution of monohydrate sat. at  $6^\circ$  contains 31.57%  $\text{BaCl}_2$  (Schreinemakers, Chem. Weekbl. 1910, 7. 213.)

2.5 grams of the monohydrate are sol. in 100 cc. of methyl alcohol at  $14^\circ$ . (Kirschner, Z. phys. Ch. 1911, 76. 176.)

Exact solubility in methyl alcohol cannot be determined as  $\text{BaCl}_2 + \text{H}_2\text{O}$  separates out from a sat. solution of the dihydrate. (Kirschner, Z. phys. ch. 1911, 76. 177.)

Barium cadmium chloride,  $\text{BaCl}_2, \text{CdCl}_2 + 4\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (v. Hauer.)

Solubility in H<sub>2</sub>O at t°.

t°	100 pts. solution contain pts.			100 g. of solution contain g. salt	100 g. H <sub>2</sub> O dissolve g. salt	100 mols. H <sub>2</sub> O dissolve mols. of anhydrous salt
	Cl	Ba	Cd			
22.5	15.19	14.71	11.98	41.88	72.06	3.32
32.9	16.18	16.09	12.40	44.59	80.73	3.72
41.4	16.95	16.81	13.05	46.87	88.01	4.06
53.4	18.21	18.13	13.95	50.30	101.21	4.66
62.0	18.81	18.74	14.73	52.28	109.56	5.05
97.8	22.48	22.00	17.57	62.05	163.50	7.53
108.3	23.51	22.79	18.53	64.83	184.33	8.49
109.2	23.69	29.95	18.67	65.31	188.27	8.67

(Rimbach, B. 1897, 30. 3083)

BaCl<sub>2</sub>·2CdCl<sub>2</sub>·5H<sub>2</sub>O. Quite difficultly sol. in H<sub>2</sub>O. (v. Haucr.)Solubility in H<sub>2</sub>O at t°.

t°	100 pts. by wt. of solution contain pts. by wt.			100 g. of solution contain g. salt	100 g. H <sub>2</sub> O dissolve g. salt	100 mols. H <sub>2</sub> O dissolve mols. of anhydrous salt
	Cl	Ba	Cd			
22.6	16.89	11.00	17.71	45.60	83.82	2.63
41.3	18.15	11.77	19.22	49.14	96.62	3.03
53.9	18.78	12.41	19.85	51.04	104.25	3.27
62.2	19.66	12.83	20.59	53.08	113.18	3.55
69.5	20.18	13.09	21.20	54.47	119.64	3.76
107.2	23.31	14.87	24.11	62.29	165.18	5.19
107.2	23.16	14.93	24.39	62.48	166.53	5.23

(Rimbach, B. 1897, 30. 3083)

Barium mercuric chloride, basic, BaCl<sub>2</sub>, HgO + 6H<sub>2</sub>ODecomp. by H<sub>2</sub>O (André, C. R. 104. 431.)Barium mercuric chloride, BaCl<sub>2</sub>, 2HgCl<sub>2</sub> + 2H<sub>2</sub>OEfflorescent in dry air, sol. in H<sub>2</sub>O (v. Bonsdorff, Pogg. 17. 130)The salt BaCl<sub>2</sub>, 2HgCl<sub>2</sub> + 2H<sub>2</sub>O described by Bonsdorff does not form under the conditions which he gives. (Foote, Am. Ch. J. 1904, 32. 251)BaCl<sub>2</sub>·3HgCl<sub>2</sub>·6H<sub>2</sub>O. Solubility determinations with mixtures of BaCl<sub>2</sub> and HgCl<sub>2</sub> show that these chlorides do not form a double salt at 25°, but that a transition temp. exists at about 17.2° below which the salt BaCl<sub>2</sub>·3HgCl<sub>2</sub>·6H<sub>2</sub>O forms. (Foote, Am. Ch. J. 1904, 32. 251.)+ 8H<sub>2</sub>O. Less sol. in H<sub>2</sub>O than the Sr and Mg double salts. (Swan, Am. Ch. J. 1898, 20. 433.)Barium rhodium chloride, 3BaCl<sub>2</sub>, Rh<sub>2</sub>Cl<sub>4</sub>.

See Chlororhodite, barium.

Barium stannous chloride, BaCl<sub>2</sub>, SnCl<sub>2</sub> + 4H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Poggiale, C. R. 20. 1183.)

Barium stannic chloride.

See Chlorostannate, barium.

Barium uranium chloride, BaCl<sub>2</sub>·UCl<sub>4</sub>.Decomp. by H<sub>2</sub>O. (Aloy, Bull. Soc. 1899, (3) 21. 265.)Barium zinc chloride, BaCl<sub>2</sub>, ZnCl<sub>2</sub> + 4H<sub>2</sub>O. Deliquescent, and sol. in H<sub>2</sub>O. (Warner, C. N. 27. 271)Pptd. from warm solution only. (Ephraim, Z. anorg. 1910, 67. 381)  
+ 2½H<sub>2</sub>O Pptd. from cold solution. (Ephraim)Barium chloride hydrazine, BaCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.

Hydroscopic. (Franzen, Z. anorg. 1908, 60. 290)

Barium chloride hydroxylamine, BaCl<sub>2</sub>, 2NH<sub>2</sub>OH.Very sol. in H<sub>2</sub>O. (Crismer, Bull. Soc. (3) 3. 118)Barium chloride sulphuric anhydride, BaCl<sub>2</sub>, 2SO<sub>3</sub>.Decomp. by H<sub>2</sub>O (Schultz-Sellack, B. 4. 113.)

Barium chlorofluoride, BaClF.

Difficultly sol. in H<sub>2</sub>O, but much more sol. than BaF<sub>2</sub>. Decomp. by H<sub>2</sub>O, so that when washed on filter, the filtrate contains more BaCl<sub>2</sub> than BaF<sub>2</sub>. (Berzelius, Pogg. 1. 19.)Insol. in and undecomp. by boiling alcohol; sol. in conc. HCl and HNO<sub>3</sub>. Decomp. by hot H<sub>2</sub>O, hot H<sub>2</sub>SO<sub>4</sub>, dil. acetic acid, dil. HCl or dil. HNO<sub>3</sub>. (Defacqz, C. R. 1904, 138. 198.)Barium cyanamide, BaCN<sub>2</sub>.Decomp. by H<sub>2</sub>O. (Frank, C. C. 1902, II. 774.)

**Barium subfluoride sodium fluoride, BaF, NaF**

Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1903, 136. 750.)

**Barium fluoride, BaF<sub>2</sub>**

Scarcely sol. in H<sub>2</sub>O (Berzelius); less sol. in H<sub>2</sub>O than CaF<sub>2</sub>.

1 liter H<sub>2</sub>O dissolves 1630 mg. BaF<sub>2</sub> at 18°. (Kohlrausch, Z. phys. Ch. 1904, 60. 356.)

1605 mg. are contained in 1 l of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1903, 64. 168.)

Insol. in molten MnCl<sub>2</sub>, MnBr<sub>2</sub>, MnI<sub>2</sub>, MnCl<sub>2</sub>+BaCl<sub>2</sub>, MnBr<sub>2</sub>+BaBr<sub>2</sub> and MnI<sub>2</sub>+BaI<sub>2</sub> (Defacqz, A. ch. 1904, (8) 1. 350.)

Easily sol. in HCl, HNO<sub>3</sub>, or HF+Ag. (Gay-Lussac and Thénard.)

Sl. sol. in liquid HF. (Franklin, Z. anorg. 1905, 46. 2.)

Insol. in ethyl acetate (Naumann, B. 1910, 43. 314.)

Sol. in an aqueous solution of sodium citrate. (Spiller.)

**Barium tin (stannic) fluoride.**

See Fluostannate, barium.

**Barium tellurium fluoride, BaF<sub>2</sub>, 2TeF<sub>4</sub>**

Decomp. by H<sub>2</sub>O. (Högbom, Bull. Soc (2) 35. 60.)

**Barium titanium fluoride.**

See Fluotitanate, barium.

**Barium titanyl fluoride, TiO<sub>2</sub>F<sub>2</sub>, BaF<sub>2</sub>**

See Fluoxypertitanate and fluoxytitanate, barium.

**Barium uranyl fluoride.**

See Fluoxyuranate, barium.

**Barium vanadyl fluoride.**

See Fluoxyvanadate, barium.

**Barium zirconium fluoride, 3BaF<sub>2</sub>, 2ZrF<sub>4</sub>+2H<sub>2</sub>O.**

Insoluble precipitate. (Marignac.)

See also Fluozirconate, barium.

**Barium fluoiodide, BaF<sub>2</sub>, BaI<sub>2</sub>**

Decomp. by H<sub>2</sub>O, dil HCl, dil. HNO<sub>3</sub> or hot H<sub>2</sub>SO<sub>4</sub>. Sol. in HI and HNO<sub>3</sub>. Insol. in and undecomp. by boiling alcohol. Decomp. by dil. acetic acid (Defacqz, C. R. 1904, 138. 199.)

**Barium hydride, BaH.**

Decomp. by H<sub>2</sub>O or HCl+Ag. (Winkler, B. 24. 1979.)

Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1901, 132. 964.)

**Barium hydrosulphide, BaS<sub>2</sub>H<sub>2</sub>**

Easily sol. in H<sub>2</sub>O. Insol. in alcohol.

+4H<sub>2</sub>O. Sol. in H<sub>2</sub>O, and the solution dissolves S (Veley, Chem. Soc. 49. 369.)

**Barium hydroxide, BaO<sub>2</sub>H<sub>2</sub>**

100 pts cold H<sub>2</sub>O dissolve 5 pts. BaO<sub>2</sub>H<sub>2</sub> boiling 50

(Davy)

100 pts H<sub>2</sub>O at 20° dissolve 3 45 pts BaO

(Bancroft, C. R. 41. 509)

100 pts H<sub>2</sub>O at 13° dissolve 2 86 pts BaO

" " 47° " 13 3

" " 70° " 17 9

(Osann)

100 pts. H<sub>2</sub>O dissolve pts BaO at t°.

t°	Pts BaO	t°	Pts BaO	t°	Pts BaO
0	1 5	30	5 0	60	18.76
5	1 75	35	6 17	65	24 67
10	2 22	40	7 36	70	31 9
15	2 89	45	9 12	75	56 85
20	3 48	50	11.75	80	90 77
25	4.19	55	14.71		

(Rosenthal and Rühlmann, J. B. 1870. 314.)

100 pts H<sub>2</sub>O dissolve at 25° 55.08 millimols. BaO<sub>2</sub>H<sub>2</sub>

(Herz and Knoch, Z. anorg. 1904, 41. 315.)

Sp. gr. of BaO<sub>2</sub>H<sub>2</sub>+Aq

%BaO	Sp. gr	%BaO	Sp gr
30	1 6	1 8	1 02
19	1 3	0 9	1 01
2 6	1 03		

(Dalton)

Sp. gr. of BaO<sub>2</sub>H<sub>2</sub>+Aq at 18° containing 1.25% BaO<sub>2</sub>H<sub>2</sub>=1.0120; containing 2.5% = 1.0253. (Kohlrausch, W. Ann. 1879, 6. 41.)

Sp. gr. of BaO<sub>2</sub>H<sub>2</sub>+Aq at 80°.

Sp. gr	BaO <sub>2</sub> H <sub>2</sub> by volume	BaO <sub>2</sub> H <sub>2</sub> by weight	Sp gr	BaO <sub>2</sub> H <sub>2</sub> by volume	BaO <sub>2</sub> H <sub>2</sub> by weight
1 514	58 22	38.45	1 219	24.53	20 12
1 500	56 31	37.54	1.200	23 00	19.17
1 479	54 14	36.60	1 195	22 15	18.53
1.458	49 38	33 87	1.174	19 83	16.89
1 450	48 90	33 72	1.152	17 78	15.43
1.413	45 99	32 55	1.129	15 01	14.18
1.400	45 00	32 14	1.125	15 80	14 04
1 390	44.22	31 81	1.114	14 56	13 07
1 375	42.40	30 84	1 100	13 06	11.87
1 368	41.45	30.30	1.076	10 58	9.83
1 350	38 60	28 59	1 062	9 16	8 62
1 338	37.30	27 88	1.049	7 55	7 20
1 312	35 02	26 69	1 040	6 51	6 26
1.301	34 02	26 13	1 031	5 18	5 02
1.278	31 48	24.67	1 022	4 78	4 67
1.249	28 14	22.52	1 015	3 90	3 84
1 236	26 41	21 36	1 009	3 37	3.34

(Haff, C. N. 1902, 86. 284.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)

More sol. in NaCl+Aq, KNO<sub>3</sub>+Aq, or NaNO<sub>3</sub>+Aq than in H<sub>2</sub>O. (Karsten.)

\* Not precipitated by alcohol

Sol. with combination in absolute alcohol and anhydrous methyl alcohol. Insol. in ether.

Insol. in acetone. (Naumann, B 1904, 37. 4329; Erdmann, C. C. 1899, II. 1014.)

Solubility in acetone + Aq at 25°.

A = cc. acetone in 100 cc. acetone + Aq.  
 $\frac{\text{BaO}_2\text{H}_2}{2}$  = millimols.  $\text{BaO}_2\text{H}_2$  in 100 cc. of the solution.

S = sp. gr. of the solution.

A	$\frac{\text{BaO}_2\text{H}_2}{2}$	S
0	55.08	1.04790
10	31.84	1.01677
20	17.79	0.99268
30	9.10	0.97630
40	4.75	0.95605
50	1.54	0.93980
60	0.48	0.91790
70	0.08	0.89562

(Herz, Z. anorg. 1904, 41. 321.)

$\text{BaO}_2\text{H}_2$  is sol. in an aqueous solution of cane sugar (Hunton, Phil. Mag. (3) 11. 156); also in an aqueous sol. of mannite (Favre, A. ch. (3) 11. 76), sorbine (Pelouze); hot solution of quercite, separating on cooling (Des-saignes).

+  $3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  free from carbonic acid. Sl. sol. in alcohol and ether (Bauer, Z. anorg. 1905, 47. 416.)

Solubility in  $\text{H}_2\text{O}$  the same as that of the comp. with  $8\text{H}_2\text{O}$ . Insol. in alcohol and ether. (Bauer, Zeit. angew. Ch. 1903, 17. 341.)

Nearly insol. in alcohol and ether. (Bauer, Zeit. angew. Ch. 1903, 16. 349.)

+  $8\text{H}_2\text{O}$ . Sol. in 20 pts. cold, and 3 pts. boiling  $\text{H}_2\text{O}$  (Graham); 17.5 pts.  $\text{H}_2\text{O}$  at 15.5°, and in all proportions of hot  $\text{H}_2\text{O}$ . (Hope.) Sol. in 19 pts.  $\text{H}_2\text{O}$  at 15°, and 2 pts. at 100°. (Wittstein.)

If  $\text{BaO}_2\text{H}_2 + 8\text{H}_2\text{O}$  is heated it dissolves in the crystal  $\text{H}_2\text{O}$  and the solution has the following bpts.

%BaO	49.05	50.05	52.43	53.72
B.-pt.	103°	104°	105°	106°
%BaO	55.35	57.49	58.74	61.44
B.-pt.	107°	108°	108.5°	109°

$\text{BaO}_2\text{H}_2 + 3\text{H}_2\text{O}$  separates at 109°. (Bauer, Zeit. angew. Ch. 1903, 17. 345.)

B.-pt. of  $\text{BaO}_2\text{H}_2 \cdot 8\text{H}_2\text{O} + \text{Aq}$  at 732 mm.

Bpt.	Time	%BaO
78° (mpt.)	0	48.45
78	4'	48.45
103	8' 30"	49.05
104	6' 45"	50.05
105	7' 30"	52.43
106	9' 25"	53.72
107	10' 45"	55.35

B.-pt. of  $\text{BaO}_2\text{H}_2 \cdot 8\text{H}_2\text{O} + \text{Aq}$ , etc.—Continued.

Bpt.	Time	%BaO
108	12'	57.49
108.5	—	58.74
109	13'	61.44
109	17' 40"	63.65
108	17' 50"	66.53
105	18'	67.51
100	18' 45"	68.17

(Bauer, Z. anorg. 1905, 47. 407.)

Solubility in  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at 25°  
 Solution sat. with respect to both  $\text{Ba}(\text{NO}_3)_2$  and  $\text{BaO}_2\text{H}_2 \cdot 8\text{H}_2\text{O}$ .

Sp. gr. 25°/25°	g BaO as $\text{Ba}(\text{OH})_2$ in 100 g $\text{H}_2\text{O}$	g $\text{Ba}(\text{NO}_3)_2$ in 100 g $\text{H}_2\text{O}$
1.1448	5.02	11.48
1.1371	4.93	10.21
1.1288	4.83	8.66
1.1220	4.72	7.55
1.1133	4.72	7.01
1.1062	4.65	6.82
1.1044	4.61	6.55
1.1010	4.64	6.08
1.0975	4.60	5.66
1.0949	4.55	5.46
1.0937	4.54	5.32
1.0885	4.52	4.44
1.0864	4.53	4.41
1.0840	4.52	4.04
1.0790	4.48	3.47
1.0774	4.46	3.14
1.0731	4.40	2.79
1.0711	4.42	2.53
1.0651	4.35	1.88
1.0626	—	—
1.0640	4.35	1.45
1.0538	4.29	0.43
1.0512	4.29	0

(Parsons and Corson, J. Am. Chem. Soc. 1910, 32. 1385.)

Solubility of  $\text{Ba}(\text{OH})_2 + 8\text{H}_2\text{O}$  (solid phase) in  $\text{MCl} + \text{Aq}$  (mol. per litre of solution) at 25°.

Solution of	(Cl')	(OH')
LiCl	0	0.555
"	0.75	0.745
"	1.42	0.937
"	2.30	1.336
KCl	0.88	0.645
"	1.75	0.680
"	3.40	0.676
NaCl	0	0.555
"	0.73	0.630
"	1.43	0.699
"	2.82	0.806
RbCl	1.25	0.648

(Herz, Z. anorg. 1910, 67. 366.)

## Solubility of BaO in NaOH + Aq at 30°

% NaOH	% BaO	Solid phase
0	4.99	BaO 9H <sub>2</sub> O
4.78	1.29	"
6.43	0.89	"
9.63	0.57	"
11.62	0.53	"
17.87	0.47	"
23.28	1.06	"
24.63	1.87	BaO 9H <sub>2</sub> O + BaO 4H <sub>2</sub> O
26.14	1.84	BaO 4H <sub>2</sub> O
27.72	1.75	"
28.43	1.58	"
29.24	1.34	BaO 4H <sub>2</sub> O + BaO 2H <sub>2</sub> O
32.12	0.82	BaO 2H <sub>2</sub> O
34.72	0.59	"
41.09	0.57	BaO 2H <sub>2</sub> O + NaOH H <sub>2</sub> O
42	0	NaOH H <sub>2</sub> O

(Schreinemakers, Z. phys. Ch. 1909, 68, 84.)

50% alcohol dissolves less than 0.5% of its wt. of BaO<sub>2</sub>H<sub>2</sub>+8H<sub>2</sub>O. (Beckmann, J. pr. 1883, (2) 27, 138.)

**Barium subiodide sodium iodide, BaI, NaI.**

Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1903, 136, 750.)

**Barium iodide, BaI<sub>2</sub>.**

Not deliquescent. Very sol in H<sub>2</sub>O and alcohol. 100 pts. of anhydrous salt dissolve: at 0° 19 5° 30° 40° 60° 90° 106° in 59 48 44 43 41 37 35 pts. H<sub>2</sub>O. (Kremers, Pogg. 103, 366.)

Sp. gr. of BaI<sub>2</sub>+Aq containing:

5	10	15	20	25	30% BaI <sub>2</sub>
1.045	1.091	1.143	1.201	1.265	1.333
35	40	45	50	55	60% BaI <sub>2</sub>
1.412	1.495	1.596	1.704	1.825	1.970

(Kremers, Pogg. 111, 63, calculated by Gerlach, Z. anal. 8, 279.)

Easily sol. in alcohol (Henry.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Sol in acetone (Naumann, B. 1904, 37, 4328; Erdmann, C. C. 1899, II 1014.)

Sol. in methyl acetate. (Naumann, B. 1906, 42, 3789.)

+2H<sub>2</sub>O At 15°C, 1 pt. by weight in sol. in:

22	pts. methyl alcohol	sp. g.	0.790
93	"	"	0.8035
307	"	"	0.8085

(Rohland, Z. anorg 1897, 15, 413.)

+7H<sub>2</sub>O. (Thomson, B. 10, 1343.)

The composition of the hydrates formed by BaI<sub>2</sub> at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by BaI<sub>2</sub> and of the conductivity and sp. gr. of BaI<sub>2</sub>+Aq. (Jones, Am. Ch. J. 1905, 34, 306.)

**Barium iodide, basic, Ba(OH)I+9H<sub>2</sub>O.**

See Barium oxyiodide.

**Barium bismuth iodide, BaI<sub>3</sub>, 2BiI<sub>3</sub>+18H<sub>2</sub>O.**

Deliquescent; decomp. by H<sub>2</sub>O. (Linau, Pogg. 111, 240.)

**Barium cadmium iodide, BaI<sub>2</sub>, CdI<sub>2</sub>+5H<sub>2</sub>O.**

Deliquescent. (Croft.)

**Barium mercuric iodide, BaI<sub>2</sub>, 2HgI<sub>2</sub>.**

Decomp. by much H<sub>2</sub>O (Boullay.)

BaI<sub>2</sub>, HgI<sub>2</sub> Sol. in H<sub>2</sub>O (Boullay.)

Sp. gr. of sat. solution = 3.575-3.588. (Rohrbach, W. Ann. 20, 169.)

+5H<sub>2</sub>O. (Duboin, C. R. 1903, 143, 314.)

2BaI<sub>2</sub>, 3HgI<sub>2</sub>+16H<sub>2</sub>O. (Duboin, C. R. 1906, 142, 888.)

BaI<sub>2</sub>, 5HgI<sub>2</sub>+8H<sub>2</sub>O As the corresponding Ca salt. (Duboin, C. R. 1906, 142, 888.)

3BaI<sub>2</sub>, 5HgI<sub>2</sub>+21H<sub>2</sub>O. Very deliquescent. (Duboin, C. R. 1906, 142, 889.)

**Barium stannous iodide.**

Very sol in H<sub>2</sub>O (Boullay.)

**Barium zinc iodide, BaI<sub>2</sub>, 2ZnI<sub>2</sub>.**

Deliquescent, and sol. in H<sub>2</sub>O. (Rammelsberg.)

+4H<sub>2</sub>O. Very hygroscopic. (Ephraim, Z. anorg. 1910, 67, 385.)

**Barium nitride, Ba<sub>3</sub>N<sub>2</sub>.**

Decomp. H<sub>2</sub>O violently, not alcohol. (Maquenne, A. ch. (6) 29, 219.)

Ba<sub>3</sub>N<sub>4</sub>

See Barium azoimide.

**Barium oxide, BaO**

Sol in H<sub>2</sub>O with evolution of heat

Easily sol. in dil HNO<sub>3</sub>, or HCl+Aq.

Solubility in NaOH+Aq. See Barium hydroxide.

Solubility in Na<sub>2</sub>O, HCl, +H<sub>2</sub>O at 30°. (Schreinemakers, Z. phys. Ch. 1909, 68, 98.)

Solubility in Na<sub>2</sub>O, NaCl, BaCl<sub>2</sub>+Aq at 30°. (Schreinemakers.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20, 827.)

Sol. with combination in absolute alcohol and anhydrous wood-spirit. Insol in ether.

Easily sol. in absolute methyl alcohol

1 l. absolute ethyl alcohol sat. with BaO at 9° contains 213.8 g BaO. (Berthelot, B.M. Soc. 8, 389.)

Sol. in methyl alcohol. (Neuberg and Neumann, Biochem. Z. 1905, 1, 173.)

Insol. in acetone (Erdmann, C. C. 1899, II, 1014, Naumann, B. 1904, 37, 4329.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790.)

See also Barium hydroxide.

**Barium peroxide, BaO<sub>2</sub>.**

• Insol. in H<sub>2</sub>O, decomp. by boiling H<sub>2</sub>O.

Sol. in acids with formation of hydrogen dioxide.

Forms hydrate with  $8\text{H}_2\text{O}$ ; also  $10\text{H}_2\text{O}$  (Berthelot, A. ch. (5) 21. 157), also a compound  $\text{BaO}_2 \cdot \text{H}_2\text{O}_2$ , which is very unstable, sl. sol. in cold  $\text{H}_2\text{O}$ , and insol in alcohol or ether (Schöne, A. 192. 257)

+ $8\text{H}_2\text{O}$ . 100 cc pure  $\text{H}_2\text{O}$  dissolve 0.168 g  $\text{BaO}_2 \cdot 8\text{H}_2\text{O}$ ; if  $\text{H}_2\text{O}$  contains 0.3 g  $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$ , only 0.102 g.  $\text{BaO}_2 \cdot 8\text{H}_2\text{O}$  are dissolved; if 0.6 g  $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$  only 0.019 g.  $\text{BaO}_2 \cdot 8\text{H}_2\text{O}$  are dissolved. (Schöne, A. 1878, 192. 266.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014, Naumann, B. 1904, 37. 4329.)

**Barium oxybromide,  $\text{Ba}(\text{OH})\text{Br} + 2\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Beckmann, J. pr. (2) 27. 132)

$\text{BaBr}_2 \cdot \text{BaO} + 5\text{H}_2\text{O}$  Sl. sol. in  $\text{H}_2\text{O}$  (Tas-silly, C. R. 1895, 120. 1340)

**Barium oxychloride,  $\text{Ba}(\text{OH})\text{Cl} + 2\text{H}_2\text{O}$**

Decomp. by  $\text{H}_2\text{O}$  (Beckmann, J. pr. (2) 26. 388, 474.)

**Barium mercury oxychloride,  $\text{BaCl}_2 \cdot \text{HgO} + 8\text{H}_2\text{O}$**

Decomp. by  $\text{H}_2\text{O}$  (André, C. R. 104. 431.)

**Barium oxyiodide,  $\text{Ba}(\text{OH})\text{I} + 9\text{H}_2\text{O}$**

Decomp. by  $\text{H}_2\text{O}$  and alcohol. (Beckmann, B. 14. 2154)

$\text{BaI}_2 \cdot \text{BaO} + 9\text{H}_2\text{O}$  Sl. sol. in  $\text{H}_2\text{O}$  (Tas-silly, C. R. 1895, 120. 1340)

**Barium oxysulphides,  $\text{Ba}_7\text{O}_5\text{S}_4 + 58\text{H}_2\text{O}$ ,  
 $\text{Ba}_4\text{OS} + 10\text{H}_2\text{O}$ ,  $\text{Ba}_4\text{OS}_2 + 28\text{H}_2\text{O}$ .**

Very unstable; decomp. by recrystallization into  $\text{BaS}_2\text{H}_2$  and  $\text{BaO}_2\text{H}_2$

**Barium phosphide,  $\text{BaP}_2$**

Decomp. by  $\text{H}_2\text{O}$ . (Dumas, A. ch. 32. 364.)

$\text{Ba}_3\text{P}_4$ . Crystallized. Sol. in dil. acids; insol. in conc. acids, decomp. by  $\text{H}_2\text{O}$ . Insol. in organic solvents at ord. temp. (Jabon, C. R. 1899, 129. 765)

**Barium selenide,  $\text{BaSe}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp.

Sl. sol. in  $\text{H}_2\text{O}$  (Favre, C. R. 102. 1469.)

**Barium silicide,  $\text{Ba}_2\text{Si}$ .**

(Jungst, C. C. 1905, I. 195.)

$\text{BaSi}_2$ . Slowly decomp. by  $\text{H}_2\text{O}$ , not by  $\text{NH}_4\text{OH} + \text{Aq}$ . Rapidly decomp. by conc.  $\text{NaOH}$ . Sol. in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$  with evolution of spontaneously inflammable gas. Sol. in  $\text{HF}$  and  $\text{HCl}$ . Sol. in acetic acid without evolution of gas. (Moissan, *Traité* ch. min. 1904, III. 680.)

Decomp. rapidly in both hot and cold  $\text{H}_2\text{O}$  (Bradley, C. N. 1900, 62. 150.)

**Barium sulphide,  $\text{BaS}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp.

Crystallized. Decomp. by  $\text{H}_2\text{O}$ .

Attacked by cold conc.  $\text{HNO}_3$ . (Mourlot, A. ch. 1899, (7) 17. 521.)

Cryst. modification is less readily acted on by an and other reagents than the amorphous modification, sol. in fuse oxidizing agents. (Mourlot, C. R. 1898, 126. 645.)

+ $\text{H}_2\text{O}$ . (Neuberg and Neumann, *Biochem. Z.* 1906, 1. 174.)

+ $6\text{H}_2\text{O}$ . Slowly sol. in boiling  $\text{H}_2\text{O}$ , with decomp.; insol. in, but decomp. by boiling alcohol (Schöne)

**Barium sulphide,  $\text{Ba}_2\text{S}_7 + 25\text{H}_2\text{O}$  (?)**

Sol. in  $\text{H}_2\text{O}$ . (Schöne, Pogg. 112. 215)

**Barium trisulphide,  $\text{BaS}_3$**

Sol. in large amount of boiling  $\text{H}_2\text{O}$ . (Schöne, Pogg. 112. 215)

**Barium tetrasulphide,  $\text{BaS}_4 + \text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ , especially if hot, sol. in 2.42 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ ; insol. in  $\text{CS}_2$  or alcohol. (Schöne, Pogg. 112. 224)

+ $2\text{H}_2\text{O}$ . (Veley, *Chem. Soc.* 49. 369.)

**Barium pentasulphide,  $\text{BaS}_5$ .**

Known only in solution.

**Barium mercuric sulphide,  $\text{BaS} \cdot \text{HgS} + 5\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  (Wagner, J. pr. 98. 23.)

**Barium nickel sulphide,  $\text{BaS} \cdot 4\text{NiS}$ .**

Sol. in warm conc.  $\text{HCl}$  (Bellucci, C. A. 1909, 293.)

**Barium stannic sulphide.**

See Sulphostannate, barium.

**Barium uranyl sulphide,  $6\text{BaS} \cdot \text{UO}_2\text{S} + x\text{H}_2\text{O}$  (?)**

Decomp. by  $\text{HCl} + \text{Aq}$ . (Remelé, Pogg. 124. 159.)

**Baryta.**

See Barium oxide;  $\text{BaO}$ .

**Beryllium,  $\text{Be}$ .**

For beryllium and its salts, see Glucinum and the corresponding salts.

**Bismuth,  $\text{Bi}$ .**

Not attacked by  $\text{H}_2\text{O}$ . Very slowly attacked by  $\text{HCl} + \text{Aq}$  (Troost). Very sl. sol. in conc.  $\text{HCl} + \text{Aq}$  (Schutzenberger, Willm). Not attacked by dil.  $\text{HCl} + \text{Aq}$  (Naquet and Hanriot). Very slowly attacked by cold  $\text{HCl} + \text{Aq}$  (Godeffroy). According to very careful experiments pure  $\text{Bi}$  is absolutely unattacked by hot or cold, dil. or conc.  $\text{HCl} + \text{Aq}$  except in presence of oxygen (Ditte and Metzner, A. ch. (6) 29. 397.)

Not attacked by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Decomp.

by hot conc  $\text{H}_2\text{SO}_4$ . Easily sol. in dil or conc.  $\text{HNO}_3$ +Aq. or aqua regia.

Not attacked by pure  $\text{HNO}_3$ +Aq. of 1.52 to 1.42 sp. gr. at  $20^\circ$ , violently attacked by a more dil. acid, but the acid becomes concentrated thereby. Conc.  $\text{HNO}_3$ +Aq. attacks only by heating or adding  $\text{NO}_2$ . (Millon, A. ch. (3) 6. 95.)

Insol. in liquid  $\text{NH}_3$  (Gore, Am. Ch. J. 1898, 20. 827.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0091 g. Bi in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

#### Bismuth arsenide, $\text{Bi}_2\text{As}_3$

(Descamp, C. R. 86. 1065.)

#### Bismuth dibromide, $\text{Bi}_2\text{Br}_4$ .

Not known in a pure state (Weber, Pogg. 107. 599.)

#### Bismuth tribromide, $\text{BiBr}_3$ .

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol or ether.

Sol. in  $\text{AlBr}_3$  (Isbekow, Z. anorg. 1913, 84. 27.)

#### Bismuth hydrogen bromide, $\text{BiBr}_3 \cdot 2\text{HBr} + 4\text{H}_2\text{O}$ .

Deliquescent.

Decomp. in the air (Aloy, Bull. Soc. 1906, (3) 35. 398.)

#### Bismuth cesium bromide, $2\text{BiBr}_3 \cdot 3\text{CsBr}$ .

Ppt. Insol. in  $\text{HBr}$ .

Sol. in  $\text{HCl}$  and in  $\text{HNO}_3$  (Hutchins, J. Am. Chem. Soc. 1907, 29. 33.)

#### Bismuth potassium bromide, $\text{BiBr}_3 \cdot 2\text{KBr}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Aloy, Bull. Soc. 1906, (3) 35. 398.)

#### Bismuth bromide ammonia, $\text{BiBr}_3 \cdot 3\text{NH}_3$ .

Sol. in  $\text{HCl}$ +Aq.

$\text{BiBr}_3 \cdot 2\text{NH}_3$  (?)

$2\text{BiBr}_3 \cdot 5\text{NH}_3$  Not deliquescent; not decomp. by  $\text{H}_2\text{O}$ , easily sol. in dil. acids (Muir, Chem. Soc. 29. 144.)

#### Bismuth bromide potassium chloride,

$\text{K}_2\text{BiCl}_2\text{Br}_2 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Atkinson, Chem. Soc. 43. 289.)

#### Bismuth dichloride, $\text{Bi}_2\text{Cl}_4$ .

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$ , dil. acids, or conc.  $\text{NH}_4\text{Cl}$ +Aq. (Weber, Pogg. 107. 596.)

#### Bismuth trichloride, $\text{BiCl}_3$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$ +Aq. and alcohol. Not decomp. by  $\text{H}_2\text{O}$  in presence of citrates. (Spiller.)

0.08 g. sol. in 100 ccm. liquid  $\text{H}_2\text{S}$  (Antony, C. C. 1905, I. 1692.)

Moderately sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

1 g.  $\text{BiCl}_3$  is sol. in 5.59 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 0.9194$  (Naumann, B. 1904, 37. 4331.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

1 pt. is sol. in 60.36 pts. ethyl acetate at  $18^\circ$ . Sp. gr. at  $18^\circ/40^\circ = 0.9106$ . (Naumann, B. 1910, 43. 320.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

#### Bismuth chloride, $\text{Bi}_2\text{Cl}_6$ (?)

Decomp. by  $\text{H}_2\text{O}$ . (Dehéraïn, C. R. 54. 724.)

#### Bismuth hydrogen chloride, $2\text{BiCl}_3 \cdot \text{HCl} + 3\text{H}_2\text{O}$ .

Not deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Engel, C. R. 106. 1797.)

$\text{BiCl}_3 \cdot 2\text{HCl}$ . (Jacquelin, A. ch. (2) 62. 363.)

#### Bismuth cesium chloride, $\text{BiCl}_3 \cdot 3\text{CsCl}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in cold dil.  $\text{HCl}$ +Aq. but easily sol. on warming. (Brigham, Am. Ch. J. 14. 181.)

$2\text{BiCl}_3 \cdot 3\text{CsCl}$  As above. (Brigham.)

$\text{BiCl}_3 \cdot 6\text{CsCl}$  Easily sol. in  $\text{H}_2\text{O}$  and dil.  $\text{HCl}$ +Aq. (Godefroy, B. 8. 9.)

Does not exist. (Brigham.)

#### Bismuth hydrazine chloride, $\text{BiCl}_3$ ,

$3\text{N}_2\text{H}_4\text{HCl}$ .

Sol. in acids, from which it is pptd. by  $\text{H}_2\text{O}$ . (Ferranti, C. A. 1912. 1613.)

#### Bismuth nitrosyl chloride, $\text{BiCl}_3 \cdot \text{NOCl}$ .

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Sudborough, Chem. Soc. 59. 662.)

#### Bismuth potassium chloride, $\text{BiCl}_3 \cdot \text{KCl} + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Cannot be recryst. except from conc.  $\text{BiCl}_3$ + $\text{HCl}$ . Decomp. by  $\text{HCl}$ +Aq. into  $\text{BiCl}_3 \cdot 2\text{KCl} + 2\text{H}_2\text{O}$ . (Brigham, Am. Ch. J. 14. 167.)

$\text{BiCl}_3 \cdot 2\text{KCl}$ . Decomp. by  $\text{H}_2\text{O}$ . (Arppe, Pogg. 64. 37.)

Deliquescent

Sol. in  $\text{H}_2\text{O}$  with decomp. into the oxychloride when excess  $\text{H}_2\text{O}$  is used (Aloy, Bull. Soc. 1906, (3) 35. 397.)

+ $2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Jacquelin, J. pr. 14. 1.)

Sol. in moderately conc.  $\text{HCl}$ +Aq.

$\text{BiCl}_3 \cdot 3\text{KCl}$ . Decomp. by  $\text{H}_2\text{O}$  (Arppe.) Does not exist. (Brigham.)

**Bismuth rubidium chloride,  $\text{BiCl}_3$ ,  $\text{RbCl}$  +  $\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ ; sol. in dil  $\text{HCl}$  +  $\text{Aq}$ , from which  $\text{BiCl}_3$ ,  $3\text{RbCl}$  crystallizes (Brigham, Am. Ch. J. 14, 174.)

$\text{BiCl}_3$ ,  $3\text{RbCl}$  Decomp. by  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HCl}$  +  $\text{Aq}$  without decomp. (Brigham.)

$\text{BiCl}_3$ ,  $6\text{RbCl}$ . Decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$  +  $\text{Aq}$  (Codeffroy, B. S. 9); does not exist. (Brigham.)

$10\text{BiCl}_3$ ,  $23\text{RbCl}$  (?). As above (Brigham.)

**Bismuth sodium chloride,  $\text{BiCl}_3$ ,  $2\text{NaCl}$  +  $\text{H}_2\text{O}$**

+  $3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Arppe, Pogg. 64, 237.)

$\text{BiCl}_3$ ,  $3\text{NaCl}$

**Bismuth thallous chloride,  $\text{BiCl}_3$ ,  $3\text{TlCl}$ .**

Ppt. (Ephraim, Z. anorg 1909, 61, 254.)

$\text{BiCl}_3$ ,  $6\text{TlCl}$ . Ppt. (Ephraim.)

**Bismuth chloride ammonia,  $2\text{BiCl}_3$ ,  $\text{NH}_3$ .**

Stable (Dehéran, C. R. 54, 724.)

$\text{BiCl}_3$ ,  $2\text{NH}_3$ . (D.)

$\text{BiCl}_3$ ,  $3\text{NH}_3$ . (D.)

**Bismuth chloride nitric oxide,  $\text{BiCl}_3$ ,  $\text{NO}$ .**

Very hygroscopic. (Thomas, C. R. 1895, 121, 129.)

**Bismuth chloride nitrogen peroxide,  $\text{BiCl}_3$ ,  $\text{NO}_2$**

Decomp. by moist air, but stable in dry air. (Thomas, C. R. 1896, 122, 613.)

**Bismuth chloride selenide.**

See Bismuth selenochloride.

**Bismuth trifluoride,  $\text{BiF}_3$ .**

Insol. in  $\text{H}_2\text{O}$  or alcohol. (Gott and Murr, Chem. Soc. 53, 138.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 827.)

**Bismuth hydrogen fluoride,  $\text{BiF}_3$ ,  $3\text{HF}$**

Deliquescent. Decomp. by boiling  $\text{H}_2\text{O}$ . (Murr, Chem. Soc. 39, 21.)

**Bismuth gold,  $\text{Au}_2\text{Bi}$ .**

Insol. in equal pts. of  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9, 71.)

**Bismuthous hydroxide,  $\text{Bi}(\text{OH})_3$ .**

Sol. in strong acids. Insol. in solutions of alkalis, alkali carbonates,  $(\text{NH}_4)_2\text{CO}_3$ , or  $\text{NH}_4\text{NO}_3$ ; or of amyl amine (Wurtz). When recently pptd. is sol. in  $\text{NH}_4\text{Cl}$  +  $\text{Aq}$ , but insol. in  $\text{NH}_4\text{NO}_3$  +  $\text{Aq}$  (Brett, 1837). Not pptd. in presence of Na citrates (Spiller).

Solubility of freshly pptd.  $\text{Bi}(\text{OH})_3$  in  $\text{NaOH}$  +  $\text{Aq}$

g $\text{NaOH}$ per l.	g $\text{Bi}$ dissolved per l. at $20^\circ$	g $\text{Bi}$ dissolved per l. at $100^\circ$
400	0.16	1.70
320	0.11	1.20
240	0.11	
200	0.10	0.5
160	0.08	0.5
120	0.07	
80	0.04	0.35
40	trace	0.2
20	0	0.15

(Moser, Z. anorg 1909, 61, 386.)

Solubility of freshly pptd.  $\text{Bi}(\text{OH})_3$  in  $\text{KOH}$  +  $\text{Aq}$

$\text{KOH}$ per l. g	g $\text{Bi}$ dissolved per l. at $20^\circ$	g $\text{Bi}$ dissolved per l. at $100^\circ$
560	0.14	1.65
448	0.11	1.20
336	0.11	
280	0.10	0.5
224	0.08	0.5
168	0.06	
112	0.03	0.3
56	trace	0.2
28	0	0.15

(Moser, Z. anorg 1909, 61, 386.)

$\text{Bi}_2\text{O}_3$ ,  $2\text{H}_2\text{O}$ .

$\text{Bi}_2\text{O}_3$ ,  $\text{H}_2\text{O}$ . (Muir, Chem. Soc. 32, 131.)

See also Bismuth trioxide.

**Bismuth tetrahydroxide,  $\text{Bi}_4\text{O}_4$ ,  $\text{H}_2\text{O}$**

$\text{Bi}_4\text{O}_4$ ,  $2\text{H}_2\text{O}$ . (Wernicke, Pogg. 141, 109.)

**Bismuthic hydroxide (Bismuthic acid),  $\text{Bi}_2\text{O}_3$ ,  $\text{H}_2\text{O}$**

Insol. in  $\text{H}_2\text{O}$ ; easily decomp. by acids. (Fremy, A. ch. (3) 12, 495.) Decomp. by  $\text{H}_2\text{SO}_4$ ; not attacked by  $\text{SO}_2$  +  $\text{Aq}$ ; neither dissolved nor decomp. by dil  $\text{HNO}_3$  +  $\text{Aq}$ , but slowly converted into an allotropic modification (?) Partially decomp. by conc.  $\text{HNO}_3$ . Slowly but wholly dissolved by hot conc.  $\text{HNO}_3$ . Sl. sol. in conc  $\text{KOH}$  +  $\text{Aq}$  (Arppe.) Sol. in about 100 pts boiling  $\text{KOH}$  +  $\text{Aq}$ , so conc. that it solidifies on removing the lamp. (Murr, Chem. Soc. 51, 77.)

$\text{Bi}_2\text{O}_3$ ,  $2\text{H}_2\text{O}$ . (Bödeker, A. 123, 61.)

Does not exist (Hoffmann and Geuther.)

**Bismuth iodide,  $\text{BiI}_3$ .**

Not attacked by cold  $\text{H}_2\text{O}$ , but by boiling,  $\text{BiOI}$  is formed. 100 pts. absolute alcohol dissolve  $3\frac{1}{4}$  pts. salt at  $20^\circ$ . (Gott and Muir, Chem. Soc. 57, 138.)

Sol. in  $\text{HNO}_3$  and  $\text{HI}$  +  $\text{Aq}$ , from which it is reprecip. by  $\text{H}_2\text{O}$  or alcohol. Sol. in  $\text{KI}$  +  $\text{Aq}$  or  $\text{KOH}$  +  $\text{Aq}$ . (Rammelsberg.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

100 g. absolute alcohol dissolve 3.5 g.  $\text{BiI}_3$  at  $20^\circ$  (Gott and Mur, Chem. Soc. 57, 138)

\* Sol. in acetone (Naumann, B. 1904, 37, 4328)

100 pts. methylene iodide dissolve 0.15 pt.  $\text{BiI}_3$  at  $12^\circ$ , and very little more at higher temperatures. (Retgers, Z. anorg. 3, 343.)

Sol. in methyl acetate (Naumann, B. 1909, 42, 3790.)

Bismuth hydrogen iodide,  $\text{BiI}_3$ ,  $\text{HI} + 4\text{H}_2\text{O}$ . (Arppe, Pogg. 44, 248.)

Bismuth cesium iodide,  $3\text{CsI} \cdot 2\text{BiI}_3$ .  
Very sl. sol. in  $\text{H}_2\text{O}$  (Wells, Am. J. Sci. 1897, (4) 3, 464)

Bismuth calcium iodide,  $2\text{BiI}_3$ ,  $\text{CaI}_2 + 18\text{H}_2\text{O}$   
Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Linau, Pogg. 111, 240.)

Bismuth magnesium iodide,  $2\text{BiI}_3$ ,  $\text{MgI}_2 + 12\text{H}_2\text{O}$ .  
Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Linau, Pogg. 111, 240.)

Bismuth potassium iodide,  $\text{BiI}_3$ ,  $4\text{KI}$ .  
Ppt. (Arppe, Pogg. 44, 237)

$\text{BiI}_3$ ,  $3\text{KI}$  (Astre, C. R. 110, 1137)  
 $\text{BiI}_3$ ,  $2\text{KI}$ . Sol. in acetic ether. (Astre)  
 $+ 4\text{H}_2\text{O}$ . Sol. in small amt  $\text{H}_2\text{O}$  without pptn., but decomp. by much  $\text{H}_2\text{O}$ .

$\text{BiI}_3$ ,  $2\text{KI}$ ,  $\text{HI}$  (Arppe.)  
 $2\text{BiI}_3$ ,  $3\text{KI} + 2\text{H}_2\text{O}$ . (Astre.)  
 $\text{BiI}_3$ ,  $\text{KI} + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Nicklès, C. R. 51, 1097)

$2\text{BiI}_3$ ,  $\text{KI}$ . Sol. in acetic ether. (Astre.)

Bismuth sodium iodide,  $\text{BiI}_3$ ,  $\text{NaI} + \text{H}_2\text{O}$ .  
Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Nicklès, C. R. 51, 1097)

$2\text{BiI}_3$ ,  $3\text{NaI} + 12\text{H}_2\text{O}$  As above. (Linau, Pogg. 111, 240.)

Bismuth zinc iodide,  $2\text{BiI}_3$ ,  $\text{ZnI}_2 + 12\text{H}_2\text{O}$ .  
Very deliquescent. (Linau, Pogg. 111, 240.)

Bismuth iodide ammonia,  $\text{BiI}_3$ ,  $3\text{NH}_3$   
Decomp. by  $\text{H}_2\text{O}$  (Rammelsberg.)

Bismuth iodide zinc bromide.  
Sol. in  $\text{H}_2\text{O}$  (Linau, Pogg. 111, 240.)

Bismuth nitride.  
Explosive. (Fischer, B. 1910, 43, 1471)  
 $\text{BiN}$ . Ppt. Decomp. by  $\text{H}_2\text{O}$  or dil acids (Franklin, J. Am. Chem. Soc. 1905, 27, 847.)

Bismuth dioxide,  $\text{Bi}_2\text{O}_3$ .  
Sol. in conc.  $\text{HNO}_3 + \text{Aq}$ . Decomp. by strong acids, and boiling  $\text{KOH} + \text{Aq}$ .  
Decomp. by  $\text{H}_2\text{O}$  (Tanatar, Z. anorg. 1901, 27, 438.)

# Bismuth dioxide, $\text{Bi}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in conc. acids.

Solubility of  $\text{Bi}_2\text{O}_3$  in  $\text{HNO}_3 + \text{Aq}$  at  $20^\circ$ .

In 100 g. of the liquid phase		Solid phase
g. $\text{Bi}_2\text{O}_3$	g. $\text{N}_2\text{O}_5$	
0.321	0.963	$\text{Bi}_2\text{O}_3$ , $\text{N}_2\text{O}_5$ , $2\text{H}_2\text{O}$
0.337	0.982	"
3.54	4.68	"
6.37	7.17	"
13.67	12.50	"
14.85	13.31	"
18.74	15.90	$\text{Bi}_2\text{O}_3$ , $\text{N}_2\text{O}_5$ , $\text{H}_2\text{O}$
23.50	19.21	"
23.60	19.29	"
27.15	20.96	"
28.11	21.64	"
29.50	22.53	"
30.19	22.90	"
31.48	23.70	"
32.93	24.83	{ $\text{Bi}_2\text{O}_3$ , $\text{N}_2\text{O}_5$ , $\text{H}_2\text{O} +$ $\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $10\text{H}_2\text{O}$ . $\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $10\text{H}_2\text{O}$ .
32.80	24.86	"
32.67	24.70	"
32.59	24.60	"
32.24	24.68	"
30.74	25.13	"
29.83	25.30	"
24.16	28.25	"
16.62	35.40	"
12.17	43.37	"
11.66	46.62	"
11.19	49.38	"
11.19	50.20	"
15.20	54.66	"
20.76	53.75	"
27.85	51.02	{ $\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $10\text{H}_2\text{O} +$ $\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $3\text{H}_2\text{O}$ . $\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $3\text{H}_2\text{O}$ .
8.58	68.28	"
4.05	74.90	"

(Rutten, Z. anorg. 1902, 30, 336.)

Solubility of  $\text{Bi}_2\text{O}_3$  in  $\text{HNO}_3 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{Bi}_2\text{O}_3$	% $\text{N}_2\text{O}_5$	Solid phase
$9^\circ$	20.8	17.1	$\text{Bi}_2\text{O}_3$ , $\text{N}_2\text{O}_5$ , $\text{H}_2\text{O}$
	24.02	19.1	"
	31.09	23.8	{ $\text{Bi}_2\text{O}_3$ , $\text{N}_2\text{O}_5$ , $\text{H}_2\text{O} +$ $\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $10\text{H}_2\text{O}$
	31.2	23.9	"
$30^\circ$	34.2	26.5	"
	28.2	29.6	$\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $10\text{H}_2\text{O}$
	16.1	47.7	"
$65^\circ$	5.55	7.44	$\text{Bi}_2\text{O}_3$ , $\text{N}_2\text{O}_5$ , $\text{H}_2\text{O}$
	27.62	22.46	"
	40.80	31.60	$\text{Bi}_2\text{O}_3$ , $\text{N}_2\text{O}_5$ , $\text{H}_2\text{O} + \text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $10\text{H}_2\text{O}$
	37.82	35.80	$\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $10\text{H}_2\text{O}$
	35.73	47.02	{ $\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $10\text{H}_2\text{O} +$ $\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $3\text{H}_2\text{O}$
	4.59	77.90	$\text{Bi}_2\text{O}_3$ , $3\text{N}_2\text{O}_5$ , $3\text{H}_2\text{O}$

(Rutten.)

Solubility of $\text{Bi}_2\text{O}_3$ in $\text{HNO}_3 + \text{Aq}$ at $t^\circ$				
$t^\circ$	% $\text{Bi}_2\text{O}_3$	% $\text{N}_2\text{O}_5$	Solid phase	
72°	37.23	47.76	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 4\text{H}_2\text{O}$	
75°	36.74	47.91	"	
80°	39.75	45.16	"	
9°	31.2	23.9	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O} +$	
20°	32.8	24.8	$\text{Bi}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 \cdot \text{H}_2\text{O}$	
30°	34.2	26.4	"	
50°	26.9	28.9	"	
64°	40.8	31.1	"	
65°	40.8	31.6	"	
75 5°	45.4	34.6	"	
72°	45.9	35.6	"	
11 5°	25.36	52.57	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O} +$	
20°	27.85	51.02	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 3\text{H}_2\text{O}$	
50°	32.22	49.29	"	
65°	35.73	47.02	"	

(Rutten.)

Solubility in $\text{NaOH} + \text{Aq}$ at $25^\circ$		
Conc. of $\text{NaOH}$ Mol./l.	g $\text{Bi}_2\text{O}_3$ in 100 cc of solution. Mean result	
1.0	0.0013 $\pm$ 0.0002	
2.0	0.0026 $\pm$ 0.0002	
3.0	0.0049 $\pm$ 0.0005	

(Knox, Chem. Soc. 1909, 95, 1787.)

Insol. in acetone. (Eidmann, C C 1899, II, 1014.)

Min. *Bismite* Easily sol. in  $\text{HNO}_3 + \text{Aq}$ .

See also Bismuthous hydroxide.

**Bismuth tetroxide,  $\text{Bi}_2\text{O}_4$ .**

Sol. in conc.  $\text{HCl} + \text{Aq}$ , with evolution of  $\text{Cl}_2$ ; in oxygen acids with evolution of  $\text{O}$ . Less easily sol. in conc.  $\text{H}_2\text{SO}_4$  than in  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ .

**Bismuth oxide,  $\text{Bi}_2\text{O}_3$  (?).**

(Hoffmann and Geuther.)

**Bismuth pentoxide,  $\text{Bi}_2\text{O}_5$**

Sol. in dil acids. Combines with  $\text{H}_2\text{O}$  to form bismuthic hydroxide, which see (Hasebroek, B. 20, 213.)

**Bismuth oxybromide, etc.**

See Bismuthyl bromide, etc.

**Bismuth palladium,  $\text{PdBi}_3$ .**

Insol. in equal pts.  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9, 70.)

**Bismuth platinum,  $\text{PtBi}_3$ .**

Insol. equal pts.  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9, 69.)

**Bismuth phosphide,  $\text{BiP}$**

(Cavazzi.)

**Bismuth triselenide,  $\text{Bi}_2\text{Se}_3$**

Insol. in  $\text{H}_2\text{O}$ , alkalis, or alkali sulphides +  $\text{Aq}$ , sl. attacked by  $\text{HCl} + \text{Aq}$ ; oxidized by  $\text{HNO}_3 + \text{Aq}$ . (Schneider, Pogg 94, 628.)  
Min. *Frenzelite*.

**Bismuth potassium selenide.**

See Selenobismuthite, potassium.

**Bismuth selenochloride,  $\text{Bi}_2\text{SeCl}$**

Not attacked by  $\text{H}_2\text{O}$ ; very sl. sol. in  $\text{HCl} + \text{Aq}$ , easily and completely sol. with decomp. in  $\text{HNO}_3 + \text{Aq}$  (Schneider.)

**Bismuth disulphide,  $\text{Bi}_2\text{S}_3 + 2\text{H}_2\text{O}$  (?).**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{HCl} + \text{Aq}$

**Bismuth trisulphide,  $\text{Bi}_2\text{S}_3$ .**

Insol. in  $\text{H}_2\text{O}$ .

1 l.  $\text{H}_2\text{O}$  dissolves  $0.35 \times 10^{-4}$  moles  $\text{Bi}_2\text{S}_3$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58, 294.)

Easily sol. in moderately dil.  $\text{HNO}_3 + \text{Aq}$ , and conc.  $\text{HCl} + \text{Aq}$ , with separation of  $\text{S}$ . Insol. in alkalis, alkali sulphides,  $\text{Na}_2\text{S}_2\text{O}_3$ , or  $\text{KCN} + \text{Aq}$ , insol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett). Insol. in potassium thiocarbonate +  $\text{Aq}$  (Rosenblatt, Z. anal. 26, 15.)

Insol. in alkali hydroxides or alkali hydro-sulphides.

Insol. in  $2\text{N}-(\text{NH}_4)_2\text{S} + \text{Aq}$ .

0.0090 g.  $\text{Bi}_2\text{S}_3$  is sol. in 100 cc.  $\text{N}-\text{Na}_2\text{S}_3 + \text{Aq}$  at  $25^\circ$ . (Knox, Chem. Soc. 1909, 95, 1764.)

Somewhat sol. in  $\text{Na}_2\text{S} + \text{Aq}$ . 75 cc. of  $\text{Na}_2\text{S} + \text{Aq}$  (sp. gr. 1.06) dissolve an amt. of  $\text{Bi}_2\text{S}_3$  corresponding to 0.031 g.  $\text{Bi}_2\text{O}_3$ . (Stillman, J. Am. Chem. Soc. 1896, 18, 683.)

Solubility in  $\text{Na}_2\text{S} + \text{NaOH} + \text{Aq}$  at  $25^\circ$ .

Conc. of $\text{Na}_2\text{S}$ Mol./l.	Conc. of $\text{NaOH}$ Mol./l.	g $\text{Bi}_2\text{S}_3$ in 100 cc. of solution
0.5	1.0	0.0185
1.0	1.0	0.0838

(Knox, Chem. Soc. 1909, 95, 1763.)

**Bismuth sulphide pptd. from acid solution** is not dissolved by subsequent treatment with  $\text{K}_2\text{S} + \text{Aq}$ . (Stone, J. Am. Chem. Soc. 1896, 18, 1091.)

Sol. in  $\text{K}_2\text{S} + \text{Aq}$ . (Ditte, C. R. 1895, 120, 187.)

Solubility in  $\text{K}_2\text{S} + \text{KOH} + \text{Aq}$  at  $25^\circ$ .

Conc. of $\text{K}_2\text{S}$ Mol./l.	Conc. of $\text{KOH}$ Mol./l.	g $\text{Bi}_2\text{S}_3$ in 100 cc. of solution
0.5	1.0	0.0240
1.0	1.0	0.1230
1.25	1.25	0.2354

(Knox, Chem. Soc. 1909, 95, 1763.)

Solubility in alkali sulphides + Aq at 25°.

Alkali sulphide	Conc. of alkali sulphide Mol/l	g Bi <sub>2</sub> S <sub>3</sub> in 100 cc of solution
Na <sub>2</sub> S	0.5	0.0040
	1.0	0.0238
	1.5	0.1023
K <sub>2</sub> S	0.5	0.0042
	1.0	0.0337
	1.25	0.0639

(Knox, Chem. Soc. 1909, 95. 1762.)

Decomp. by FeCl<sub>3</sub> + Aq (Cammerer, C. C. 1891, II. 525.)

Insol. in KCN + Aq (Hoffmann, A. 1884, 223. 134.)

Min. *Bismuthinite*. Easily sol. in HNO<sub>3</sub> + AqBismuth cuprous sulphide, Bi<sub>2</sub>S<sub>3</sub>, Cu<sub>2</sub>S.Insol. in H<sub>2</sub>O. Sol. with decomp. in HNO<sub>3</sub> + Aq (Schneider, J. pr. (2) 40. 564.)Min *Emplectonite*.Bismuth potassium sulphide, Bi<sub>2</sub>S<sub>3</sub>, K<sub>2</sub>S.

(Schneider, Pogg. 136. 460.)

Insol. in ethyl acetate (Naumann, B. 1910, 43. 314.)

Bi<sub>2</sub>S<sub>3</sub>. 4K<sub>2</sub>S + 4H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. Very sol. in K<sub>2</sub>S + Aq. Efflorescent in dry air. (Ditte, C. R. 1895, 120. 186.)

See also Sulphobismuthite, potassium.

Bismuth silver sulphide, Bi<sub>2</sub>S<sub>3</sub>, Ag<sub>2</sub>S.Insol. in cold HCl, or HNO<sub>3</sub>. Sol. in warm HNO<sub>3</sub> with separation of S, in boiling HCl with separation of H<sub>2</sub>S.Min. *Plenargyrite*, *Matildite*

(Schneider, J. pr. 1890, (2) 41. 414.)

Bismuth sodium sulphide, Bi<sub>2</sub>S<sub>3</sub>, Na<sub>2</sub>S.

(Schneider.)

Bismuth sulphide telluride, Bi<sub>2</sub>S<sub>3</sub>, 2Bi<sub>2</sub>Te.Min. *Tetradymite*. Sol. in HNO<sub>3</sub> with separation of S.Bi<sub>2</sub>S<sub>3</sub>, 2Bi<sub>2</sub>Te.Min *Joseite*. As above.

Bismuth sulphobromide, BiSBr.

(Mur and Eagles, Chem. Soc. 1895, 67. 91.)

Bismuth sulphochloride, BiSCl

Insol. in H<sub>2</sub>O or dil. HCl + Aq. Sol. in conc. HCl, or HNO<sub>3</sub> + Aq. Decomp. by alkalis + Aq. (Schneider, Pogg. 93. 464.)

Bismuth sulphoiodide, BiSI.

Not attacked by boiling H<sub>2</sub>O, and dil. acids. Decomp. by hot conc. HCl + Aq, and HNO<sub>3</sub> + Aq. KOH + Aq. dissolves out I<sub>2</sub>. (Schneider, Pogg. 110. 114.)Bismuth telluride, Bi<sub>2</sub>Te.Min. *Tetradymite*. Sol. in HNO<sub>3</sub> + Aq

See also Bismuth sulphide telluride.

Bismuthic acid, HBiO<sub>3</sub>.

See Bismuthic hydroxide.

Potassium bismuthate, KBiO<sub>3</sub>Sol. in H<sub>2</sub>O. (Arppe)KH(BiO<sub>3</sub>)<sub>2</sub>. Insol. in H<sub>2</sub>O.Not decomp. by boiling H<sub>2</sub>O (André, C. R. 113. 860.)No salts of HBiO<sub>3</sub> can exist. (Muir and Carnegie, Chem. Soc. 51. 77.)

Bismuthicotungstic acid.

Ammonium bismuthicotungstate, 3(NH<sub>4</sub>)<sub>2</sub>O, 2Bi<sub>2</sub>O<sub>3</sub>, 11WO<sub>3</sub> + 10H<sub>2</sub>O

A yellow oil which dries to a yellow glass. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1232.)

Potassium bismuthicotungstate, 3K<sub>2</sub>O, 2Bi<sub>2</sub>O<sub>3</sub>, 11WO<sub>3</sub> + 15H<sub>2</sub>O.

A yellow oil which dries to a pale yellow glass. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1233.)

Strontium bismuthicotungstate, 3SrO, 2Bi<sub>2</sub>O<sub>3</sub>, 11WO<sub>3</sub> + 11H<sub>2</sub>O.A yellow wax, insol. in pure H<sub>2</sub>O, but sol. in H<sub>2</sub>O containing a few drops HNO<sub>3</sub>. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1233.)

Bismuthyl bromide, BiOBr.

Insol. in H<sub>2</sub>O, sol. in moderately conc. HBr + Aq.Insol. in H<sub>2</sub>O (Herz, Z. anorg. 1903, 36. 348.)Bi<sub>2</sub>O<sub>3</sub>Br<sub>6</sub>. Insol. in H<sub>2</sub>O, easily sol. in conc. HCl, or HNO<sub>3</sub> + Aq; less sol. in dil. HNO<sub>3</sub> + Aq.Bi<sub>11</sub>O<sub>13</sub>Br<sub>7</sub>. As the preceding comp. (Muir.)

Bismuthyl chloride, BiOCl

Insol. in H<sub>2</sub>O or dil. acids. Sol. in conc. HCl, or HNO<sub>3</sub> + Aq.Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 327.)

Insol. in acetone. (Naumann, B. 1904, 34. 4329.)

+ H<sub>2</sub>O. (Heintz, Pogg. 63. 55.)+ 3H<sub>2</sub>O. (Phillips, Br. Arch. (1) 39. 41.)Bi<sub>2</sub>O<sub>3</sub>Cl<sub>3</sub>. (Arppe.)BiO<sub>2</sub>Cl<sub>2</sub>. Insol. in H<sub>2</sub>O; sol. in hot HCl, or HNO<sub>3</sub> + Aq. (Muir.)

Bismuthyl fluoride, BiOF.

Insol. in H<sub>2</sub>O; sol. in HCl, HBr, or HI + Aq. (Gott and Muir, Chem. Soc. 33. 139.)BiOF, 2HF. Insol. in H<sub>2</sub>O.

**Bismuthyl iodide, BiOI**

Not decomp. by  $H_2O$  or alkaline solutions  
Sol. in  $HCl + Aq.$  Decomp. by  $HNO_3 + Aq.$   
(Schneider, J. pr. 79. 424)

Insol. in  $KCl$ , or  $KI + Aq.$   
 $3BiOI, 7Bi_2O_3$ . Sol. in dil.  $HCl$ ; decomp.  
by  $HNO_3$ ; insol. in boiling  $H_2O$  and alkali.  
(Blyth, C. N. 1896, 74. 200)

$BiI_3, 5Bi_2O_3$ . Ppt. Sl. sol. in  $HC_2H_3O_2 + Aq.$   
Not decomp. by  $H_2O$ . (Fletcher and  
Cooper, Pharm. J. (3) 13. 254.)

$4BiI_3, 5Bi_2O_3$ . Easily sol. in  $HCl + Aq.$   
Decomp. by  $HNO_3 + Aq.$  Sl. attacked by  
 $H_2SO_4$ , somewhat sol. in  $H_2C_4H_4O_6$ , and  
 $KHC_4H_4O_6 + Aq.$

Sol. in  $(NH_4)_2S$ , and  $KOH + Aq.$  (Storer's  
Dict.)

**Bismuthyl sulphide,  $Bi_2O_3S$ .**

(Hermann, J. pr. 75. 452.)  
 $Bi_2O_3S$ . Insol. in  $H_2O$  (Scherpenberg,  
C. C. 1889, II. 641.)

$Bi_2O_3S$   
Min. *Karelinite*.

**Boracic acid.**

See Boric acid.

**Borax.**

See Tetraborate, sodium.

**Boric acid, anhydrous,  $B_2O_3$** 

See Boron trioxide.

**Metaboric acid,  $HBO_2$ .**

Sol. in  $H_2O$   
Sl. sol. in hot glacial acetic acid. (Holt,  
Chem. Soc. 1911, 100. (2) 720.)

**Orthoboric acid,  $H_3BO_3$ .**

Sol. in 83 pts.  $H_2O$  at  $10^\circ$   
" 25 " "  $20^\circ$   
" 3 " "  $100^\circ$ .  
(Bezezeus)

Sol. in 20 pts.  $H_2O$  at  $18.75^\circ$  (Abl)  
100 pts.  $H_2O$  at  $100^\circ$  dissolve 2 pts. (Ure's Dict.)

1 pt. crystallized acid dissolves in—

25 66 pts.  $H_2O$  at  $19^\circ$ .  
14 88 " "  $25^\circ$ .  
12 66 " "  $37.5^\circ$ .  
10 16 " "  $50^\circ$ .  
6 12 " "  $62.5^\circ$ .  
4 73 " "  $75^\circ$ .  
3 55 " "  $87.5^\circ$ .  
2 97 " "  $100^\circ$ .

Or, 100 pts.  $H_2O$  dissolve at—

$19^\circ$  3 9 pts.  $H_3BO_3$ .  
 $25^\circ$  6 8 " "  
 $37.5^\circ$  7 8 " "  
 $50^\circ$  9 8 " "  
 $62.5^\circ$  16 0 " "  
 $75^\circ$  21 0 " "  
 $87.5^\circ$  28 0 " "  
 $100^\circ$  34 0 " "

Or, sat. aqueous solution contains at—

$19^\circ$  3 75%  $H_3BO_3$ .  
 $25^\circ$  6 27 " "  
 $37.5^\circ$  7 32 " "  
 $50^\circ$  8 96 " "  
 $62.5^\circ$  14 04 " "  
 $75^\circ$  17 44 " "  
 $87.5^\circ$  21 95 " "  
 $100^\circ$  25 17 " "

(Brandes and Farnhaber, Arch. Pharm. 7. 50.)

1 litre  $H_2O$  dissolves at—

$0^\circ$  19 47 g.  $H_3BO_3$ .  
 $12^\circ$  29 20 " "  
 $20^\circ$  39 92 " "  
 $40^\circ$  60 91 " "  
 $62^\circ$  114 16 " "  
 $80^\circ$  168 15 " "  
 $102^\circ$  291 16 " "

(Ditte, C. R. 85. 1069.)

1 l.  $H_2O$  dissolves 0.901 mol.  $H_3BO_3$  at  $25^\circ$ .  
(Herz, Z. anorg. 1910, 66. 359)

1 l.  $H_2O$  dissolves 0.898 mol.  $H_3BO_3$  at  $25^\circ$ .  
Sp. gr. of the solution = 1.0168. (Müller, Z.  
phys. Ch. 1907, 57. 529.)

1 l.  $H_2O$  dissolves 0.887 mol.  $H_3BO_3$  at  $25^\circ$   
and 1.025 mol. at  $30^\circ$ . (Ageno and Valla,  
Ist. Ven. (VIII) 14. II, 331.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	g. $H_3BO_3$ in 100 g. of the solution
0	2 50
12 2	3 69
21	4 90
31	6 44
40	8 02
50	10 35
60	12 90
69 5	15 58
80	19 11
90	23 30
99 5	28 10
108	36 7
115	45 0
120	52 4

(Nasini and Ageno, Z. phys. Ch. 1909, 69.  
483.)

Solubility curve for orthoboric acid in  
 $H_2O$  at various temp. up to  $120^\circ$ . (Nasini  
and Ageno, Gazz. ch. it. 1911, 41. (1) 131)

Sp. gr. of  $H_3BO_3 + Aq$  sat at  $8^\circ$  = 1.014 (Anthon, A.  
24. 241.)  
Sp. gr. of  $H_3BO_3 + Aq$  sat at  $15^\circ$  = 1.0245 (Stolba, J.  
pr. 90. 457.)

Sp. gr. of  $H_3BO_3 + Aq$  at  $15^\circ$ .

% $H_3BO_3$	Sp. gr.	% $H_3BO_3$	Sp. gr.
1	1.0034	4	1.0147
2	1.0069	Sat. sol.	1.015
3	1.0106		

(Gerlach, Z. anal. 28. 473)

Sp. gr. of  $\text{H}_3\text{BO}_3 + \text{Aq}$  at  $18^\circ$   
 $\text{H}_3\text{BO}_3$  0.776 1.92 2.88 3.612  
 Sp. gr. 1.0029 1.0073 1.0109 1.0131  
 (Bock, W. Ann. 1887, 30. 638)

Volatile with steam.  
 More sol. in dil.  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ .  
 Sol. in warm conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ .

Solubility in  $\text{HCl} + \text{Aq}$  at  $35^\circ$

Millimoles $\text{HCl}$ in 10 ccm. of the solution	Millimoles $\text{H}_3\text{BO}_3$ in 10 ccm of the sat. solution
	9.01
7.0	7.69
13.7	6.66

(Herz, Z. anorg. 1910, 66. 359.)

Solubility of  $\text{H}_3\text{BO}_3$  in  $\text{HCl} + \text{Aq}$  at  $16^\circ$

Normality of $\text{HCl}$	Normality of $\text{H}_3\text{BO}_3$
0	0.907
0.130	0.895
0.260	0.870
0.390	0.842
1.30	0.645
2.16	0.542
4.32	0.308
6.00	0.338
7.08	0.327
8.74	0.327
9.51	0.338

(Herz, Z. anorg. 1902, 33. 354.)

Solubility in  $\text{HF} + \text{Aq}$  at  $26^\circ$ .

(1) Titer of $\text{HF}$	(2) Titer after saturation with $\text{H}_3\text{BO}_3$ at $26^\circ$	(3) Titer after addition of mannitol	(3)-(2) equals free boric acid
3.21n.	1.61	2.36	0.75
2.80n.	1.25(1.40?)	2.21	0.96(0.81?)

The values 0.75 and 0.81 represent the solubility of  $\text{H}_3\text{BO}_3$  in the concentrations of fluoroboric acid resulting from the original concentration of  $\text{HF} + \text{Aq}$ .

(Abegg, Z. anorg. 1903, 35. 145.)

Solubility of  $\text{H}_3\text{BO}_3$  in acids +  $\text{Aq}$  at  $26^\circ$ .

Acid	Normality of the acid	Normality of $\text{H}_3\text{BO}_3$
$\text{H}_2\text{SO}_4$	0.548	0.746
	2.74	0.518
	5.48	0.312
	8.75	0.092
$\text{HNO}_3$	0.241	0.818
	1.206	0.676
	1.607	0.593
	2.411	0.567
	5.96	0.268
	7.38	0.238

(Herz, Z. anorg. 1903, 34. 205.)

Solubility in  $\text{KOH} + \text{Aq}$ .  
 See Borates, potassium.  
 Solubility in  $\text{NaOH} + \text{Aq}$ .  
 See Borates, sodium.

Solubility in  $\text{LiCl} + \text{Aq}$  at  $25^\circ$ .

Millimoles $\text{LiCl}$ in 10 ccm. of the solution	Millimoles $\text{H}_3\text{BO}_3$ in 10 ccm of the sat. solution
	9.01
7.1	8.13
10.3	7.65
22.3	6.42
37.2	5.02

(Herz, Z. anorg. 1910, 66. 359.)

Solubility in  $\text{KCl} + \text{Aq}$  at  $25^\circ$ .

Millimoles $\text{KCl}$ in 10 ccm. of the solution	Millimoles $\text{H}_3\text{BO}_3$ in 10 ccm. of the sat. solution
	9.01
1.9	9.20
7.9	9.44
15.6	9.80
30.6	10.75

(Herz.)

Solubility in  $\text{RbCl} + \text{Aq}$  at  $25^\circ$ .

Millimoles $\text{RbCl}$ in 10 ccm. of the solution	Millimoles $\text{H}_3\text{BO}_3$ in 10 ccm of the sat. solution
	9.01
14.0	9.66
25.3	10.60

(Herz.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $25^\circ$ .

Millimoles $\text{NaCl}$ in 10 ccm. of the solution	Millimoles $\text{H}_3\text{BO}_3$ in 10 ccm of the sat. solution
	9.01
8.2	8.49
15.2	8.25
29.4	8.20

(Herz.)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of  $\text{KCl}$ ,  $\text{KNO}_3$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{NaNO}_3$ , and  $\text{Na}_2\text{SO}_4$ .

In general the solubility in  $\text{H}_2\text{O}$  is increased by the presence of both electrolytes and non-electrolytes. (Bogdan, C. C. 1903, II. 2.)

Sol. in borax +  $\text{Aq}$ . (McLauchlan, Z. anorg. 1903, 37. 371.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Unattacked and undissolved by liquid  $\text{NO}_2$ . (Frankland, Chem. Soc. 1901, 79. 1362.)

Sol. in 6 pts. alcohol (Wittstein), 5 pts. boiling alcohol (Wenzel). Only traces dissolve in anhydrous ether. (Schiff) Sol. in 100 pts. ether. (Hager's Comm.) Sol. in several essential oils.

1 l.  $\text{H}_2\text{O}$  sat. with amyl alcohol dissolves 0.8952 mol.  $\text{H}_3\text{BO}_3$  at  $25^\circ$ . (Auerbach, Z. anorg. 1903, 37. 357.)

Solubility of  $H_3BO_3$  in amyl alcohol + Aq at  $t^\circ$ .M = millimols  $H_3BO_3$  in 1 l. of  $H_2O$ A = millimols  $H_3BO_3$  in 1 l. of alcohol

$t^\circ$	M	A
15°	607.2	176.4
	589.3	177.4
	589.0	177.1
	588.0	173.4
	427.4	127.6
	425.8	127.0
	289.1	84.9
	894.0	264.0
	372.0	110.0
	371.8	110.8
25°	301.2	85.7
	180.8	54.0
	49.15	15.45
	51.04	15.45
	26.02	8.05
35°	146.3	44.27

(Müller, Z. phys. Ch. 1907, 57, 514)

Sp. gr. of amyl alcohol + Aq sat. with  $H_3BO_3$ 

g. water in 1 l. of alcohol + Aq	$d_{25^\circ/4^\circ}$
32.481	0.82229
35.465	0.82324
37.339	0.82321
42.479	0.82392
45.175	0.82447
45.636	0.82456
47.883	0.82454
51.461	0.82527
52.043	0.82585
59.270	0.82699
63.179	0.82739
64.254	0.82779
66.403	0.82701
66.024	0.82670
68.253	0.82856
69.211	0.82884
75.610	0.82999(?)

(Müller.)

Solubility of  $H_3BO_3$  in amyl alcohol and NaCl + Aq at 25°.

Water phase		Amyl alcohol phase			
NaCl normality	mol $H_3BO_3$	Sp. gr. 25°/4°	1 l. contains		
			mol $H_2O$	mol amyl alcohol	mol $H_3BO_3$
0.00	0.880	0.8296	4.10	8.39	0.2640
0.945	0.866	0.8277	3.55	8.49	0.2638
1.490	0.850	0.8268	3.27	8.54	0.2689
1.865	0.844	0.8259	3.03	8.56	0.2724
2.355	0.833	0.8254	2.86	8.59	0.2850
2.845	0.827	0.8247	2.62	8.62	0.2877
3.06	0.810	0.8241	2.39	8.66	0.2891
3.48	0.810	0.8240	2.32	8.69	0.3006
3.57	0.807	0.8236	2.15	8.70	0.3066
4.01	0.801	0.8233	1.99	8.72	0.3162
4.28	0.798	0.8229	1.78	8.75	0.3210

(Müller)

Solubility in hydroxy-compounds + Aq at 25°

Organic substance added	Mol. of organic substance in 100 mol. of the mixture	Mol. of boric acid sol in 1 l. of solution	Sp. gr. of the pure mixture	Sp. gr. of the mixture sat. with boric acid
Lactic acid	2.321	1.07	1.0252	1.0444
	6.819	1.61	1.0722	1.0986
	18.77	1.86	1.1405	1.1635
	36.33	2.08	1.2023	1.2254
Glycerine	24.64	1.208	1.1574	1.1707
	46.75	2.132	1.2260	1.2260
	67.71	2.96	1.2370	1.2526
	90.58	3.78	1.2531	1.2710

Solubility in hydroxy-compounds, etc.—*Continued*

Organic substance added	Mol of organic substance in 100 mol of the mixture	Mol of boric acid sol in 1 l of solution	Sp. gr. of the pure mixture	Sp. gr. of the mixture sat with boric acid
Mannitol	0 790	1 007		1.0425
	0 810	1 015	1 0244	1.0433
	0 945	1 020	1 0288	
	1 585	1 136	1 0475	
Dulcitol	0 065	0 8876	0 9995	1 0686
	0 130	0 9078	1 0018	1 0212
	0 260	0 9360	1 0060	1 0260

(Muller)

Solubility of  $H_2BO_3$  in alcohols + Aq at 25°.  
 M = Mol. of alcohol in 100 mol of alcohol + Aq  
 $H_2BO_3$  = Mol. of  $H_2BO_3$  in 1 l. of the solution.  
 $d_1$  = Sp. gr. of alcohol + Aq.  
 $d_2$  = Sp. gr. of alcohol + Aq sat. with  $H_2BO_3$ .

Alcohol added	M	$H_2BO_3$	$d_1$	$d_2$
Methyl alcohol	11 74	0 895		
	28 64	1 012		
	36 02	1 098		
	43 95	1 161		
	52 31	1 307		
	100	2.900	0 7924	0 8904
Ethyl alcohol	8 996 <sup>1</sup>	0 829		
	22 28	0 800		
	44 46	0 729		
	55 62	0 700		
	79 89	0 893		
	88 10	1 105		
	99 26	1 527	0 7860	0 8353
n-Propyl alcohol	23 66	0 6437	0 9043	0 9192
	53 63	0.4569	0 8231	0 8570
	83 65	0 5776	0 8133	0 8466
	100	0 961	0 8010	0 8297
t-Butyl alcohol	0 70	0 884	0 9923	1 0124
	2 15	0 857	0 9853	0 0038
	2 18	0 857	0.9855	0 0046
	71 4	0 323	0 8173	0 8351
	77.1	0 347	0.8133	0 8220
	85 6	0 4212	0.8081	0.8195
	100	0 6927	0.7984	0.8172
t-Amyl alcohol	0.448	0 883	0 9943	1 0132
	0 520	0 880	0 9936	1 0125
	0 525 <sup>1</sup>	0 880	0 9931	1.0123
	67 26 <sup>2</sup>	0 2584	0 8232	0.829
	75 54	0 2722	0 8183	0 8253
	83.40	0 3190	0 8142	0 8223
	100	0 5703	0 8068	0 8220

<sup>1</sup> Water sat. with alcohol<sup>2</sup> Alcohol sat. with water

(Müller)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)

Solubility in acetone + Aq at 20°  
A = cem acetone in 100 cem. acetone + Aq.  
H<sub>3</sub>BO<sub>3</sub> = millimols H<sub>3</sub>BO<sub>3</sub> in 100 cem. of the solution.

A	H <sub>3</sub> BO <sub>3</sub>
0	79 15
20	81 71
30	83 35
40	82.74
50	81 61
60	76 40
70	67 62
80	55 05
100	8 06

(Herz, Z. anorg. 1904, 41. 319)

100 g. pure anhydrous ether dissolve 0.00775 g H<sub>3</sub>BO<sub>3</sub>

100 g. ether sat. with H<sub>2</sub>O dissolve 0.2391 g. H<sub>3</sub>BO<sub>3</sub>

(J A Rose, Dissert. 1902.)

Sol. in 10 pts glycerine. (Hager)

100 pts. glycerine (sp. gr 1.26 at 15.5°) dissolve pts H<sub>3</sub>BO<sub>3</sub> at t°.

t°	Pts H <sub>3</sub> BO <sub>3</sub>	t°	Pts H <sub>3</sub> BO <sub>3</sub>	t°	Pts H <sub>3</sub> BO <sub>3</sub>
0	20	40	38	80	61
10	24	50	44	90	67
20	28	60	50	100	72
30	33	70	56		

(Hooper, Ph. J. Trans. (3) 13. 258)

Solubility of H<sub>3</sub>BO<sub>3</sub> in glycerine + Aq at 25°

G = g. glycerine in 100 g. glycerine + Aq.  
H<sub>3</sub>BO<sub>3</sub> = Millimols H<sub>3</sub>BO<sub>3</sub> in 100 cc. of the solution.

G	H <sub>3</sub> BO <sub>3</sub>	Sp. gr
0	90 1	1.0170
7.15	90 1	1.0379
20 44	90 6	1.0629
31 55	92 9	1.0897
40 95	97.0	1.1130
48 7	103 0	1.1328
69 2	140 2	1.1871
100	390 3	1.2719

(Herz, Z. anorg. 1905, 45. 268.)

Solubility of H<sub>3</sub>BO<sub>3</sub> in organic acids + Aq at 26°.

Acid	Normality of the acid	Normality of H <sub>3</sub> BO <sub>3</sub>
Acetic	0.570	0.887
	2.85	0.538
	5.70	0.268

### Solubility of H<sub>3</sub>BO<sub>3</sub>, etc.—Continued

Acid	Normality of the acid	Normality of H <sub>3</sub> BO <sub>3</sub>
Tartaric	0.955	0.890
	1.909	0.923
	2.51	0.962
	3.316	1.07

(Herz, Z. anorg. 1903, 34. 206.)

The solubility of H<sub>3</sub>BO<sub>3</sub> in H<sub>2</sub>O is increased by the presence of racemic acid.

Millimols racemic acid in 10 cem. of the solvent	Millimols boric acid in 10 cem. of the solution
0	9.01
6.3	9.86
12.6	10.46
24.7	11.65

(Herz, Z. anorg. 1911, 70. 71.)

Solubility of H<sub>3</sub>BO<sub>3</sub> in H<sub>2</sub>O is increased by the presence of tartaric acid.

Millimols tartaric acid in 10 cem. of the solvent	Millimols boric acid in 10 cem. of the solution
0	9.01
7.5	10.00
15	10.70
30	12.07

(Herz, Z. anorg. 1911, 70. 71)

### Solubility in oxalic acid + Aq at 25°.

Millimols oxalic acid in 10 cem. of the solution	Millimols H <sub>3</sub> BO <sub>3</sub> in 10 cem. of the sat. solution
	9.01
2.97	9.95
5.95	10.80
13.77	11.98

(Herz, Z. anorg. 1910, 66. 93)

Solubility in H<sub>2</sub>O is increased by the presence of urea, acetone or propyl alcohol. (Bogdan, C. C. 1903, II, 2.)

Readily sol. in hot glacial acetic acid. (Holt Chem. Soc. 1911, 100 (2) 720.)

Sol. in 250 pts. benzene. (Hager.)

Solubility of H<sub>3</sub>BO<sub>3</sub> in mannite + Aq at t°.

Solid phase, H <sub>3</sub> BO <sub>3</sub>					
t°	Mg.-mols in 1 l		t°	Mg.-mols in 1 l	
	Mannite	H <sub>3</sub> BO <sub>3</sub>		Mannite	H <sub>3</sub> BO <sub>3</sub>
25°	0	0.887	30°	0	1.025
"	0.1	0.951	"	0.1	1.056
"	0.3	1.015	"	0.2	1.086
"	0.4	1.039	"	0.3	1.118
"	0.5	1.071	"	0.4	1.157
"	0.6	1.102	"	0.5	1.193
"	0.7	1.142	"	0.6	1.219
"	0.8	1.173	"	0.7	1.258
"	1.043	1.244			
"	1.409	1.404			
"	1.781	1.521			

Solid phase, mannite		
t°	Mg mols in 1 l	
	Mannite	H <sub>3</sub> BO <sub>3</sub>
25°	1 075	0
"	1 1424	0 2646
"	1 259	0 463
"	1 265	0 559
"	1 354	0 794
"	1 409	0.927
"	1 536	1 243
"	1 781	1 521

(Ageno and Valla, Ist. Ven. (VIII) 14. 331.)

Distribution between H<sub>2</sub>O and amyl alcohol at 25°w = concentration of H<sub>3</sub>BO<sub>3</sub> in H<sub>2</sub>O layer expressed in millimolsa = concentration of H<sub>3</sub>BO<sub>3</sub> in alcohol layer expressed in millimols

w	a
265 8	76 6
196 5	59 5
159 6	47 5
126	37 1
87 9	33 2
75.2	22 7
64 6	19.76

(Abegg, Z. anorg. 1903, 35. 130)

Partition of H<sub>3</sub>BO<sub>3</sub> between water and mixtures of amyl alcohol and CS<sub>2</sub>.W = Millimols H<sub>3</sub>BO<sub>3</sub> in 10 ccm of the aqueous layer.G = Millimols H<sub>3</sub>BO<sub>3</sub> in 10 ccm. of the amyl alcohol—CS<sub>2</sub> layer.

Composition of the solvent mixture	G	W	W/G
75% by vol. amyl alcohol + 25% by vol. CS <sub>2</sub>	0.145	0 624	4 31
	0 275	1.198	4 36
	0.429	1 844	4 30
	0 589	2.565	4 45
50% by vol. amyl alcohol + 50% by vol. CS <sub>2</sub>	0 145	0 756	5 47
	0.259	1.353	5.21
	0.364	1.946	5 34
	0 555	2.889	5 22
25% by vol. amyl alcohol + 75% by vol. CS <sub>2</sub>	0 085	0.699	8 24
	0.175	1 467	8 40
	0 264	2.165	8 12
	0 384	3 129	8 14

(Herz, Z. Elektrochem. 1910, 16. 870.)

## Distribution between HF + Aq and amyl alcohol at 25°.

c = HF concentration (millimols)

a = H<sub>3</sub>BO<sub>3</sub> concentration in alcohol layer (expressed in millimols)w = H<sub>3</sub>BO<sub>3</sub> concentration in water layer (expressed in millimols).

c	a	w
500	14 3	71 2
"	19 2	99 2
"	25 3	144 2
"	114 3	979 0
250	30.1	144 5
"	37 0	194 8
"	56 8	321.5
"	108 0	652.0
125	39 0	170.5
"	47 2	214.0
"	52 8	240 5
"	96 0	442 0
62 5	30 4	111 2
"	39 4	151 8
"	65 (68°)	272 8
"	90 0	362 2

(Abegg, Z. anorg. 1903, 35. 131)

See also Boron trioxide.

Pyroboric (tetraboric) acid, H<sub>2</sub>B<sub>4</sub>O<sub>7</sub>.Sol. in H<sub>2</sub>O.Sp. gr. of solutions of boric acid, calculated as H<sub>2</sub>B<sub>4</sub>O<sub>7</sub>, containing—6 3 1 27 1 91 2 54% H<sub>2</sub>B<sub>4</sub>O<sub>7</sub>  
1 0034 1 0069 1 0106 1 0147 sp. gr.

Sat. solution at 15° has sp. gr. 1.015. (Geilach, Z. anal. 28. 473)

Insol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, 100. (2) 720.)

## Borates.

No borate is quite insol. in H<sub>2</sub>O, the alkali borates are very sol. The less sol. borates are easily decomp. by H<sub>2</sub>O; the easily sol. salts are also decomp., but less quickly. The less sol. borates are easily sol. in H<sub>2</sub>BO<sub>3</sub>, HNO<sub>3</sub>, etc. They are more sol. in H<sub>2</sub>O containing tartaric acid or potassium tartrate than in pure H<sub>2</sub>O. (Souberain) The normal borates of the alkaline-earth are sol. to no inconsiderable extent in H<sub>2</sub>O, and more readily in hot, than in cold H<sub>2</sub>O. (Berzelius, Pogg. 34. 568.)

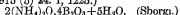
All borates are insol. or sl. sol. in alcohol.

Aluminum borate, 2Al<sub>2</sub>O<sub>3</sub>, B<sub>2</sub>O<sub>3</sub>Min. *Jeremievite*.+ 3H<sub>2</sub>O. Ppt. (Rose, Pogg. 91. 452.)3Al<sub>2</sub>O<sub>3</sub>, B<sub>2</sub>O<sub>3</sub>. *Crystallized* Insol. in HNO<sub>3</sub> + Aq. (Ebelmen, A. ch. (3) 33. 62.)3Al<sub>2</sub>O<sub>3</sub>, 2B<sub>2</sub>O<sub>3</sub> + 7H<sub>2</sub>O. Ppt. (Rose, l. c.)

## Ammonium borate.

The system (NH<sub>4</sub>)<sub>2</sub>O, B<sub>2</sub>O<sub>3</sub>, H<sub>2</sub>O at 60° has

been studied by Sborgi (Real Ac. Lanc. 1915 (5) 24. I, 1225.)



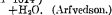
#### Ammonium diborate.

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328)

Ammonium tetraborate,  $(\text{NH}_4)_2\text{B}_4\text{O}_7 + 4\text{H}_2\text{O}$ , or perhaps  $\text{NH}_4\text{H}(\text{BO}_3)_2 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in 12 pts. cold  $\text{H}_2\text{O}$ ; decomp. by heat (Rammelsberg, Pogg. 90. 21.)

Sol. in acetone. (Eidmann, C. C. 1899, II 1014)



Ammonium octaborate,  $(\text{NH}_4)_2\text{B}_8\text{O}_{13} + 6\text{H}_2\text{O}$ .

Sol. in 8 pts. cold, decomp. by boiling  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 90. 21.)



Min. *Lurdelleite* Sol. in  $\text{H}_2\text{O}$  with decomp.

Ammonium dekaborate,  $(\text{NH}_4)_2\text{B}_{10}\text{O}_{16} + 6\text{H}_2\text{O}$ .

Permanent. Sol. in  $\text{H}_2\text{O}$  (Rammelsberg.)  
+  $8\text{H}_2\text{O}$  (Atterberg, Bull. Soc. (2) 22. 350.)

Ammonium dodekaborate,  $(\text{NH}_4)_2\text{B}_{12}\text{O}_{18} + 9\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . (Bechi, Sill Am J (2) 17. 129)

Ammonium perborate,  $\text{NH}_4\text{BO}_3$

See Perborate, ammonium.

Ammonium calcium borate,  $(\text{NH}_4)_2\text{CaB}_4\text{O}_{11} = \text{CaB}_4\text{O}_7 + 4(\text{NH}_4)_2\text{O}$

(Ditte, C. R. 96. 1863.)

Ammonium magnesium borate.

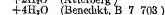
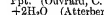
Sol. in  $\text{H}_2\text{O}$ , decomp. by boiling (Rammelsberg, Pogg. 49. 451.)

Ammonium zinc borate,  $4(\text{NH}_4)_2\text{B}_4\text{O}_7$ ,  $\text{Zn}(\text{BO}_3)_2 + 5\text{H}_2\text{O}$ .

(Ditte, C. R. 96. 1663)

Barium borate,  $\text{Ba}(\text{BO}_3)_2$ .

Ppt. (Ouvrard, C. R. 1906, 142. 283)



Sol. in 3,300 pts. 45% alcohol.

" 7,800 " 50 "

" 25,000 " 60 "

" 55,000 " 75 "

(Berg, Z. anal. 16. 25.)

+  $10\text{H}_2\text{O}$ . Sl. sol. in cold, more readily in hot  $\text{H}_2\text{O}$ , especially in presence of ammonium salts. (Berzelius, Pogg. 34. 568.) Sol. in sodium citrate + Aq. (Spiller.) Insol. in wood spirit. (Ebelmen)

$2\text{BaO} \cdot \text{B}_2\text{O}_3$  Decomp. by  $\text{H}_2\text{O}$  forming  $\text{BaO}$ ,  $\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$  (Ouvrard, C. R. 1906, 142. 283)

$3\text{BaO} \cdot \text{B}_2\text{O}_3$ . Easily sol. in mineral acids. Sl. attacked by dil. acetic acid (Ouvrard, C. R. 1901, 132. 258)

$\text{Ba}_3\text{B}_4\text{O}_{13}$ . Slowly sol. in warm dilute  $\text{HNO}_3$  + Aq (Ditte, C. R. 77. 892)

+  $5\text{H}_2\text{O}$  Sol. in 100 pts. cold, and more freely in hot  $\text{H}_2\text{O}$ . When freshly pptd. sol. in cold  $\text{NH}_4\text{Cl}$  + Aq (Wackenroder, A. 41. 315);  $\text{NH}_4\text{NO}_3$  + Aq (Brett, Phil Mag. (3) 10. 96); and  $\text{BaCl}_2$  + Aq (Rose).

$\text{Ba}_3\text{B}_4\text{O}_{13} + 13\frac{1}{2}\text{H}_2\text{O}$ . (Laurent, A. ch. (2) 67. 215.)

$\text{Ba}_4\text{B}_5\text{O}_{16}$ . (Bloxam, Chem. Soc. 14. 143.)



$\text{Ba}_2\text{B}_{10}\text{O}_{15} + 6\text{H}_2\text{O}$  Sol. in 100 pts. cold  $\text{H}_2\text{O}$ . Easily sol. in ammonium nitrate, or chloride, or barium chloride + Aq. (Rose, Pogg. 87. 1.)

$\text{Ba}_2\text{B}_6\text{O}_{11}$ . Easily sol. in warm dilute acids.



+  $15\text{H}_2\text{O}$ . (Laurent, A. ch. (2) 67. 215.)

Barium borate bromide,  $3\text{BaO} \cdot 5\text{B}_2\text{O}_3$ ,  $\text{BaBr}_2$ . (Ouvrard, C. R. 1906, 142. 283.)

Barium borate chloride,  $3\text{BaO} \cdot 5\text{B}_2\text{O}_3$ ,  $\text{BaCl}_2$ .

Unaffected by  $\text{H}_2\text{O}$ . Sol. in acids. (Ouvrard, C. R. 1906, 142. 283)

Bismuth borate,  $\text{BiBO}_3 + 2\text{H}_2\text{O}$ .

Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{S}$ . Not decomp. by  $\text{KOH}$  + Aq (Vanino, J. pr. 1906, (2) 74. 152.)

Cadmium borate,  $\text{Cd}_3(\text{BO}_3)_2$ .

Insol. in  $\text{H}_2\text{O}$ , easily sol. in dil. acids. (Ouvrard, C. R. 1900, 130. 174)

$\text{Cd}(\text{BO}_3)_2$  Difficultly sol. in  $\text{H}_2\text{O}$  (Stromeyer); insol. in  $\text{H}_2\text{O}$ , sol. in  $\text{HCl}$  + Aq (Odling); easily sol. in warm  $\text{NH}_4\text{Cl}$  + Aq (Rose).

(Guertler, Z. anorg. 1904, 40. 242)

$3\text{CdO} \cdot 2\text{B}_2\text{O}_3 + 3\text{H}_2\text{O}$ . Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 88. 299)

$\text{CdO} \cdot 2\text{B}_2\text{O}_3 + 2\text{H}_2\text{O}$ . (Ditte, A. ch. 1883, (5) 30. 255)

$\text{CdO} \cdot 4\text{B}_2\text{O}_3 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; decomp. on heating. (Ditte, A. ch. 1883, (5) 30. 255)

Cadmium borate bromide,  $6\text{CdO} \cdot 8\text{B}_2\text{O}_3$ ,  $\text{CdBr}_2$ .

Insol. in  $\text{H}_2\text{O}$  and fuming  $\text{HCl}$  or  $\text{HBr}$  + Aq. (Rousseau and Allaire, C. R. 1894, 119. 72)

Cadmium borate chloride,  $6\text{CdO} \cdot 8\text{B}_2\text{O}_3$ ,  $\text{CdCl}_2$ .

(Rousseau and Allaire, C. R. 1894, 118. 1256.)

Cadmium borate iodide,  $6\text{CdO} \cdot 8\text{B}_2\text{O}_3$ ,  $\text{CdI}_2$ .

(Allaire, C. R. 1898, 127. 557.)

Cesium borate,  $\text{Cs}_2\text{B}_6\text{O}_{16}$ .

Very sol. in  $\text{H}_2\text{O}$ , less in alcohol (Reischle, Z. anorg. 4. 116.)

**Calcium borate,  $\text{Ca}(\text{BO}_2)_2$ .**

Sl sol. in  $\text{H}_2\text{O}$ , insol in alkali chlorides, or boiling conc. acetic acid + Aq, sol. in cold or hot solutions of ammonium salts, especially ammonium nitrate, in  $\text{CaCl}_2$  + Aq, and also easily sol in dilute mineral acids at  $50^\circ$ . (Ditte, C. R. 80. 490, 561.)

+  $2\text{H}_2\text{O}$ .

+  $4\text{H}_2\text{O}$ , two modifications of which one is very unstable (van't Hoff and Meyerhoffer, A 1906, 351. 101.)

+  $6\text{H}_2\text{O}$ . When warmed in  $\text{H}_2\text{O}$  it goes over into  $\text{CaB}_2\text{O}_4 + 4\text{H}_2\text{O}$ . (van't Hoff and Meyerhoffer.)

Sol in  $\text{H}_2\text{O}$  without decomp., 1 l solution contains 2 g. salt (Ditte, C. R. 96. 1663.)

$\text{CaB}_2\text{O}_7$ . Decomp. by  $\text{H}_2\text{O}$  (Blount, C. N. 54. 208.)

Insol in methyl acetate. (Naumann, B 1909, 42. 3790.)

+  $3\text{H}_2\text{O}$  (Ditte, C. R. 96. 1663.)

+  $4\text{H}_2\text{O}$ . Min. *Bechthite*.

+  $6\text{H}_2\text{O}$ . Min. *Borocalcite*. Sol. in acids  $\text{CaB}_2\text{O}_5 + 4\text{H}_2\text{O}$

+  $8\text{H}_2\text{O}$  Unstable. On standing in the solution in which it is formed it changes into  $\text{CaB}_2\text{O}_{10} + 4\text{H}_2\text{O}$

+  $12\text{H}_2\text{O}$ . Unstable; Goes over into  $\text{CaB}_2\text{O}_{10} + 8\text{H}_2\text{O}$ . (van't Hoff and Meyerhoffer, A 1906, 351. 104.)

$\text{CaB}_2\text{O}_{10} + 12\text{H}_2\text{O}$  (Ditte, C. R. 96. 1663.)

$2\text{CaO} \cdot \text{B}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ , sol. in dil. acids. (Ouvrard, C. R. 1905, 141. 353.)

$\text{Ca}_2\text{B}_2\text{O}_{11}$  (Ditte, C. R. 77. 785.)

+  $3\text{H}_2\text{O}$  Min. *Pandermite*, *Priceite*. See  $4\text{CaO} \cdot 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$

+  $5\text{H}_2\text{O}$ . Min. *Colemanite*.

If all the Ca is in form of colemanite, the solution contains in 100 g, 4.8 g.  $\text{H}_3\text{BO}_3$ , and 0.1 g. CaO (van't Hoff, B. A. B. 1907, 653.)

+  $7\text{H}_2\text{O}$ .

+  $9\text{H}_2\text{O}$ . (van't Hoff and Meyerhoffer, A. 1906, 351. 101.)

$3\text{CaO} \cdot \text{B}_2\text{O}_3$ . Easily sol. in 'dil. acids. (Ouvrard, C. R. 1901, 132. 258.)

$3\text{CaO} \cdot 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$  (van't Hoff, B. A. B. 1908, II 568.)

$4\text{CaO} \cdot 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$ . True composition of Pandemite. (van't Hoff, B. A. B 1906, II 572.)

**Calcium iron (ferrous) borate silicate,**

$\text{Ca}_2\text{FeB}_3\text{Si}_2\text{O}_{16}$

Min *Homilite*. Easily sol in  $\text{HCl}$  + Aq

**Calcium magnesium borate,  $\text{CaO} \cdot \text{MgO} \cdot 3\text{B}_2\text{O}_3 + 6\text{H}_2\text{O}$ .**

Min. *Hydroboracite*. Somewhat sol in  $\text{H}_2\text{O}$ . Easily sol. in warm  $\text{HCl}$  + Aq or  $\text{HNO}_3$  + Aq.  $3\text{CaO} \cdot 3\text{MgO} \cdot 4\text{B}_2\text{O}_3$  (Ditte, C. R. 77. 894.)

**Calcium sodium borate,  $2\text{CaO} \cdot \text{Na}_2\text{O} \cdot 5\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$ .**

(van't Hoff, B. A. B. 1907, 303)

$\text{Ca}_2\text{B}_{10}\text{O}_{18} \cdot \text{Na}_2\text{B}_4\text{O}_{10} + 15$ , or  $24\text{H}_2\text{O}$ .

Min. *Natroborocalcite*, *Ulexite*. Decomp. by boiling with  $\text{H}_2\text{O}$ . Sol in acids

$\text{Ca}_2\text{Na}_2\text{B}_{12}\text{O}_{22} + 15\text{H}_2\text{O}$ . Min *Franklandite*. Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl}$ , and  $\text{HNO}_3$  + Aq

**Calcium borate bromide,  $3\text{CaO} \cdot 3\text{B}_2\text{O}_3 \cdot \text{CaBr}_2$ .**

Sl. attacked by  $\text{H}_2\text{O}$  Very sol. in dilute acetic acid. (Ouvrard, C. R. 1905, 141. 1023.)

$3\text{CaO} \cdot 5\text{B}_2\text{O}_3 \cdot \text{CaBr}_2$  Hardly attacked by cold  $\text{H}_2\text{O}$  or very dil acetic acid. Sol. in strong acids, even when dilute. (Ouvrard, C. R. 1905, 141. 1023.)

**Calcium borate chloride,  $\text{Ca}_2\text{B}_2\text{O}_6 \cdot \text{CaCl}_2$ .**

Decomp. quickly by moist air or  $\text{H}_2\text{O}$ , slowly by absolute alcohol (Chateher, C. R. 99. 276.)

$3\text{CaO} \cdot 3\text{B}_2\text{O}_3 \cdot \text{CaCl}_2$ . (Ouvrard, C. R. 1905, 141. 353.)

$3\text{CaO} \cdot 5\text{B}_2\text{O}_3 \cdot \text{CaCl}_2$ . Sl. attacked by cold  $\text{H}_2\text{O}$  and dil acetic acid + Aq Strong acids dissolve even when very dilute. (Ouvrard, C. R. 1905, 141. 352.)

**Calcium borate silicate,  $2\text{CaO} \cdot \text{B}_2\text{O}_3 \cdot 2\text{SiO}_2 + \text{H}_2\text{O}$ .**

Min. *Dalolite*. Sol. in  $\text{HCl}$  + Aq with separation of gelatinous silica

+  $2\text{H}_2\text{O}$  Min *Botryolite*.

$\text{CaO} \cdot \text{B}_2\text{O}_3 \cdot \text{SiO}_2$ . Min. *Danburite* Very sl. attacked by  $\text{HCl}$  + Aq before ignition.

**Chromous borate.**

Precipitate. Sol. in free acids, insol. in borax + Aq. (Moberg)

**Chromic borate,  $7\text{Cr}_2\text{O}_3 \cdot 4\text{B}_2\text{O}_3$ .**

Insol in  $\text{H}_2\text{O}$ ; sol. in excess of borax + Aq. (Hebberling, C. C 1870. 122.)

**Chromic magnesium borate,  $3\text{Cr}_2\text{O}_3 \cdot 6\text{MgO} \cdot 2\text{B}_2\text{O}_3$** 

Not attacked by acids (Ebelmen, A. ch. (3) 33. 52.)

$2\text{Cr}_2\text{O}_3 \cdot 9\text{MgO} \cdot 3\text{B}_2\text{O}_3$  (Mallard, C. R. 105. 1260.)

**Cobaltous borate,  $3\text{CoO} \cdot 2\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 88. 299.)  $3\text{CoO} \cdot \text{B}_2\text{O}_3$ . (Mallard, C. R. 105. 1260.)  $2\text{CoO} \cdot \text{B}_2\text{O}_3$ . (Ouvrard, C. R. 1900, 130. 337.)

**Cobaltous borate bromide,  $6\text{CoO} \cdot 8\text{B}_2\text{O}_3 \cdot \text{CoBr}_2$ .**

(Rousseau and Allaire, C. R. 1894, 119. 73.)

**Cobaltous borate chloride,  $6\text{CoO} \cdot 8\text{B}_2\text{O}_3 \cdot \text{CoCl}_2$** 

(Rousseau and Allaire, C. R. 1894, 118. 1257.)

**Cobaltous borate iodide,  $6\text{CoO} \cdot 8\text{B}_2\text{O}_3 \cdot \text{CoI}_2$ .**

(Allaire, C. R. 1898, 127. 557.)

**Cuprous borate,  $3\text{Cu}_2\text{O} \cdot 2\text{B}_2\text{O}_3$** 

(Guertler, Z. anorg. 1904, 38. 459.)

**Cupric borate.**

Composition depends on temperature and concentration of solutions. Boiling  $H_2O$  dissolves out all the boric acid. Sol. in acids, slowly sol. in hot conc.  $NH_4Cl + Aq$ .

$Cu(BO_2)_2$ . Insol. in cold dil. acids, even HF. Slowly sol. in hot conc.  $HCl$ . Not attacked by alkalis or alkali carbonates +  $Aq$ . (Guertler, Z. anorg. 1904, 38, 456.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

**Cupric borate ammonia**,  $CuB_4O_7 \cdot 4NH_3 + 8H_2O$ .

Efflorescent. Can be recrystallized from a little  $NH_4OH + Aq$ . (Pasternack, A. 161, 237.)

**Didymium borate**,  $DiBO_3$ .

Insol. in  $H_2O$  acidulated with  $HCl + Aq$  (Cleve, Bull. Soc. (2) 43, 363.)

$Di_2(B_4O_7)_2$ . Insol. in  $H_2O$ ; sol. in acids (Freuchs and Smith, A. 191, 355.)

**Glucinum borate, basic**,  $5GHO \cdot B_2O_3$ .

Insol. in  $H_2O$ ; sol. in acids (Kruss and Morant, B. 23, 735.)

**Iron (ferrous) borate.**

Ppt.  $H_2O$  dissolves out all the boric acid. (Tunerman.)

**Iron (ferric) borate**,  $Fe_2(BO_2)_4 + 3H_2O$ .

Ppt. Insol. in  $H_2O$ .  
Min. *Lagovate*. Sol. in acids.  
 $2Fe_2O_3 \cdot 3B_2O_3$  (Mallard, C. R. 105, 1260.)  
 $6Fe_2O_3 \cdot B_2O_3 + 6H_2O$ . Ppt. (Rose, Pogg. 89, 473.)

$9Fe_2O_3 \cdot B_2O_3 + 9H_2O$ . Ppt. (Rose.)

**Iron (ferric) magnesium borate**,  $3Fe_2O_3 \cdot 6MgO \cdot 2B_2O_3$ .

Insol. in  $H_2O$ . Sol. in conc.  $HCl + Aq$  (Ebelmen, A. ch. (3) 33, 53.)  
 $2Fe_2O_3 \cdot 9MgO \cdot 3B_2O_3$  (Mallard, C. R. 105, 1260.)

**Iron (ferroferric) magnesium borate**,  $3MgO \cdot FeO \cdot Fe_2O_3 \cdot B_2O_3$ .

Min. *Ludwigite*. Slowly sol. in  $HCl + Aq$ , when finely powdered.

**Iron (ferrous) borate bromide**,  $6FeO \cdot 8B_2O_3 \cdot FeBr_3$ .

Slowly sol. in hot  $HNO_3 + Aq$  (Rousseau and Allaire, C. R. 116, 1445.)

**Iron (ferrous) borate chloride**,  $6FeO \cdot 8B_2O_3 \cdot FeCl_2$ .

Slowly sol. in hot  $HNO_3 + Aq$  (Rousseau and Allaire, C. R. 116, 1195.)

**Lanthanum borate**,  $2La_2O_3 \cdot B_2O_3$ .

(Nordenskjöld, Pogg. 114, 618.)

$La_2(B_4O_7)_2$ . Ppt. (Smith.)

Formula is  $La_2B_4O_{15} + xH_2O$ . (Cleve, B. 11, 910.)

**Lead borate, basic,**

$2PbO \cdot B_2O_3 + 2H_2O$ . Ppt.  
 $4PbO \cdot 3B_2O_3 + 4H_2O$ . Ppt.  
 $+ 5H_2O$ . Ppt.  
 $6PbO \cdot 5B_2O_3 + 6H_2O$ . Ppt.  
 $8PbO \cdot 3B_2O_3 + 8H_2O$ . Ppt.  
 $9PbO \cdot 5B_2O_3 + 9H_2O$ . Ppt. (Rose, Pogg. 87, 470.)

**Lead borate**,  $Pb(BO_2)_2 + H_2O$ .

Insol. in  $H_2O$ . Easily sol. in dil.  $HNO_3$ , or boiling  $HC_2H_3O_2 + Aq$ . Decomp. by  $H_2SO_4$ ,  $HCl$ , also by boiling  $KOH$ , or  $NaOH + Aq$ . Insol. in alcohol. (Herapath, Phil. Mag. (3) 34, 375.)

Sol. in  $NH_4Cl + Aq$ ; sol. in sat.  $NaCl + Aq$ .  
 $2PbO \cdot 3B_2O_3 + 4H_2O$  (Herapath.)  
 $PbB_4O_7 + 4H_2O$ . Slightly sol. in pure  $H_2O$ , but insol. in solutions of Na salts as  $Na_2B_4O_7 + Aq$ . (Souberran.)

**Lead borate chloride**,  $Pb(BO_2)_2 \cdot PbCl_2 + H_2O$ .

Insol. in cold, very slowly decomp. by hot  $H_2O$  into its constituents. Easily sol. in dil. hot  $HNO_3 + Aq$ ; insol. in alcohol. (Herapath, Phil. Mag. (3) 34, 375.)

**Lead borate nitrate**,  $Pb(BO_2)_2 \cdot Pb(NO_3)_2 + H_2O$ .

Insol. in alcohol. (Herapath.)

**Lithium borate**,  $LiBO_2$ .

Solubility in $H_2O$ . 100 g. $H_2O$ dissolve g. $LiBO_2$ at $t^\circ$ .			
$t^\circ$	g. $LiBO_2$	$t^\circ$	g. $LiBO_2$
0	0.7	30	4.9
10	1.4	40	11.12
20	2.6	45	20.

(Le Chatelier, C. R. 1897, 124, 1094.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37, 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

$+ 8H_2O$  (Le Chatelier, Bull. Soc. 1899, (3) 21, 35.)

$+ 16H_2O$ . Effloresces in the air, slowly sol. in cold  $H_2O$ , rapidly in hot  $H_2O$  (Le Chatelier, C. R. 1897, 124, 1092.)

$Li_2H_4(BO_3)_2 + 14H_2O$ . (Reischle, Z. anorg. 4, 166.)

$Li_2B_4O_7$ . Deliquescent; easily sol. in  $H_2O$ . (Arfvedson, A. ch. 10, 82.)

Sol. in acetone. (Eidmann, C. C. 1899, II, 1014.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

$+ 5H_2O$ . Insol. in alcohol (Filsinger, Arch. Ph. (3) 8, 198.)

$\text{Li}_2\text{O}$ ,  $3\text{B}_2\text{O}_3 + 6\text{H}_2\text{O}$  Very sol. in  $\text{H}_2\text{O}$ , insol. in alcohol (Filsinger).  
 $\text{Li}_2\text{O}$ ,  $4\text{B}_2\text{O}_3$  Insol. in  $\text{H}_2\text{O}$  (Le Chatelier, Bull. Soc. 1899, (3) 21. 35).  
 $+10\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Filsinger)

"Acid lithium borate" is less sol. than the tetraborate (Gmelin)

$\text{Li}_2\text{O}$ ,  $5\text{B}_2\text{O}_3 + 10\text{H}_2\text{O}$  (Dukelski, C. A. 1908. 1089)

**Magnesium borate**,  $\text{Mg}(\text{BO}_2)_2$ .

(Ditte, C. R. 77. 893.)  
 $+3\text{H}_2\text{O}$ . Min *Pinnole*  
 $+4\text{H}_2\text{O}$ . (Laurent, A. ch (2) 67. 215)  
 $+8\text{H}_2\text{O}$ . Insol. in cold or hot  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ . Decomp. by conc.  $\text{HCl} + \text{Aq}$  into  $\text{H}_3\text{BO}_3$  and  $\text{MgCl}_2$ . (Wohler.)  
 $\text{MgB}_4\text{O}_7 + 8\text{H}_2\text{O}$ . (Popp, A. Suppl 8. 1)  
 $\text{MgO}$ ,  $3\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$  Very slowly sol. in  $\text{H}_2\text{O}$ . (Rose, A. 84. 221.)  
 Sol. in 75 pts cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 49. 445.)

$2\text{MgO}$ ,  $\text{B}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ , but sol. in  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . (Guertler, Z. anorg. 1904, 40. 236.)

$+ \text{H}_2\text{O}$ . Very sl sol. in  $\frac{1}{10}$  N  $\text{HCl} + \text{Aq}$ . (van't Hoff, B. A. B 1907, 658.)

Min *Aschurite*  
 $3\text{MgO}$ ,  $\text{B}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Ebelmen, A. 80. 208.)

Very sl. sol. in cold, but somewhat decomp. by boiling  $\text{H}_2\text{O}$  (Rammelsberg.)

$+9\text{H}_2\text{O}$  Somewhat sol. in cold  $\text{H}_2\text{O}$  (Wohler, Pogg. 28. 525)

$3\text{MgO}$ ,  $2\text{B}_2\text{O}_3$ . Sol. in warm  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$  (Ditte, C. R. 77. 993.)

$\text{MgO}$ ,  $6\text{B}_2\text{O}_3 + 18\text{H}_2\text{O} = \text{Mg}(\text{BO}_2)_2$ ,  $10\text{HBO}_2 + 13\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 49. 445.)

$3\text{MgO}$ ,  $4\text{B}_2\text{O}_3$  Sol. in hot dil acids, insol. in acetic acid (Ditte, C. R. 77. 993.)

$5\text{MgO}$ ,  $2\text{B}_2\text{O}_3 + 1\frac{1}{2}$ , and  $3\text{H}_2\text{O}$  Min. *Szabolite* Difficultly sol. in  $\text{HCl} + \text{Aq}$

$9\text{MgO}$ ,  $\text{B}_2\text{O}_3$  (Mallard, C. R. 106. 260)

**Magnesium manganous borate**,  $3\text{MgB}_2\text{O}_6$ ,  $4\text{Mn}_2\text{B}_2\text{O}_6 + 7\text{H}_2\text{O}$ .

Min *Sussexite*. Sol. in  $\text{HCl} + \text{Aq}$

**Magnesium potassium borate**,  $\text{KMg}_3\text{B}_{11}\text{O}_{34} + 9\text{H}_2\text{O}$ .

Min. *Kaliborite*. Insol. in  $\text{H}_2\text{O}$  (Feit, Ch. Z. 1889, 13. 1188)

$2\text{MgO}$ ,  $2\text{K}_2\text{O}$ ,  $11\text{B}_2\text{O}_3 + 20\text{H}_2\text{O}$  (van't Hoff and Lichtenstein, B. A. B 1904, 936.)

**Magnesium sodium borate**,  $\text{Mg}_2\text{B}_4\text{O}_{11}$ ,  $\text{Na}_2\text{B}_4\text{O}_7 + 30\text{H}_2\text{O}$ .

Eflorescent. About as sol. in cold  $\text{H}_2\text{O}$  as borax; solution separates out a Mg borate on warming, which redissolves on cooling. Decomp. by boiling  $\text{H}_2\text{O}$ . (Rammelsberg)

**Magnesium strontium borate**,  $3\text{MgO}$ ,  $3\text{SrO}$ ,  $4\text{B}_2\text{O}_3$

Easily sol. in dil. acids. (Ditte, C. R. 77. 895)

**Magnesium borate bromide**,  $2\text{Mg}_3\text{B}_5\text{O}_{16}$ ,  $\text{MgBr}_2$  or  $6\text{MgO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{MgBr}_2$ . (Rousseau and Allaire, C. R. 1894, 119. 71)

**Magnesium borate chloride**,  $2\text{Mg}_3\text{B}_5\text{O}_{16}$ ,  $\text{MgCl}_2$

Min *Boracile* Insol. in  $\text{H}_2\text{O}$ , slowly sol. in acids (Kraut)

*Stassfurthite* Easily sol. in warm acids. (Bischof)

**Magnesium borate iodide**,  $6\text{MgO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{MgI}_2$

(Allaire, C. R. 1898, 127. 556.)

**Magnesium borate phosphate**,  $\text{Mg}(\text{BO}_2)_2$ ,  $2\text{MgHPO}_4 + 7\text{H}_2\text{O}$

Min. *Lüneburgite*.

**Magnesium borate sulphate**,  $2\text{Mg}_2\text{B}_4\text{O}_6$ ,  $3\text{MgSO}_4 + 12\text{H}_2\text{O}$ .

Min. *Magnesium sulphoborate*. Sol. in mineral acids when ground (Nauert, B. 1893, 26. 874)

**Manganous borate**,  $\text{MnB}_4\text{O}_7$  (?).

Insol. in  $\text{H}_2\text{O}$  (Berzelius), very sl sol. in  $\text{H}_2\text{O}$  (Thomas, Am. Ch. J. 4. 358); decomp. by warm, slowly by cold  $\text{H}_2\text{O}$  Sol. in  $\text{MgSO}_4 + \text{Aq}$  (Berzelius).

$+3\text{H}_2\text{O}$ . (Endemann and Paisley, Zeit. angew. Ch. 1903, 16. 176.)

$+5\text{H}_2\text{O}$ . Ppt (Endemann and Paisley.) Very hygroscopic. (Endemann, Am. Ch. J. 1903, 29. 72)

$3\text{MnO}$ ,  $\text{B}_2\text{O}_3$  (Mallard, C. R. 105. 1260.) Not attacked by  $\text{H}_2\text{O}$  Very sol. in acids (Ouvrard, C. R. 1900, 130. 336)

$3\text{MnO}$ ,  $2\text{B}_2\text{O}_3$ . (Mallard)

$\text{MnH}_2(\text{BO}_2)_2$  Very sl sol. in  $\text{H}_2\text{O}$ .

Solubility in 2%  $\text{Na}_2\text{SO}_4 + \text{Aq}$ . At  $18.5^\circ$ , 0.77 g.  $\text{MnH}_2(\text{BO}_2)_2$  are dissolved per litre;

at  $40^\circ$ , 0.65 g.; at  $60^\circ$ , 0.36 g., at  $80^\circ$ , 0.12 g.

Solubility in 2%  $\text{NaCl} + \text{Aq}$ . 1 l solution dissolves 1.31 g. salt at  $18.2^\circ$ , 0.6 g. at  $59^\circ$ ; and 0.29 g. at  $80^\circ$ .

Solubility in 2%  $\text{CaCl}_2 + \text{Aq}$ . 1 l.  $\text{CaCl}_2 + \text{Aq}$  dissolves 2.91 g. salt at  $17.6^\circ$ ; 2.44 g. at  $43.0^\circ$ ; 2.25 g. at  $61^\circ$ ; and 1.35 g. at  $80^\circ$ . (Hartley and Ramage, Chem. Soc. 63. 129.)

**Manganous borate bromide**,  $6\text{MnO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{MnBr}_2$ .

(Rousseau and Allaire, C. R. 1894, 119. 73.)

**Manganous borate chloride**,  $6\text{MnO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{MnCl}_2$ .

(Rousseau and Allaire, C. R. 1894, 118. 1257.)

**Molybdenum borate**,  $\text{MoO}_2$ ,  $2\text{B}_2\text{O}_3$  (?).

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_3\text{BO}_3 + \text{Aq}$  (Berzelius)

**Molybdenum borate,  $\text{Mo}_3\text{O}_7, \text{B}_2\text{O}_3$ .**

Precipitate. Insol. in  $\text{H}_2\text{O}$ ; sl sol in a solution of boric acid (Berzelius)

See **Boromolybdic Acid**.

**Nickel borate,  $\text{Ni}(\text{BO}_3)_2 \cdot 2\text{H}_2\text{O}$ .**

Insol in  $\text{H}_2\text{O}$ . Easily sol in acids. Easily sol in warm  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose, Pogg 88. 299.)

$2\text{NiO}, \text{B}_2\text{O}_3 + x\text{H}_2\text{O}$  Easily sol. in acids. (Rose.)

$3\text{NiO}, 2\text{B}_2\text{O}_3 + 5\text{H}_2\text{O}$  Easily sol. in acids. (Rose.)

$3\text{NiO}, \text{B}_2\text{O}_3$ . Not attacked by  $\text{H}_2\text{O}$ , sol in acids. (Ouvrard, C. R. 1900, 130. 337)

**Nickel borate bromide,  $6\text{NiO}, 8\text{B}_2\text{O}_3, \text{NiBr}_2$ .**

(Rousseau, C. R. 1894, 119. 73)

**Nickel borate chloride,  $6\text{NiO}, 8\text{B}_2\text{O}_3, \text{NiCl}_2$ .**

(Rousseau, C. R. 1894, 118. 1257.)

**Potassium borates.**

Solubility of  $\text{B}_2\text{O}_3$  in  $\text{K}_2\text{O} + \text{Aq}$  at  $30^\circ$

Solution contains		Solid phase
% by wt $\text{K}_2\text{O}$	% by wt $\text{B}_2\text{O}_3$	
47 50		$\text{KOH}, 2\text{H}_2\text{O}$
46 45	0 72	"
46 36	0 91	$\text{K}_2\text{O}, \text{B}_2\text{O}_3, 2.5\text{H}_2\text{O}$
40 51	1 25	"
36 82	1 80	"
36 72	1 85	"
32 74	3 51	"
29 63	6 98	"
26 89	12 12	"
24 84	17 63	"
23 30	18 19	$\text{K}_2\text{O}, 2\text{B}_2\text{O}_3, 4\text{H}_2\text{O}$
16 21	13 10	"
11 78	9 82	"
9 18	8 00	"
6 22	9 13	"
7 79	13 20	"
7 73	13 37	$\text{K}_2\text{O}, 2\text{B}_2\text{O}_3, 4\text{H}_2\text{O} + \text{K}_2\text{O}, 5\text{B}_2\text{O}_3, 8\text{H}_2\text{O}$
7 81	13 28	"
7 67	13 19	"
7 71	13 21	$\text{K}_2\text{O}, 5\text{B}_2\text{O}_3, 8\text{H}_2\text{O}$
7 63	13 28	"
3 42	7 59	"
1 80	4 15	"
0 80	3 05	"
0 61	3 19	"
0 33	4 58	$\text{K}_2\text{O}, 5\text{B}_2\text{O}_3, 8\text{H}_2\text{O} + \text{B}(\text{OH})_3$
0 38	4 51	"
0 31	4 46	"
0 28	4 36	$\text{B}(\text{OH})_3$
	3 54	"

At  $30^\circ$  only the three potassium borates  $\text{K}_2\text{O}, \text{B}_2\text{O}_3 + 2.5\text{H}_2\text{O}$ ;  $\text{K}_2\text{O}, 2\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$  and  $\text{K}_2\text{O}, 5\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$  exist in stable form.

(Dukelski, Z anorg 1906, 50. 42.)

**Potassium metaborate,  $\text{KBO}_2$ .**

Sol in small amount of  $\text{H}_2\text{O}$ . (Berzelius, Pogg 34. 568.)

$+1\frac{1}{2}\text{H}_2\text{O}$ . Only stable hydrate (Dukelski, Z anorg 1906, 50. 42)

$+1\frac{1}{2}\text{H}_2\text{O}$  (Atterberg, Bull. Soc. (2) 22. 350)

**Potassium tetraborate,  $\text{K}_2\text{B}_4\text{O}_7$ .**

Very sol. in  $\text{H}_2\text{O}$ .

$+4\text{H}_2\text{O}$  (Atterberg, Bull. Soc. (2) 22. 350.)

Only stable hydrate. (Dukelski, l. c.)

$+5\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ ; more sol. than  $\text{K}_2\text{B}_4\text{O}_{10}$  or  $\text{K}_2\text{B}_{10}\text{O}_{16}$ .

$+6\text{H}_2\text{O}$ . (Atterberg, l. c.)

**Potassium hexaborate,  $\text{K}_2\text{B}_6\text{O}_{10} + 5$ , and  $8\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ .

Does not exist. (Dukelski, l. c.)

**Potassium dekaborate,  $\text{K}_2\text{B}_{10}\text{O}_{16} + 8\text{H}_2\text{O}$ .**

Sol in  $\text{H}_2\text{O}$ . (Rammelsberg.)

Only hydrate. (Dukelski)

**Potassium dodekaborate,  $\text{K}_2\text{B}_{12}\text{O}_{18} + 10\text{H}_2\text{O}$ .**

Sl sol. in cold, very sol. in hot  $\text{H}_2\text{O}$ . (Laurent, A. ch. 67. 215.)

$= \text{K}_2\text{B}_{10}\text{O}_{16}$  (Rammelsberg.)

Does not exist (Dukelski.)

**Potassium borate fluoride,  $\text{KBO}_2, \text{KF}$ .**

Sol in  $\text{H}_2\text{O}$ . (Schiff and Sestini, A. 228. 72)

$\text{KBO}_2, 2\text{KF}$  Sol. in little, decomp. by much  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  (Schiff and Sestini, A. 228. 72)

**Rubidium borate,  $\text{Rb}_2\text{B}_4\text{O}_7$ .**

Anhydrous. (Reischle, Z. anorg. 4. 166.)

$+6\text{H}_2\text{O}$  Not deliquescent or efflorescent.

Sol in  $\text{H}_2\text{O}$ . (Reissig, A. 127. 33)

**Samarium borate,  $\text{SmBO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$  (Cleve, Bull. Soc. (2) 43. 1670.)

**Scandium borate,  $\text{ScBO}_3$ .**

Sol. in dil. acids. (Crookes, Phil Trans. 1910, 210. A. 364.)

**Silver borate,  $\text{AgBO}_2$ .**

Sl. sol in  $\text{H}_2\text{O}$ . By washing with  $\text{H}_2\text{O}$  the boric acid is dissolved out (Rose, Pharm. Centralbl. 1853. 205.)

Sol with decomp. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Herschel); sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  if pptd. cold.

1 l.  $\text{H}_2\text{O}$  dissolves ca.  $6 \times 10^{-2}$  gram-atoms at  $25^\circ$ . (Abegg and Cox, Z. phys. Ch. 1903, 46. 11.)

Insol in ethyl acetate (Naumann, B. 1910, 43. 314)

$3\text{Ag}_2\text{O}, 4\text{B}_2\text{O}_3$ . (Rose, l. c.)

## Sodium borates.

Solubility of  $B_2O_3$  in  $Na_2O + Aq$  at  $30^\circ$ .

Solution contains		Solid phase
% by wt $Na_2O$	% by wt $B_2O_3$	
42 00		$NaOH, H_2O$
40 85	2 71	"
41 37	5 10	"
38 85	5 55	$Na_2O, B_2O_3, 4H_2O$
34 44	3 73	"
29 39	2 51	"
28 61	2 38	"
27 78	2 44	"
26 13	2 75	"
25 08	2 98	"
23 00	3 82	"
16 01	13 69	"
21 58	4 63	$Na_2O, B_2O_3, 4H_2O + Na_2O, B_2O_3, 8H_2O$
20 58	4 69	$Na_2O, B_2O_3, 8H_2O$
18 31	4 97	"
15 32	6 21	"
13 25	8 18	"
12 39	9 12	"
8 85	10 49	$Na_2O, 2B_2O_3, 10H_2O$
5 81	6 94	"
4 00	4 76	"
1 88	2 41	"
1 38	5 16	"
1 84	7 36	"
2 02	7 79	"
2 40	9 48	"
4 08	17 20	$Na_2O, 2B_2O_3, 10H_2O + Na_2O, 5B_2O_3, 10H_2O$
3 79	15 84	$Na_2O, 5B_2O_3, 10H_2O$
3 47	13 30	"
2 26	12 14	"
1 99	11 84	$Na_2O, 5B_2O_3, 10H_2O + B(OH)_3$
1 86	11 78	"
1 81	11 18	"
0 64	6 11	"
	3 54	"

At  $30^\circ$ , only the four sodium borates  $Na_2O, B_2O_3 + 4H_2O$ ,  $Na_2O, B_2O_3 + 8H_2O$ ,  $Na_2O, 2B_2O_3 + 10H_2O$ ; and  $Na_2O, 5B_2O_3 + 10H_2O$  exist as stable phases (Dukelski, Z. anorg. 1906, 50. 46.)

Sodium metaborate,  $NaBO_2$ .

Anhydrous. Easily sol in  $H_2O$ , with evolution of heat.

+ $H_2O$ . Easily sol in  $H_2O$ . (Benedikt.)  
 + $2H_2O$ . Easily sol. in  $H_2O$ . (Benedikt, B 7. 703.)

+ $3H_2O$ . Easily sol. in  $H_2O$ . (Berzelius.)  
 + $4H_2O$ . Sl. efflorescent. Sol. in hot, less sol. in cold  $H_2O$ . Melts at  $57^\circ$  in its crystal  $H_2O$ . (Dukelski, Z. anorg. 50. 42.)

+ $4\frac{1}{2}H_2O$ . (Attenberg, Z. anorg. 1906, 48. 370.)

+ $5\frac{1}{2}H_2O$  (Attenberg.)

+ $8H_2O$ . (Attenberg)  
 + $4H_2O$  and + $8H_2O$  are the only hydrates formed. (Dukelski)

System  $Na_2O, B_2O_3, H_2O$  at  $60^\circ$  investigated by Sborgh. (Real. Ac. Linc 1915, (5) 24. I, 443.)

Sodium tetraborate,  $Na_2B_4O_7$  (Borax)

100 g  $H_2O$  dissolve at:

$5^\circ$   $10^\circ$   $21^\circ$   $5^\circ$   $30^\circ$   $37^\circ$   $5^\circ$

1 3 1 6 2 8 3 9 5.6 g. anhydrous salt.

$45^\circ$   $50^\circ$   $54^\circ$   $55^\circ$   $56^\circ$   $57^\circ$

8.1 10 5 13.3 14.2 15 0 16 0 g. anhydrous salt.

(Horn and van Wagener, Am. Ch. J. 1903, 30. 347.)

Insol. in ethyl acetate (Naumann, B. 1910, 43. 314.)

Sol. in amyl alcohol in the presence of meta-arsonic acid and excess of  $H_2BO_3$  (Auerbach, Z. anorg. 1903, 37. 358.)

+ $4H_2O$ .

+ $5H_2O$

100 g  $H_2O$  dissolve at.

$65^\circ$   $70^\circ$   $80^\circ$   $90^\circ$   $100^\circ$

22.0 24.4 31.4 40.8 52.3 g. anhydrous salt

(Horn and van Wagener, Am. Ch. J. 1903, 30. 347.)

+ $6H_2O$ . Grows opaque in the air. (Bechi, Sill. Am. J. (2) 17. 129.)

+ $10H_2O$ . Only stable hydrate. (Dukelski, Z. anorg. 50. 30.) Efflorescent on surface in dry air. Not efflorescent when free from  $Na_2CO_3$  (Sims)

Sol. in 12 pts. cold, and 2 pts. hot  $H_2O$ . Sat. cold  $Na_2B_4O_7 + Aq$  contains 9.23%, and sat. hot  $Na_2B_4O_7 + Aq$  contains 33.3%  $Na_2B_4O_7$  (Gmelin)  
 Sol. in 20 pts. cold, and 6 pts. boiling  $H_2O$  (Wallerius)

Sol. in 15 pts.  $H_2O$  at  $18.75^\circ$  (Abl.)  
 100 pts.  $H_2O$  at  $15.5^\circ$  dissolve 5 pts., at  $65^\circ$ , 40 pts., at  $100^\circ$ , 106 pts.  $Na_2B_4O_7 + 10H_2O$ . (Ure's Dictionary)  
 100 pts. sat.  $Na_2B_4O_7 + Aq$  at  $105.5^\circ$  contain 32.5 pts.  $Na_2B_4O_7$ , or 100 pts.  $H_2O$  dissolve 110.54 pts.  $Na_2B_4O_7$ , or 1 pt.  $Na_2B_4O_7$  in sol. in 0.9047 pt.  $H_2O$  at  $106.5^\circ$  (Griffith, Quar. J. Sci. 18. 90)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $Na_2B_4O_7$	Pts. $Na_2B_4O_7 + 10H_2O$	$t^\circ$	Pts. $Na_2B_4O_7$	Pts. $Na_2B_4O_7 + 10H_2O$
0	1 49	2 83	60	18 09	40 43
10	2 42	4 65	70	24 22	57 85
20	4 05	7 88	80	31 17	76 19
30	6 00	11 90	90	40 14	116 06
40	8 79	17 90	100	55 16	201 43
50	12 93	27 41			

(Poggiale, A. ch. (3) 8. 46.)

100 pts.  $H_2O$  dissolve 1.4 pts.  $Na_2B_4O_7$  at  $0^\circ$ , and 55.3 pts. at  $100^\circ$ . (Mulder)  
 $Na_2B_4O_7 + Aq$  sat. at  $15^\circ$  has sp. gr. = 1.0199, and contains 3.926 pts.  $Na_2B_4O_7$  to 100 pts.  $H_2O$ . (Michel and Kiaft, A. ch. (3) 41. 471)

$\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  sat at  $17^\circ$  has sp gr = 1.0208 (Stolba, J pr. 97. 503)

Sp gr. of  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  at  $15^\circ$

$\frac{\text{C}}{\text{Na}_2\text{B}_4\text{O}_7}$	$\frac{\text{C}}{\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}}$	Sp gr	$\frac{\text{C}}{\text{Na}_2\text{B}_4\text{O}_7}$	$\frac{\text{C}}{\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}}$	Sp gr
1	0.52	1.0049	4	2.11	1.0199
2	1.06	1.0099	5	2.64	1.0249
3	1.59	1.0149	6	3.17	1.0299

(Gerlach, Z anal 28. 473.)

Sp gr. of  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  sat. at  $15^\circ = 1.032$  (Gerlach)

Sat  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  boils at  $105.5^\circ$ , and contains 110.5 pts  $\text{Na}_2\text{B}_4\text{O}_7$  to 100 pts  $\text{H}_2\text{O}$ . (Griffith)

Sat.  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  forms a crust at  $103^\circ$ , and contains 60.14 pts  $\text{Na}_2\text{B}_4\text{O}_7$  to 100 pts  $\text{H}_2\text{O}$ ; highest temp observed,  $104.3^\circ$  (Gerlach, Z. anal. 26. 427)

B-pt. of  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  containing pts  $\text{Na}_2\text{B}_4\text{O}_7$  to 100 pts  $\text{H}_2\text{O}$ .

B-pt	Pts $\text{Na}_2\text{B}_4\text{O}_7$	B-pt	Pts $\text{Na}_2\text{B}_4\text{O}_7$
100 $5^\circ$	8.64	103 $0^\circ$	61.2
101 0	17.2	103 5	75.4
101 5	26.5	104 0	90.8
102 0	37.5	104 5	109.0
102 5	48.5	104 6	112.3

(Gerlach, Z anal 26. 452)

M-pt of  $\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$  is  $75.5^\circ$  (Thlden, Chem. Soc. 45. 407)

Insol in alcohol

100 g alcohol (0.941 sp. gr) dissolve 2.48 g at  $15.5^\circ$  (U. S. P.)

Sol in alcoholic solution of  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2$ . (Stromeyer)

Sol in 147 pts glycerine of 1.225 sp gr. (Vogel)

Sol in 1 pt glycerine (Schultze, Arch. Pharm (3) 6. 149)

100 g glycerine dissolve 60.3 g at  $15.5^\circ$  (U. S. P.)

Min Tineal.

Sodium borate,  $\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$ .

Sol. in 5-6 pts cold  $\text{H}_2\text{O}$ . (Bolley, A. 68. 122.) Perhaps sodium hydrogen tetraborate  $\text{NaHB}_4\text{O}_7 + 4\frac{1}{2}\text{H}_2\text{O}$ .

$\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Atterberg, Z. anorg. 48. 370)

Stabile (Dukelski, Z anorg. 50. 42.)

+11 $\text{H}_2\text{O}$  (Laurent, C. R. 29. 5)

Sodium borate fluoride,  $\text{NaBO}_2, 3\text{NaF} + 4\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ .

Basarow (B 7. 112) considers this salt to be a mixture.

$\text{Na}_2\text{B}_4\text{O}_7, 12\text{NaF} + 22\text{H}_2\text{O}$ . Can be separated into its constituents by  $\text{H}_2\text{O}$  (Berzelius, Berz J. B. 23. 96)

Strontium borate,  $\text{Sr}(\text{BO}_2)_2$ .

(Ditte, C R 77. 788)

Easily hydrated by  $\text{H}_2\text{O}$  forming  $\text{SrO}, \text{B}_2\text{O}_3 + 2\text{H}_2\text{O}$ . Very sol. in dil acetic acid (Ouvrard, C R. 1906, 142. 282)

Insol. in acetone (Naumann, B. 1904, 37. 4329.)

+2 $\text{H}_2\text{O}$  (Ouvrard, l. c)

+4 $\text{H}_2\text{O}$  (Ouvrard, l. c)

+5 $\text{H}_2\text{O}$  1 l.  $\text{H}_2\text{O}$  dissolves 2.3 g. at  $10^\circ$ .

(Ditte, A. ch. 1883 (5) 30. 253.)

$\text{SrB}_4\text{O}_7$ . Insol in  $\text{H}_2\text{O}$ ; sol in dil. acids.

(Guertier, Z anorg. 1904, 40. 243)

+4 $\text{H}_2\text{O}$  Sol. in 130 pts. boiling  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  at  $100^\circ$  dissolve 7.7 pts (Ure's Dict.). Easily sol. in cold  $\text{NH}_4$  salts +  $\text{Aq}$ , sol. in cold  $\text{HNO}_3 + \text{Aq}$ .

2 $\text{SrO}, \text{B}_2\text{O}_3$ . Easily decomp. by  $\text{H}_2\text{O}$  forming  $\text{B}_2\text{O}_3, \text{SrO}, 4\text{H}_2\text{O}$  Very sol. in acids. (Ouvrard, C. R. 1906, 142. 282)

3 $\text{SrO}, \text{B}_2\text{O}_3$ . Less easily attacked by  $\text{H}_2\text{O}$  than Ca comp Very sol. in mineral acids. Sl attacked by dil. acetic acid. (Ouvrard, C R. 1901, 132. 258.)

$\text{SrB}_4\text{O}_7$  Very sl. sol. in  $\text{H}_2\text{O}$ ; sol in acids. (Laurent)

$\text{SrB}_4\text{O}_{11} + 7\text{H}_2\text{O}$  Ppt. (Laurent.)

+12 $\text{H}_2\text{O}$ . (Ditte)

$\text{Sr}_3\text{B}_4\text{O}_{13}$ . Sol. in cold mineral acids and acetic acid. (Ditte, C. R. 77. 785.)

2 $\text{SrO}, 3\text{B}_2\text{O}_3$ . Easily sol. in acids (Ditte, l. c)

Strontium borate bromide,  $3\text{SrO}, 5\text{B}_2\text{O}_3, \text{SrBr}_2$ .

As the chloride (Ouvrard, C R. 1906, 142. 283.)

Strontium borate chloride,  $3\text{SrO}, 5\text{B}_2\text{O}_3, \text{SrCl}_2$ .

Sl. attacked by cold  $\text{H}_2\text{O}$ , not attacked by dilute acetic acid. (Ouvrard, C. R. 1906, 142. 282.)

Thallous borate,  $\text{TlBO}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

Decomp. in the air (Buchta, J pr. 1913, (2) 88. 784)

$\text{Tl}_2\text{B}_4\text{O}_7$  (Buchta)

$\text{Tl}_2\text{B}_4\text{O}_7$ . Ppt. Sol. in boiling  $\text{H}_2\text{O}$ , insol. in cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Crookes)

+2 $\text{H}_2\text{O}$ . (Buchta, J. pr 1913 (2) 88. 774.)

$\text{Tl}_2\text{B}_4\text{O}_{10} + 3\text{H}_2\text{O}$  (Buchta.)

$\text{Tl}_2\text{B}_4\text{O}_{13} + 4\text{H}_2\text{O}$  (Buchta.)

$\text{Tl}_2\text{B}_{10}\text{O}_{18} + 8\text{H}_2\text{O}$  (Buchta.)

$\text{Tl}_2\text{B}_{10}\text{O}_{18} + 7\text{H}_2\text{O}$  (Buchta.)

Thorium borate (?).

Precipitate. Insol in  $\text{H}_2\text{O}$  and  $\text{H}_3\text{BO}_3 + \text{Aq}$  (Berzelius)

Tin (stannous) borate (?).

Ppt. (Wenzel.)

**Divanadyl borate.**

Insol. in  $H_2O$ ; sol. in  $H_2BO_3 + Aq$  (Berzelius)

**Ytterbium borate,  $YbBO_3$ .**

Insol. in conc.  $HCl$ ; sol. in  $HF$  (Cleve, Z anorg 1902, 32. 148)

**Yttrium borate.**

Precipitate. (Berlin, Pogg. 13. 105.)

**Zinc borate,  $3ZnO, 2B_2O_3$ .**

(Mallard, C. R. 105. 1260.)

Decomp. by  $H_2O$ , very sol. in dil. acids. (Ouvrard, C. R. 1900, 130. 336)

$ZnO, 2B_2O_3 + 4H_2O$  Sol. in  $H_2O$  with decomp. (Ditte, A. ch 1883, (5) 30. 256)

$3ZnO, 4B_2O_3 + H_2O$  Ppt. (Holdermann, Arch. Pharm. 1904, 242. 567.)

$ZnO, 4B_2O_3 + 10H_2O$  (Ditte, A. ch. 1883, (5) 30. 256)

$9ZnO, 4B_2O_3 + 9H_2O$  Sl. sol. in  $H_2BO_3 + Aq$  (Rose, Pogg. 88. 299)

$3ZnO, B_2O_3$  Insol. in mineral acids. (le Chatelier, C. R. 113. 1034)

**Zinc borate ammonia,  $ZnB_2O_7, 4NH_3 + 6H_2O$ .**

Easily sol. in  $NH_4OH, HC_2H_3O_2, H_2SO_4, HCl$ , and  $HNO_3 + Aq$ . (Büchner, A. 161. 234.)

**Zinc borate bromide,  $6ZnO, 8B_2O_3, ZnBr_2$ .**

(Rousseau and Allau, C. R. 116. 1446.)

**Zinc borate chloride,  $6ZnO, 8B_2O_3, ZnCl_2$ .**

Insol. in  $HCl$  (Rousseau, C. R. 1894, 118. 1256)

**Zinc borate iodide,  $6ZnO, 8B_2O_3, ZnI_2$ .**

(Allau, C. R. 1898, 127. 556.)

**Zirconium borate, (?)**

Insol. in  $H_2O$ .

**Perboric acid.**

See Perboric Acid.

**Boric phosphoric acid.**

See Phosphoboric acid.

**Boric tungstic acid.**

See Borotungstic acid.

**Boric acid sulphur trioxide.**

See Borosulphuric acid.

**Borimide,  $B_2(NH)_2$** 

Decomp. by  $H_2O$ ; insol. in all indifferent solvents; sol. in liquid  $NH_3 + S$  to form a dark blue solution. (Stock, B. 1901, 34. 3044.)

**Borimide hydrochloride,  $B_2(NH)_2, 3HCl$ .**

Decomp. by  $H_2O$ , insol. in all ordinary organic solvents (Stock, B. 1901, 34. 3045.)

**Borofluorhydric acid,  $HBFl_4$ .**

See Fluoboric acid.

**Borofluorides.**

See Fluoborides.

**Boromolybdic acid.**

Sol. in  $H_2O$ . Decomp. by alcohol. (Berzelius)

**Boron, B**

(a) *Amorphous.* Somewhat sol. in pure  $H_2O$ , when not ignited. Salts and acids separate it out of aqueous solution. Upon evaporation of  $H_2O$  solution a crust is formed, which is only partially sol. in  $H_2O$  (Berzelius, Pogg. 2. 113.) Decomp. by hot  $H_2SO_4$  and cold moderately conc.  $HNO_3 + Aq$ . Strongly ignited amorphous B is much less easily attacked by reagents than freshly pptd., and is insol. in  $H_2O$ . (Berzelius.) Insol. in caustic alkalis +  $Aq$ ; also in alcohol and ether.

Above boron was very impure. (Moissan, C. R. 114. 392.)

Pure B is not attacked by acids, but has a strong reducing action on  $KMnO_4 + Aq, FeCl_3 + Aq$ , etc (Moissan, C. R. 114. 617)

Does not melt at  $1500^\circ$ . Readily sol. in conc. acids, as  $H_2SO_4, HNO_3, H_3PO_4$ , very sl. sol. in hydric acids; decomp.  $H_2O$  at red heat. (Moissan, A. ch 1895, (7) 6. 313-14)

Insol. in liquid  $NH_3$  (Gore, Am. Ch. J. 1898, 20. 827)

(b) *Crystallized* 1 Insol. in  $H_2O, HCl$ , or  $KOH + Aq$ . Very slightly and slowly attacked by boiling conc.  $H_2SO_4$ . Gradually sol. in hot conc.  $HNO_3$ . Formula is  $Al_2B_{10}$ . (Hampe, A. 183. 75.)

2. Very slightly attacked by conc.  $HCl$  or  $H_2SO_4$ , slowly but completely sol. in conc.  $HNO_3$ ; insol. in  $KOH + Aq$ . Formula is  $C_2Al_2B_{10}$  (Hampe.)

$C_2Al_2B_{10}$ . *Crystalline* Insol. in a solution of  $CrO_2$  in  $H_2SO_4$ . Insol. in hot conc.  $HCl$  and  $H_2SO_4$ . Sol. in hot conc.  $HNO_3$  (Biltz, B. 1910, 43. 303)

**Boron tribromide,  $BBr_3$ .**

Sol. in  $H_2O$  or alcohol with decomp. (Nickles, C. R. 60. 800)

**Boron phosphorus bromide,  $BBr_3, PBr_3$ .**

Decomp. by  $H_2O$ .

Sol. in  $CS_2$  and  $CHCl_3$ . Decomp. by alcohol, ether, etc. (Tarble, C. R. 116. 1521.)

$BBr_3, PBr_3$ . Sl. sol. in cold, easily in hot  $CS_2$ . (Tarble.)

**Boron bromide ammonia,  $BBr_3, 4NH_3$** 

Decomp. by  $H_2O$  and alkalis. (Besson, C. R. 114. 542.)

**Boron bromide phosphine,  $BBr_3, PH_3$** 

Violently decomp. by  $H_2O$  (Besson, C. R. 113. 78)

**Boron bromide phosphorus trichloride,**

Decomp. by  $\text{H}_2\text{O}$ . Sol in  $\text{BBr}_3$ ,  $\text{PCl}_3$ ,  $\text{CS}_2$ , and  $\text{CHCl}_3$ . Insol. in petroleum ether. (Taible, C. R. 1901, 132. 84.)

**Boron bromide phosphorus pentachloride,**

Sol in  $\text{BBr}_3$  and  $\text{CS}_2$ ; decomp. by  $\text{H}_2\text{O}$ , insol. in light petroleum. (Taible, C. R. 1901, 132. 85.)

**Boron bromide phosphorus diiodide,  $2\text{BBr}_3\text{,P}_2\text{I}_4$** 

Sol in  $\text{BBr}_3$ ,  $\text{CS}_2$ ,  $\text{CHCl}_3$ ; insol. in light petroleum; decomp. by  $\text{H}_2\text{O}$ . (Taible, C. R. 1901, 132. 205.)

**Boron bromide phosphoryl chloride,  $\text{BBr}_3\text{,POCl}_3$** 

Very easily decomp. (Oddo and Tealdi, Gazz. ch. it. 1903, 33. (2) 431.)

**Boron bromoiodide,  $\text{BBr}_2\text{I}$** 

Decomp. violently by  $\text{H}_2\text{O}$ . (Besson, C. R. 112. 100.)

**Boron bromosulphide,  $\text{B}_2\text{S}_3\text{,BBr}_3$** 

Decomp. by  $\text{H}_2\text{O}$ . (Stock, B. 1901, 34. 3040.)

**Boron carbide,  $\text{B}_2\text{C}$** 

Very stable, insol. in  $\text{HF}$  and in  $\text{HNO}_3$ ; sol. in  $\text{KOH}$  at red heat. (Moissan, Bull. Soc. 1894, (3) 11. 1101.)

Insol. in acids, sol. in fused alkali. (Moissan, C. R. 1894, 118. 559.)

$\text{BC}$  or  $\text{B}_2\text{C}_2$ . Insol. in all the usual solvents. (Mullhauser, Z. anorg. 5. 92.)

**Boron trichloride,  $\text{BCl}_3$** 

Rapidly absorbed by  $\text{H}_2\text{O}$  and alcohol with decomposition.

**Boron nitrosyl chloride,  $\text{BCl}_3\text{,NOCl}$** 

Decomp. violently by  $\text{H}_2\text{O}$ . (Geuther, J. pr. (2) 8. 854.)

**Boron phosphoryl chloride,  $\text{BCl}_3\text{,POCl}_3$** 

Decomp. immediately by  $\text{H}_2\text{O}$ . (Gustavson, Zeit. Chem. 1870. 521.)

**Boron chloride ammonia,  $2\text{BCl}_3\text{,3NH}_3$** 

Decomp. by  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 2. 147.)

**Boron chloride phosphine,  $\text{BCl}_3\text{,PH}_3$** 

Decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 110. 516.)

**Boron chlorosulphide,  $\text{B}_2\text{S}_3\text{,BCl}_3$** 

Decomp. by  $\text{H}_2\text{O}$ . (Stock, B. 1901, 34. 3040.)

**Boron trifluoride,  $\text{BF}_3$** 

$\text{H}_2\text{O}$  absorbs 700 vols.  $\text{BF}_3$  gas to form a

liquid of 1.77 sp. gr. On boiling,  $\frac{1}{3}$  of the  $\text{BF}_3$  is given off, and a residue boiling at  $165\text{--}200^\circ$ , with composition  $\text{BF}_3 + 2\text{H}_2\text{O}$  or  $\text{HBO}_2 + 3\text{HF}$ , is left. (J. Davy, A. ch. 86. 178.)

1 cc.  $\text{H}_2\text{O}$  absorbs at  $0^\circ$  and 762 mm. pressure 1.057 cc.  $\text{BF}_3$ .

1 vol. conc.  $\text{H}_2\text{SO}_4$  of 1.85 sp. gr. absorbs 50 vols.  $\text{BF}_3$ .

Absorbed by alcohol with decomp.

Cold oil of turpentine absorbs 6.8% of  $\text{BF}_3$ .

**Boron fluoride ammonia,  $\text{BF}_3\text{,NH}_3$ ,  $\text{BF}_3\text{,2NH}_3$ , and  $\text{BF}_3\text{,3NH}_3$** 

Decomp. by  $\text{H}_2\text{O}$ .

**Boron fluoride cyanhydric acid,  $\text{BF}_3\text{,HCN}$** 

Very unstable. (Pateau, C. R. 113. 85.)

**Boron fluoride phosphine,  $2\text{BF}_3\text{,PH}_3$** 

Very unstable at ordinary temp. Decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 110. 80.)

**Boron hydride,  $\text{BH}_3$** 

Not obtained free from  $\text{H}$ . Sol. in  $\text{H}_2\text{O}$ . (Jones, Chem. Soc. 35. 41.)

See Cyclohexaborene.

$\text{B}_2\text{H}_{10}$ . B.-pt.  $16\text{--}17^\circ$  at 760 mm.

Very unstable. Takes fire spontaneously in the air.

Decomp. by  $\text{H}_2\text{O}$ , dil.  $\text{HCl}$ , and oxidized by conc.  $\text{HNO}_3$  with explosive violence.

Absorbed by  $\text{NaOH} + \text{Aq}$ .

Decomp. by alcohol. Sol. in dry benzene. (Stock, B. 1912, 45. 3562.)

$\text{B}_2\text{H}_{12}$ . B.-pt.  $100^\circ$  at atmospheric pressure.

Decomp. by  $\text{H}_2\text{O}$ . With aqueous alkalis, hydrogen is evolved. (Stock, B. 1912, 45. 3565.)

$\text{B}_2\text{H}_6$ . Insol. in  $\text{HCl}$ . Sol. in aqua regia and  $\text{Br}_2 + \text{Aq}$ . (Winkler, B. 1890, 23. 778.)

$\text{B}_{10}\text{H}_{14}$ . M.-pt.  $99.5^\circ$ ; not attacked by cold or boiling  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NaOH} + \text{Aq}$ . Sol. in alcohol, ether, benzene, and  $\text{CS}_2$ . (Stock, B. 1913, 46. 3360.)

**Boron iodide,  $\text{BI}_3$** 

Very hygroscopic, and instantly decomp. by  $\text{H}_2\text{O}$  or alcohol. Very sol. in  $\text{CS}_2$ ,  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_6$ , less sol. in  $\text{PCl}_3$ ,  $\text{AsCl}_3$ , and a great many organic liquids. (Moissan, C. R. 112. 717.)

**Boron iodide ammonia,  $\text{BI}_3\text{,5NH}_3$** 

Decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 114. 542.)

**Boron iodophosphide,  $\text{BI}_3\text{P}$** 

Very hygroscopic; decomp. by  $\text{H}_2\text{O}$ . Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ , even if fuming, but on heating decomposition takes place. Very sl. sol. in  $\text{CS}_2$ . Insol. in benzene,  $\text{PCl}_3$ , or  $\text{CCl}_4$ . (Moissan, C. R. 113. 624.)

$\text{BIP}$ . Less hygroscopic than  $\text{BI}_3\text{P}$ , but otherwise the properties are similar. (Moissan.)

**Boron nitride, BN.**

Insol in  $H_2O$ , conc  $HNO_3$ , conc.  $HCl$  +  $Aq$ , or conc. solutions of alkalis.  
Decomp by hot conc  $H_2SO_4$  or  $HF$ .  
(Wohler, A 74. 70.)

**Boron trioxide,  $B_2O_3$ .**

Deliquescent. Sol. in  $H_2O$  with a large increase in temp (Ditte, C R. 85. 1069)

1 pt dissolves—

at 18.75°	in 47.01 pts.	$H_2O$ .
" 25°	" 27.75 "	"
" 37.5°	" 18.73 "	"
" 50°	" 15.13 "	"
" 62.5°	" 9.29 "	"
" 75°	" 7.28 "	"
" 87.5°	" 5.58 "	"
" 100°	" 4.74 "	"

Or 100 pts.  $H_2O$  dissolve—

at 18.75°	2.13 pts.	$B_2O_3$
" 25°	3.60 "	"
" 37.5°	4.24 "	"
" 50°	6.61 "	"
" 62.5°	10.76 "	"
" 75°	13.73 "	"
" 87.5°	17.92 "	"
" 100°	21.09 "	"

(Brandes and Firnhaber, Arch. Pharm. 7. 50)

1 litre  $H_2O$  dissolves—

at 0°	11.00 g	$B_2O_3$ .
" 12°	16.50 "	"
" 20°	22.49 "	"
" 40°	39.50 "	"
" 62°	64.50 "	"
" 80°	95.00 "	"
" 102°	164.50 "	"

(Ditte, C. R. 85. 1069)

Sat.  $H_2O$  solution boils at 100° (Brandes and Firnhaber.)

Sat  $H_2O$  solution boils at 103.3° (Griffiths, Quar J. Sci 18. 90.)

Sol. in acetic acid, hot conc  $HCl$  +  $Aq$ ,  $HNO_3$ , and  $H_2SO_4$ . From the three latter it separates on cooling or dilution with  $H_2O$ .

Solubility in  $Na_2O$  +  $Aq$  at 30°.

See Borates, sodium.

Solubility in  $K_2O$  +  $Aq$  at 30°.

See Borates, potassium.

Insol in hot glacial acetic acid. (Holt, Chem. Soc 1911, 100. (2) 720.)

Insol in alcohol (Graham.)

Sol. in alcohol (Berzelius, Ebelmen.)

Sol. in oils.

See also Boric acid.

**Boron trioxide potassium fluoride,  $B_2O_3, 2KF$ .**

Gradually sol in  $H_2O$  Decomp. by much  $H_2O$ . Insol. in alcohol. (Schiff and Sestini, A. 228. 82)

**Boron oxychloride,  $BOCl_3$ .**

(Gustavson, Zeit Chem. 1870. 521.)

$BOCl_3$ . Slowly decomp. by  $H_2O$ . (Coulcler, J. pr (2) 18. 399.)

Oxychlorides of either the above formulae do not exist, the true formula for boron oxychloride is  $B_2O_3Cl_2$ . (Lorenz, A. 247. 226.)

**Boron phosphide,  $BP$ .**

Insol in  $H_2O$ . Sol. in conc. boiling alkalis +  $Aq$  with decomp. Decomp. by  $HNO_3$  +  $Aq$  (Besson, C. R 113. 78)

Insol. in  $PCl_3$ ,  $AsCl_3$ ,  $SbCl_3$ ,  $CCl_4$ , and in fact in all known solvents.

Not attacked by boiling  $H_2O$ , conc.  $HCl$ , or  $HI$  +  $Aq$ . Sol. in conc.  $HNO_3$  with decomp. on heating. Not attacked by cold  $H_2SO_4$ . (Moissan, C. R 113. 726)

$B_2P_3$ . Not attacked by boiling conc.  $HNO_3$  +  $Aq$ . Insol. in all solvents. (Moissan)

**Boron phosphoriodide.**

See Boron iodophosphide.

**Boron selenide,  $B_2Se_3$ .**

Violently decomp by  $H_2O$ . (Sabatier, C. R 112. 1000)

**Boron trisulphide,  $B_2S_3$ .**

Decomp with violence with  $H_2O$ . Combines with alcohol and ether. (Fremy, A. ch (3) 38. 312.)

Insol. in most solvents, but sl. sol. in  $PCl_3$  without decomp.; more sol. in  $SCl_2$ , but does not crystallize from the solution. (Moissan, C. R. 115. 203)

**Boron trisulphide ammonia,  $B_2S_3, 6NH_3$** 

Ppt (Stock, B 1901, 34. 3042.)

**Boron pentasulphide,  $B_2S_5$ .**

Decomp. by  $H_2O$  and alcohol. (Moissan, C. R. 115. 271)

**Borosulphuric acid,  $BOHSO_4 + SO_3$** 

Decomp. by  $H_2O$ . (Schultz-Sellac, B. 4. 12.)

$B(HSO_4)_3$ . Very deliquescent. Easily sol. in fuming  $H_2SO_4$  (D'Arcy, Chem Soc. 55. 155)

$SO_3(O,BO)_2$ . Hygroscopic. Deliquescent. Sol. in  $H_2O$  with decomp. Decomp. by cold alcohols. (Pictet, Bull. Soc 1908, (4) 3. 1121.)

$(SO_3)_2B_2O_3$ . Hygroscopic. Deliquescent. Sol. in  $H_2O$  with decomp. Decomp. by cold alcohols (Pictet, Bull. Soc. 1908, (4) 3. 1121.)

**Boronotungstic acid,  $H_4B_2W_6O_{12} + 22H_2O = 9WO_3, B_2O_3, 2H_2O + 22H_2O$ .**

Sol. in less than  $\frac{1}{2}$  pt.  $H_2O$ , and as easily sol. in alcohol and ether. Sp. gr. of aqueous solution is somewhat under 3. (Klein, A. ch. (5) 28. 370.)

**Aluminum boronotungstate,  $Al_4(B_2W_6O_{12})_3 + 66H_2O$ .**

Extremely sol. in  $H_2O$ . (Klein.)

**Ammonium —,  $(NH_4)_4B_2W_6O_{12} + 18H_2O$ .**

Quickly effloresces. (Klein.)

**Barium boronotungstate**,  $\text{Ba}_2\text{B}_2\text{W}_9\text{O}_{32} + 19\text{H}_2\text{O}$ .

Sol. in 4 pts. cold, and less than  $\frac{1}{2}$  pt. hot  $\text{H}_2\text{O}$ . (Klein.)

**Cadmium** —,  $\text{Cd}_2\text{B}_2\text{W}_9\text{O}_{32} + 18\text{H}_2\text{O}$

Deliquescent

100 pts. of salt dissolve in less than 8 pts.  $\text{H}_2\text{O}$  at  $19^\circ$ . Sp. gr. of solution is 3.28. (Klein.)

Sp. gr. of sat. solution at  $15.6^\circ/4^\circ = 3.2887$ , at  $16.2^\circ/4^\circ = 3.2868$  (Kahlbaum, Z. anorg. 1902, 29. 229.)

**Calcium** —,  $\text{Ca}_2\text{B}_2\text{W}_9\text{O}_{32} + 15\text{H}_2\text{O}$ .

Sol. in  $\frac{1}{10}$  pt.  $\text{H}_2\text{O}$ . Solution has sp. gr. = 3.10. (Klein.)

**Cerium** —,  $\text{Ce}_2(\text{B}_2\text{W}_9\text{O}_{32})_2 + 57\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ , sp. gr. of solution is over 3

**Chromium** —,  $\text{Cr}_2(\text{B}_2\text{W}_9\text{O}_{32})_2 + 74\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sp. gr. of solution is 2.80 (Klein.)

**Cobalt** —,  $\text{Co}_2\text{B}_2\text{W}_9\text{O}_{32} + 18\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ , sp. gr. of solution sat. at  $19^\circ = 3.30$ . (Klein.)

100 pts.  $\text{H}_2\text{O}$  dissolve 306.8 pts. anhydrous salt at  $16.2^\circ$ ; 288 pts. at  $18.5^\circ$ ; 299.7 pts. at  $19.6^\circ$ ; 286 pts. at  $21.8^\circ$

Sp. gr. of solution sat. at  $19.2^\circ/4^\circ = 3.1369$  (Kahlbaum, Z. anorg. 1902, 29. 218.)

**Copper** —,  $\text{Cu}_2\text{B}_2\text{W}_9\text{O}_{32} + 19\text{H}_2\text{O}$ .

25 pts.  $\text{H}_2\text{O}$  dissolve 100 pts. salt. Sp. gr. of solution = 2.6. (Klein.)

**Lead** —,  $\text{Pb}_2\text{B}_2\text{W}_9\text{O}_{32} + 11\text{H}_2\text{O}$ .

Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$  (Klein.)

**Lithium** —, (?)

Very sol. in  $\text{H}_2\text{O}$ . Sp. gr. of solution is about 3.

**Magnesium** —,  $\text{Mg}_2\text{B}_2\text{W}_9\text{O}_{32} + 22\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Klein.)

**Manganous** —,  $\text{Mn}_2\text{B}_2\text{W}_9\text{O}_{32} + 17\text{H}_2\text{O}$

100 pts. dissolve in 13 pts.  $\text{H}_2\text{O}$ . Sp. gr. of solution at  $19^\circ = 3.15$ . (Klein.)

**Mercurous** —,  $3\text{Hg}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $9\text{WO}_3 + 14\text{H}_2\text{O}$  (?).

Precipitate

Insol. in  $\text{H}_2\text{O}$ . (Klein.)

Sol. in 20,000 pts. dil. cold, and 1000 pts. boiling  $\text{HNO}_3$  + Aq. of 1.42 sp. gr.

**Nickel** —,  $\text{Ni}_2\text{B}_2\text{W}_9\text{O}_{32} + 18\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ ; sp. gr. of sat. solution at  $19^\circ = 3.32$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 261.6 pts. at  $21.2^\circ$ . Sp. gr.  $15.75^\circ/4^\circ$  of solution = 2.2959. (Kahlbaum, Z. anorg. 1902, 29. 218.)

**Potassium boronotungstate**,  $\text{K}_2\text{B}_2\text{W}_9\text{O}_{32} + 13\text{H}_2\text{O}$ .

5 pts. salt dissolve in 8 pts.  $\text{H}_2\text{O}$  at  $19^\circ$  to form a solution of 1.38 sp. gr. The solution sat. at  $100^\circ$  has sp. gr. of over 2. (Klein.)

**Silver** —,  $\text{Ag}_2\text{B}_2\text{W}_9\text{O}_{32} + 14\text{H}_2\text{O}$

Very sl. sol. in  $\text{H}_2\text{O}$ .

**Sodium** —,  $\text{Na}_2\text{H}_2\text{B}_2\text{W}_9\text{O}_{32} + 23\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ . Solution sat. at  $19^\circ$  contains 84 pts. salt to 16 pts.  $\text{H}_2\text{O}$ . (Klein.)

$\text{Na}_2\text{B}_2\text{W}_9\text{O}_{32} + 12\text{H}_2\text{O}$  Sol. in less than  $\frac{1}{2}$  pt.  $\text{H}_2\text{O}$ .

**Thallium** —,  $\text{Tl}_2\text{B}_2\text{W}_9\text{O}_{32} + 5\text{H}_2\text{O}$

Sl. sol. in hot  $\text{H}_2\text{O}$  and nearly insol. in cold  $\text{H}_2\text{O}$ . (Klein.)

**Uranyl** —,  $(\text{UO}_2)_2(\text{B}_2\text{W}_9\text{O}_{32})_2 + 30\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  (Klein.)

Sp. gr. of solution = 3.1

**Zinc** —,  $\text{Zn}_2\text{B}_2\text{W}_9\text{O}_{32} + 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Sp. gr. of solution = 3.15. (Klein.)

**Borodecitungstic acid**.

**Barium borodecitungstate**,  $\text{Ba}_2\text{B}_2\text{W}_{10}\text{O}_{32} + 20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Klein, C. R. 99. 35.)

**Boroduodecitungstic acid**,  $\text{H}_2\text{B}_2\text{W}_{12}\text{O}_{41} = 4\text{H}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $12\text{WO}_3$

Known only in solution, which decomposes into boronotungstic acid and tungstic acid, when evaporated to a certain concentration (Klein, C. R. 99. 35.)

**Barium potassium boroduodecitungstate**,  $3\text{BaO}$ ,  $\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $12\text{WO}_3 + 28\text{H}_2\text{O}$ .

**Potassium** —,  $\text{K}_2\text{B}_2\text{W}_{12}\text{O}_{41} + 21\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  (Klein.)

$2\text{K}_2\text{O}$ ,  $12\text{WO}_3$ ,  $\text{B}_2\text{O}_3 + 18\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Klein.)

**Boroquatordecitungstic acid**,  $\text{H}_{12}\text{B}_2\text{W}_{14}\text{O}_{51} = 6\text{H}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3$ .

Has not been obtained in the free state. (Klein, A. ch. (5) 28. 353.)

**Barium boroquatordecitungstate**,  $\text{Ba}_2\text{B}_2\text{W}_{14}\text{O}_{51} = 3\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3 + 5\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Klein.)

**Barium sodium** —,  $3\frac{1}{2}\text{BaO}$ ,  $1\frac{1}{2}\text{Na}_2\text{O}$ ,  $5\text{H}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3 + 29\text{H}_2\text{O}$

**Potassium** —,  $3\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3 + 22\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Klein.)

**Silver** —,  $\text{Ag}_2\text{H}_2\text{B}_2\text{W}_{14}\text{O}_{51} + 7\text{H}_2\text{O}$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . (Klein.)

**Sodium** —,  $\text{Na}_2\text{H}_2\text{B}_2\text{W}_{14}\text{O}_{51} + 29\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Klein.)

Sodium strontium boroguanthiooctungstic acid,  $3\frac{1}{2}\text{SrO}$ ,  $1\frac{1}{4}\text{Na}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3 + 29\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Klein)

**Boroundegintitungstic acid.**

Barium boroundegintitungstic acid,  $4\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $19\text{WO}_3 + 30\text{H}_2\text{O}$

Can be cryst from  $\text{H}_2\text{O}$ . (Ebenhusen, Dissert 1905.)

Boroguanthioetrigintitungstic acid,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 66\text{H}_2\text{O}$ .

Deliquescent. Somewhat more sol. in  $\text{H}_2\text{O}$  than  $\text{B}_2\text{O}_3$ ,  $28\text{WO}_3 + 62\text{H}_2\text{O}$ . Also more stable (Copaux, C R 1908, 147. 975.)

Barium boroguanthioetrigintitungstic acid,  $5\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 54\text{H}_2\text{O}$

100 pts.  $\text{H}_2\text{O}$  dissolve 50 pts. salt. (Copaux, A. ch. 1909, (8) 17. 217.)

$6\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 58\text{H}_2\text{O}$  (Copaux, l. c.)

Cadmium —,  $5\text{CdO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 51\text{H}_2\text{O}$

Extremely sol. in  $\text{H}_2\text{O}$ . (Copaux, l. c.)

Calcium —,  $5\text{CaO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 44\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Copaux, l. c.)

Lithium —,  $15\text{Li}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 38\text{H}_2\text{O}$ . (Copaux, l. c.)

Magnesium —,  $5\text{MgO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 42\text{H}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$ . (Copaux, l. c.)

Mercurous —,  $9\text{Hg}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 25\text{H}_2\text{O}$ .

(Copaux, l. c.)

Potassium —,  $5\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 36\text{H}_2\text{O}$ .

(Copaux, l. c.)

Sodium —,  $5\text{Na}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 5\text{H}_2\text{O}$ . As  $\text{NH}_4$  salt. (Copaux, l. c.)

**Boroguanthioetrigintitungstic acid.**

Potassium boroguanthioetrigintitungstic acid,  $5\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $25\text{WO}_3 + 34\text{H}_2\text{O}$ . (Ebenhusen, Dissert. 1905.)

Boroduodetrigintitungstic acid,  $\text{B}_2\text{O}_3$ ,  $28\text{WO}_3 + 62\text{H}_2\text{O}$ .

Decomp in boiling aqueous solution. (Copaux, C. R. 1908, 147. 975.)

Potassium boroduodetrigintitungstic acid,  $6\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $28\text{WO}_3 + 42\text{H}_2\text{O}$ .

Decomp. by boiling alkalies. (Copaux, A. ch. 1909 (8) 17. 217.)

**Borovanadic acid.**

Sol. in  $\text{H}_2\text{O}$ . Easily decomp. (Guyard, Bull. Soc. (2) 25. 354.)

**Metabromantimonic acid**,  $\text{HSbBr}_3 + 3\text{H}_2\text{O}$ .

Very hygroscopic. Loses  $\text{Br}_2$  in the air. Decomp. by  $\text{H}_2\text{O}$  with separation of antimonic acid. (Weinland, B. 1903, 36. 256.)

**Ammonium metabromantimonate**,  $\text{NH}_4\text{SbBr}_6 + \text{H}_2\text{O}$ .

Loses  $\text{Br}_2$  in the air. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Iron (ferric) metabromantimonate**,  $\text{Fe}(\text{SbBr}_6)_3 + 14\text{H}_2\text{O}$ .

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Lithium metabromantimonate**,  $\text{LiSbBr}_6 + 4\text{H}_2\text{O}$

Very hygroscopic. Loses  $\text{Br}_2$  in the air. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Nickel metabromantimonate**,  $\text{Ni}(\text{SbBr}_6)_2 + 12\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Potassium metabromantimonate**,  $\text{KSbBr}_6 + \text{H}_2\text{O}$ .

Loses  $\text{Br}_2$  in the air. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Bromarsenious acid.**

See Arsenyl bromide.

**Bromauric acid**,  $\text{HAuBr}_4 + 3\text{H}_2\text{O}$ .

(Lengfeld, Am. Ch. J. 1901, 26. 329.)

+  $5\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Thomsen, J. pr. (2) 13. 337.)

+  $6\text{H}_2\text{O}$ . Sol. in ether and  $\text{CHCl}_3$  without decomp. (Lengfeld, Am. Ch. J. 1901, 26. 329.)

**Ammonium bromaurate**,  $\text{NH}_4\text{AuBr}_4$ .

Ppt. (Guthrie, Z. anorg. 1914, 85. 358.)

**Barium bromaurate.**

Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff, Pogg. 17. 261.)

**Cæsium bromaurate**,  $\text{CsAuBr}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$  or alcohol. Insol. in ether. (Wells and Wheeler, Sill. Am. J. 144. 157.)

Ppt. (Guthrie, Z. anorg. 1914, 85. 360.)

**Cerium bromaurate**,  $\text{CeAuBr}_6 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Jolin, Bull. Soc. (2) 21. 533.)

**Didymium bromaurate**,  $\text{DiAuBr}_6 + 9\text{H}_2\text{O}$ .

Very deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Lanthanum bromaurate**,  $\text{LaAuBr}_6 + 9\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Cleve)

**Magnesium bromaurate.**

Deliquescent in moist air. (v. Bonsdorff)

**Manganese bromaurate.**

Deliquescent. (v. Bonsdorff.)

**Potassium bromaurate,  $\text{KAuBr}_4$** 

Sl sol in  $\text{H}_2\text{O}$ . More sol in cold alcohol than in  $\text{H}_2\text{O}$  (v Bonsdorff)

+  $2\text{H}_2\text{O}$  Sol in 5.12 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , 1.56 pts at  $40^\circ$ , and 0.48 pt at  $67^\circ$ . Decomp by ether. Sl sol in  $\text{KBr} + \text{Aq.}$  (Schottlander, A 217, 314.)

+  $5\text{H}_2\text{O}$  Efflorescent (v Bonsdorff)

**Rubidium bromaurate,  $\text{RbAuBr}_4$** 

As caesium bromaurate

Ppt (Guthrie, Z anorg. 1914, 85, 359.)

**Samarium bromaurate,  $\text{SmAuBr}_4 + 10\text{H}_2\text{O}$** 

Very deliquescent. (Clevé, Bull. Soc. (2) 43, 165.)

**Sodium bromaurate,  $\text{NaAuBr}_4$** 

Slowly sol. in  $\text{H}_2\text{O}$  (v Bonsdorff)

**Zinc bromaurate,  $\text{Zn}(\text{AuBr}_4)_2$** 

Very deliquescent. (v. Bonsdorff)

**Bromauric acid.**

Not known in free state.

**Barium bromauricyanide,  $\text{Ba}[\text{Au}(\text{CN})_2\text{Br}]_2 + 10\text{H}_2\text{O}$** 

Very sol. in hot or cold  $\text{H}_2\text{O}$ , also in alcohol (Lindbom, Lund Univ Arkiv 12, No 6)

**Cadmium bromauricyanide,  $\text{Cd}[\text{Au}(\text{CN})_2\text{Br}]_2 + 6\text{H}_2\text{O}$** 

Very sol. in hot or cold  $\text{H}_2\text{O}$ , but solution is unstable (Lindbom)

**Calcium bromauricyanide,  $\text{Ca}[\text{Au}(\text{CN})_2\text{Br}]_2 + 10\text{H}_2\text{O}$** 

Extremely sol. in  $\text{H}_2\text{O}$  and alcohol (Lindbom.)

**Cobalt bromauricyanide,  $\text{Co}[\text{Au}(\text{CN})_2\text{Br}]_2 + 9\text{H}_2\text{O}$** 

Moderately sol. in  $\text{H}_2\text{O}$ . Less sol than other bromauricyanides. (Lindbom)

**Potassium bromauricyanide,  $\text{KAu}(\text{CN})_2\text{Br}_2 + 3\text{H}_2\text{O}$** 

Sol. in  $\text{H}_2\text{O}$  and alcohol

**Sodium bromauricyanide,  $\text{NaAu}(\text{CN})_2\text{Br}_2 + 2\text{H}_2\text{O}$** 

Very sol. in  $\text{H}_2\text{O}$  or alcohol

**Strontium bromauricyanide,  $\text{Sr}[\text{Au}(\text{CN})_2\text{Br}]_2 + x\text{H}_2\text{O}$** 

Very sol. in  $\text{H}_2\text{O}$  or alcohol

**Zinc bromauricyanide,  $\text{Zn}[\text{Au}(\text{CN})_2\text{Br}]_2 + 8\text{H}_2\text{O}$** 

Easily sol. in cold or hot  $\text{H}_2\text{O}$ .

**Bromhydric acid,  $\text{HBr}$ .**

Very sol. in  $\text{H}_2\text{O}$ .

The most concentrated  $\text{HBr} + \text{Aq}$  has a sp. gr. of 1.78, and contains 82.02%  $\text{HBr}$  (Champion and Pellat, C. R. 70, 620) This, or a weak acid on heating leaves a residue, which

distils unchanged at  $125-125.5^\circ$  under 785 mm. pressure, and contains 48.17%  $\text{HBr}$  (Topsoe); at  $126^\circ$  under 758 mm. pressure, and contains 46.83%  $\text{HBr}$  (Bineau), and has sp. gr. = 1.486 at  $20^\circ$  (Bineau), sp. gr. = 1.48 at  $20^\circ$  (Champion and Pellat), sp. gr. = 1.49 at  $20^\circ$  (Topsoe).

According to Roscoe (A. 116, 214) an acid of constant composition, obtained by boiling a stronger or weaker acid, if distilled under 752-763 mm pressure, contains 47.38-47.86%  $\text{HBr}$ , and boils at  $126^\circ$  at 760 mm. pressure, but the composition is dependent on the pressure, as, for example, under 1952 mm pressure, the residue boils at  $153^\circ$ , and contains 46.3%  $\text{HBr}$ . (Roscoe)

By conducting dry air through  $\text{HBr} + \text{Aq}$  an acid is obtained containing 51.65%  $\text{HBr}$  if at  $16^\circ$ , and 49.35%  $\text{HBr}$  if at  $100^\circ$  (Roscoe).

1 vol  $\text{H}_2\text{O}$  dissolves 600 vols  $\text{HBr}$  at  $10^\circ$ . (Berthelot, C. R. 76, 679)

1 pt  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm pressure dissolves pts  $\text{HBr}$

$t^\circ$	Pts $\text{HBr}$	$t^\circ$	Pts $\text{HBr}$	$t^\circ$	Pts $\text{HBr}$
-25	2 550	-5	2 280	+50	1 715
-20	2 473	0	2 212	+75	1 503
-15	2 390	+10	2 103	+100	1 300
-10	2 335	+25	1 930		

(Roozeboom, R. t. c. 4, 107)

Absorption by 1 pt.  $\text{H}_2\text{O}$  at  $t^\circ$  and p pressure in mm

$t^\circ = -25^\circ$

p	Pts $\text{HBr}$	p	Pts $\text{HBr}$
760	2 550	100	2 056
300	2 263	1	1 755
140	2 120	0.5	1 110

$t^\circ = -20^\circ$

p	Pts $\text{HBr}$	p	Pts $\text{HBr}$
760	2 473	130	2 056
375	2 267	20	1 850
180	2 119		

$t^\circ = -15^\circ$

p	Pts $\text{HBr}$	p	Pts $\text{HBr}$
760	2 390	175	2 056
470	2 266	102	1 980
250	2 119		

$t^\circ = -11.3^\circ$

p	Pts $\text{HBr}$	p	Pts $\text{HBr}$
760	2 350	310	2 118
570	2 265	216	2 055

$t^{\circ} = -5^{\circ}$			
p	Pts HBr	p	Pts HBr
760	2 280	430	2 117
730	2 264	298	2 055

$t^{\circ} = 0^{\circ}$			
p	Pts HBr	p	Pts HBr
760	2 212	350	2.054
540	2 116	5	1 085

(Roozeboom, R t c 4. 107)

Sp. gr. of HBr + Aq.

Sp. gr.	% HBr	Temp	Sp. gr.	% HBr	Temp
1.055	7 67	14°	1.335	36.67	13°
1.075	10 19	14°	1.349	37 86	13°
1.089	11 94	14°	1.368	39 13	13°
1.097	12 96	14°	1.419	43 12	13°
1.118	15 37	14°	1.431	43 99	13°
1.131	16 92	14°	1.438	44 62	13°
1.164	20 65	14°	1.451	45.45	14°
1.200	24 35	13°	1.460	46 09	13°
1.232	27 62	13°	1.485	47 87	14°
1.253	29 68	13°	1.490	48 17	14°
1.302	33 84	13°			

(Topsoe, B 3. 404.)

Sp. gr. of HBr + Aq at 14°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
1	1.007	18	1.140	35	1.314
2	1.014	19	1.149	36	1.326
3	1.021	20	1.158	37	1.338
4	1.028	21	1.167	38	1.351
5	1.035	22	1.176	39	1.363
6	1.043	23	1.186	40	1.376
7	1.050	24	1.196	41	1.389
8	1.058	25	1.206	42	1.403
9	1.065	26	1.215	43	1.417
10	1.073	27	1.225	44	1.431
11	1.081	28	1.235	45	1.445
12	1.089	29	1.246	46	1.459
13	1.097	30	1.257	47	1.473
14	1.106	31	1.268	48	1.487
15	1.114	32	1.279	49	1.502
16	1.122	33	1.290		
17	1.131	34	1.302		

(Topsoe, calculated by Gerlach, Z. anal 27. 316.)

Sp. gr. of HBr + Aq at 15°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
5	1.038	25	1.204	45	1.435
10	1.077	30	1.252	50	1.515
15	1.177	35	1.305		
20	1.159	40	1.365		

Only a "moderate degree of accuracy" is claimed for this table. (Wright, C N 23. 242)

Sp. gr. of HBr + Aq at 15°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
1	1.0082	18	1.145	35	1.314
2	1.0155	19	1.154	36	1.326
3	1.0230	20	1.163	37	1.338
4	1.0305	21	1.172	38	1.350
5	1.038	22	1.181	39	1.362
6	1.046	23	1.190	40	1.375
7	1.053	24	1.200	41	1.388
8	1.061	25	1.209	42	1.401
9	1.069	26	1.219	43	1.415
10	1.077	27	1.229	44	1.429
11	1.085	28	1.239	45	1.444
12	1.093	29	1.249	46	1.459
13	1.102	30	1.260	47	1.474
14	1.110	31	1.270	48	1.490
15	1.119	32	1.281	49	1.496
16	1.127	33	1.292	50	1.513
17	1.136	34	1.303		

(Biel, C. C 1882. 148.)

Absorbed by alcohol with formation of  $C_2H_5Br$ 

The composition of the hydrates formed by HBr at different dilutions is calculated from determinations of the lowering of the fr. pt produced by HBr and of the conductivity and sp. gr. of HBr + Aq. (Jones, Am. Ch J 1905, 34 326)

+  $H_2O$ . (Roozeboom, R t c. 5. 363)+  $2H_2O$  (Berthelot, A ch (5) 14. 369.)

(Pickering Chem. Soc 1894, 64 (2) 232)

Mpt  $-11.2^{\circ}$ . (Pickering, l c.)+  $3H_2O$ . Mpt.  $-48^{\circ}$ . (Pickering.)+  $4H_2O$ . Mpt  $-55^{\circ}$ . (Pickering)+  $5H_2O$ . (Pickering)**Bromhydric cyanhydric acid,  $3HBr$ ,  $2HCN$ .**Decomp by  $H_2O$  and alcohol.

Insol. in ether (Gautier, A ch (4) 17. 141.)

**Bromic acid,  $HBrO_3$** 

Known only in aqueous solution

Solution evaporated on water bath decomposes when it contains 4.26%  $HBrO_3$ . In vacuo, an acid containing 50.59%  $HBrO_3$  corresponding to formula  $HBrO_3 + 7H_2O$  can be obtained.Not decomp. by dil.  $HNO_3$  or  $H_2SO_4 + Aq$ . Conc  $H_2SO_4$  decomposesAlcohol and ether are quickly oxidized by  $HBrO_3$ .**Bromates.**Most of the bromates are very sol. in  $H_2O$ , a few are sl sol, but none are insol., the least sol. being  $AgBrO_3$  and  $Hg_2(BrO_3)_2$ .**Aluminum bromate,  $Al(BrO_3)_3$ .**

Deliquescent (Rammelsberg, Pogg. 55. 63.)

+  $9H_2O$ . Mpt  $62.3^{\circ}$  Less hygroscopic

than  $\text{Al}(\text{ClO}_2)_3$ . (Dobrosserdow, C. C. 1907. I, 1723.)

**Ammonium bromate,  $\text{NH}_4\text{BrO}_3$ .**

Decomposes spontaneously; sol in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 52. 85.)

**Barium bromate,  $\text{Ba}(\text{BrO}_3)_2$ .**

Solubility of  $\text{Ba}(\text{BrO}_3)_2$  in  $\text{H}_2\text{O}$ . 100 g. sat.  $\text{Ba}(\text{BrO}_3)_2 + \text{Aq}$  at  $t^\circ$  contain g anhydrous  $\text{Ba}(\text{BrO}_3)_2$ .

$t^\circ$	grams $\text{Ba}(\text{BrO}_3)_2$	$t^\circ$	grams $\text{Ba}(\text{BrO}_3)_2$
Eutectic point -0.034° = 0.002°	0.280	50°	1.72
0°	0.286	60°	2.271
+10°	0.439	70°	2.922
20°	0.652	80°	3.521
25°	0.788	90°	4.26
30°	0.95	98.7°	5.256
40°	1.31	*99.65°	5.39

\*99.65° is bpt. at 740 mm. = 100.39° at 760 mm.

(Anschutz, Z. phys. Ch. 1906, 56. 240.)

100 g. sat.  $\text{Ba}(\text{BrO}_3)_2 + \text{Aq}$  contain 0.793 g  $\text{Ba}(\text{BrO}_3)_2$  at 25°. Sp. gr. of the solution at 25°/4° = 1.0088 (Harkins J. Am. Chem. Soc. 1911, 33. 1815.)

Solubility of  $\text{Ba}(\text{BrO}_3)_2$  in salts + Aq at 25°. C = concentration of salt in salt + Aq in milliequivalents per l.

$d_1$  = sp. gr. at 25°/4° of salt + Aq.

S = solubility of  $\text{Ba}(\text{BrO}_3)_2$  in salt + Aq expressed in milliequivalents per l.

$d_2$  = sp. gr. at 25°/4° of  $\text{Ba}(\text{BrO}_3)_2 + \text{salt} + \text{Aq}$

Salt	C	$d_1$	S	$d_2$
None			40.15	1.0038
$\text{KNO}_3$	25.018	0.9985	43.86	1.0059
	50.032	1.0030	47.03	1.0081
	99.970	1.0083	52.13	1.0120
$\text{Ba}(\text{NO}_3)_2$	25.018	1.0003	36.77	1.0059
	50.039	1.0025	34.74	1.0083
	99.97	1.0073	32.63	1.0132
	199.95	1.0183	30.95	1.0233
$\text{KBrO}_3$	24.988	1.0001	26.53	1.0046
	49.971	1.0031	17.37	1.0062
	99.85	1.0093	8.76	1.0109
$\text{Mg}(\text{NO}_3)_2$	100.0		52.57	1.0114

(Harkins, J. Am. Chem. Soc. 1911, 33. 1815.)

+  $\text{H}_2\text{O}$ . Sol. in 130 pts. cold, and 24 pts. boiling  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 52. 81.)

Decomp. by  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$ .

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Bismuth bromate.**

Known only in solution, which decomp. on evaporation. (Rammelsberg, Pogg. 55. 76.)

**Cadmium bromate,  $\text{Cd}(\text{BrO}_3)_2 + \text{H}_2\text{O}$**

Sol. in 0.8 pt. cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 55. 74.)

+  $2\text{H}_2\text{O}$  (Topsoe, J. B. 1872, 164.)

**Cadmium bromate ammonia,  $\text{Cd}(\text{BrO}_3)_2 \cdot 3\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 55. 74.)

$\text{Cd}(\text{BrO}_3)_2 \cdot 4\text{NH}_3$ . Ppt. (Ephraim, B. 1915, 48. 51.)

**Calcium bromate,  $\text{Ca}(\text{BrO}_3)_2 + \text{H}_2\text{O}$ .**

Sol. in 1.1 pts. cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 52. 98.)

**Cerous bromate,  $\text{Ce}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$**

Easily sol. in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 55. 63.)

Mpt. 49°; very sol. in  $\text{H}_2\text{O}$  with decomp. (James, J. Am. Chem. Soc. 1909, 31. 914.)

**Cobaltous bromate,  $\text{Co}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$ .**

Sol. in 2.2 pts. cold  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rammelsberg, Pogg. 55. 71.)

**Cupric bromate, basic,  $6\text{CuO} \cdot \text{Br}_2\text{O}_3 + 10\text{H}_2\text{O}$ .**

Ppt. (Rammelsberg, Pogg. 55. 78.)

**Cupric bromate,  $\text{Cu}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 52. 92.)

**Cupric bromate ammonia,  $\text{Cu}(\text{BrO}_3)_2 \cdot 4\text{NH}_3$ .**

Completely sol. in a little  $\text{H}_2\text{O}$ , but decomp. by dilution.

Insol. in alcohol (Rammelsberg, Pogg. 52. 92.)

**Didymium bromate,  $\text{D}_1(\text{BrO}_3)_2 + 9\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  (Maignac.)

**Dysprosium bromate,  $\text{Dy}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$ .**

Mpt. 78°. Easily sol. in  $\text{H}_2\text{O}$ . Difficultly sol. in alcohol. (Jantsch, B. 1911, 44. 1275.)

**Erbium bromate,  $\text{Er}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$ .**

Very sol. in alcohol and  $\text{H}_2\text{O}$ .

**Glucinum bromate.**

Deliquescent.

**Iron (ferrous) bromate,  $\text{Fe}(\text{BrO}_3)_2$**

Sol. in  $\text{H}_2\text{O}$ , but solution decomp. very easily.

**Iron (ferric) bromate,  $5\text{Fe}_2\text{O}_3 \cdot \text{Br}_2\text{O}_3 + 30\text{H}_2\text{O}$**

Partially sol. in  $\text{H}_2\text{O}$ , with separation of a more basic salt. Sol. in  $\text{HBO}_3 + \text{Aq}$  (Rammelsberg, Pogg. 55. 68.)

**Lanthanum bromate,  $\text{La}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$ .**

Sol. in  $3\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at 15° (Maignac, Ann. Min. (5) 15. 274.)

Mpt. 37.5° in its water of crystallization 416 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at 25°. (James, J. Am. Chem. Soc. 1909, 31. 913.)

**Lead bromate, basic**,  $3\text{PbO}$ ,  $\text{Pb}(\text{BrO}_3)_2 + 2\text{H}_2\text{O}$

Ppt (Strömholm, Z anorg 1904, 38. 441)

**Lead bromate**,  $\text{Pb}(\text{BrO}_3)_2$ .

Sl. sol. in  $\text{H}_2\text{O}$   $13.37 \times 10^{-4}$  g. are contained in 1 liter of sat solution at  $20^\circ$  (Böttger, Z phys. Ch 1903, 46. 603)

+  $\text{H}_2\text{O}$ . Sol. in 75 pts cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 52. 96.)

**Lithium bromate**,  $\text{LiBrO}_3$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. A 55. 63)

Not deliquescent (Pohlitz, B. 23. 515 R.)

Sp. gr. of solution sat at  $18^\circ = 1.833$ , and contains 60.4%  $\text{LiBrO}_3$ . (Myhus, B 1897, 30. 1718.)

+  $\text{H}_2\text{O}$ . Not deliquescent. (Pohlitz, B.)

**Magnesium bromate**,  $\text{Mg}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$

Efflorescent. Sol in 1.4 pts cold  $\text{H}_2\text{O}$  at  $15^\circ$ . Melts in its water of crystallization when heated (Rammelsberg, Pogg. 52. 89.)

**Mercurous bromate, basic**,  $2\text{Hg}_2\text{O}$ ,  $\text{Bi}_2\text{O}_3$

Insol in warm  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg, Pogg. 55. 79.)

**Mercurous bromate**,  $\text{Hg}_2(\text{BrO}_3)_2$ .

Decomp by  $\text{H}_2\text{O}$  into basic salt. Difficultly sol in  $\text{HNO}_3 + \text{Aq}$ ; easily sol. in  $\text{HCl} + \text{Aq}$  (Rammelsberg.)

**Mercuric bromate, basic**,  $2\text{HgO}$ ,  $\text{Br}_2\text{O}_3 + \text{H}_2\text{O}$

Slowly decomp. by cold, quickly by hot  $\text{H}_2\text{O}$  into oxide and an acid salt.

Easily sol in dil. acids. (Topsoe, W. A. B. 66. 2. 2)

**Mercuric bromate**,  $\text{HgBrO}_3 + 2\text{H}_2\text{O}$ .

Sol in 650 pts. cold, and 64 pts. boiling  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Rammelsberg, Pogg. 55. 79.)

**Mercuric bromate ammonia**.

Sol with decomp in  $\text{HCl} + \text{Aq}$ . (Storer's Diet.)

**Neodymium bromate**,  $\text{Nd}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$ .

Mpt.  $66.7^\circ$ . 146 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ . (James, J. Am. Chem. Soc. 1909, 31. 915.)

**Nickel bromate**,  $\text{Ni}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$ .

Sol. in 3.58 pts. cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 55. 69)

**Nickel bromate ammonia**,  $\text{Ni}(\text{BrO}_3)_2, 2\text{NH}_3$ .

Sol in  $\text{H}_2\text{O}$ , with decomposition of the major portion. Insol. in alcohol. (Rammelsberg, l. c.)

$\text{Ni}(\text{BrO}_3)_2, 6\text{NH}_3$ . Ppt (Ephraim, B. 1915, 48. 50)

**Potassium bromate**,  $\text{KBrO}_3$

100 pts.  $\text{H}_2\text{O}$  dissolve 6.58 pts  $\text{KBrO}_3$  at  $15^\circ$  (Rammelsberg). 100 pts.  $\text{H}_2\text{O}$  dissolve 5.83 pts  $\text{KBrO}_3$  at  $17.1^\circ$  (Pohl W. A. B. 6.

595), at  $0^\circ$ , 3.11 pts.; at  $20^\circ$ , 6.92 pts., at  $40^\circ$ , 13.24 pts., at  $60^\circ$ , 22.76 pts.; at  $80^\circ$ , 33.90 pts., at  $100^\circ$  49.75 pts  $\text{KBrO}_3$ . Sat. solution boils at  $104^\circ$  (Kremers, Pogg. 97. 5.)

1 l.  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves 0.4715 moles  $\text{KBrO}_3$  (Geffcken, Z. phys. Ch 1904, 49. 296.)

1 l  $\text{H}_2\text{O}$  dissolves 0.478 mol  $\text{KBrO}_3$  at  $25^\circ$ . (Rothmund, Z. phys. Ch. 1909, 69. 539.)

Sp. gr. of  $\text{KBrO}_3 + \text{Aq}$  at  $19.5^\circ$ .

%KBrO <sub>3</sub> Sp. gr.	1	2	3	4	5
	1.009	1.016	1.024	1.031	1.039

%KBrO <sub>3</sub> Sp. gr.	6	7	8	9	10
	1.046	1.054	1.062	1.070	1.079

(Gerlach, Z. anal. 8. 290)

Solubility of  $\text{KBrO}_3$  in salts +  $\text{Aq}$  at  $25^\circ$

Salt	Moles of $\text{KBrO}_3$ sol in 1 liter of				
	3-N solution	N solution	2-N solution	3-N solution	4-N solution
$\text{NaNO}_3$	0.7545	0.6497	0.7680	0.9026	1.031
$\text{NaCl}$	0.5220	0.5616	0.6042	0.6244	0.640

(Geffcken, Z. phys. Ch. 1904, 49. 296)

Easily sol in liquid  $\text{HF}$ . (Franklin, Z. anorg. 1905, 46. 2)

Sl. sol in alcohol. (Rammelsberg)

Insol in absolute alcohol

Solubility in organic compds. +  $\text{Aq}$  at  $25^\circ$ .

Solvent	Mol $\text{KBrO}_3$ sol in 1 litre
Water	0.478
0.5-N Methyl alcohol	0.444
" Ethyl alcohol	0.421
" Propyl alcohol	0.409
" Tert. amyl alcohol	0.383
" Acetone	0.425
" Ether	0.395
" Formaldehyde	0.397
" Glycol	0.448
" Glycerine	0.451
" Mannitol	0.451
" Glucose	0.463
" Sucrose	0.431
" Urea	0.477
" Dimethyl pyrone	0.478
" Ammonia	0.445
" Diethylamine	0.384
" Pyridine	0.415
" Piperidine	0.396
" Urethane	0.433
" Formamide	0.473
" Acetamide	0.445
" Glyocoll	0.501
" Acetic acid	0.456
" Phenol	0.426
" Methylal	0.405
" Methyl acetate	0.420

(Rothmund, Z. phys. Ch. 1909, 69. 539.)

Insol. in acetone (Eidmann, C. C. 1899, II 1014, Naumann, B. 1904, 37, 4329)  
Insol. in ethyl acetate (Naumann, B. 1910, 43, 314)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790)

**Praseodymium bromate**,  $\text{Pr}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ .

Mpt. 56.5°. 190 pts. are sol. in 100 pts  $\text{H}_2\text{O}$  at 25°. (James, J. Am. Chem. Soc. 1909, 31, 914)

**Samarium bromate**,  $\text{Sm}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$

Mpt. 75° 114 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at 25°. Very sl. sol. in alcohol. (James, J. Am. Chem. Soc. 1909, 31, 915)

**Scandium bromate**.

(Crookes, Roy. Soc. Proc. 1906, 80, A, 518)

**Silver bromate**,  $\text{AgBrO}_3$ .

1 pt.  $\text{H}_2\text{O}$  dissolves 0.00810 pt.  $\text{AgBrO}_3$  at 24.5°. (Noyes, Z. phys. Ch. 6, 246.)

Sol in 595.3 pts  $\text{H}_2\text{O}$  at 25°  
Sol in 320.4 pts  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.21) at 25°

Sol in 22 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. 0.96) at 25° (Long, Gazz. ch. it. 13, 87.)

1 l  $\text{H}_2\text{O}$  dissolves 1.71 g  $\text{AgBrO}_3$  at 27° (Whitby, Z. anorg. 1910, 67, 108)

Sl. sol. in  $\text{H}_2\text{O}$  1.59 x  $10^{-4}$  g. are contained in 1 liter of sat. solution at 20° (Böttger, Z. phys. Ch. 1903, 46, 603)

Insol. in  $\text{HNO}_3$ . (Lowig.) Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$

**Silver bromate ammonia**,  $\text{AgBrO}_3 \cdot 2\text{NH}_3$

Decomp. in air or by  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 52, 94)

**Sodium bromate**,  $\text{NaBrO}_3$ .

Sol in 2.7 pts  $\text{H}_2\text{O}$  at 15°. (Rammelsberg)  
100 pts.  $\text{H}_2\text{O}$  dissolve at—  
0° 20° 40° 60° 80° 100°  
27.54 34.48 50.25 62.57 75.90 90.9 pts.  $\text{NaBrO}_3$ .  
(Kremers, Pogg. 94, 271.)

Easily forms supersaturated solutions  
Sat. solution boils at 109°. (Kremers)  
 $\text{NaBrO}_3 + \text{Aq}$  containing 10.10%  $\text{NaBrO}_3$  has sp. gr. 20°/20° = 1.0818  
 $\text{NaBrO}_3 + \text{Aq}$  containing 11.09%  $\text{NaBrO}_3$  has sp. gr. 20°/20° = 1.0900.  
(Le Blanc and Rohland, Z. phys. Ch. 1896 19, 278.)

Sp. gr. of  $\text{NaBrO}_3 + \text{Aq}$  at 19.5°

% $\text{NaBrO}_3$	5	10	15
Sp. gr.	1.041	1.083	1.129
% $\text{NaBrO}_3$	20	25	30
Sp. gr.	1.178	1.231	1.289

(Kremers, Pogg. 97, 5, calculated by Gerlach, Z. anal. 8, 290.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 829.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790)

Insol. in ethyl acetate (Naumann, B. 1910, 43, 314)

**Sodium bromate bromide**,  $3\text{NaBrO}_3, 2\text{NaBr} + 3\text{H}_2\text{O}$

Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Fitzsche.)

**Strontium bromate**,  $\text{Sr}(\text{BrO}_3)_2 \cdot \text{H}_2\text{O}$

Sol in 3 pts.  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 52, 84), less sol. in  $\text{H}_2\text{O}$  than  $\text{SrBr}_2 \cdot 6\text{H}_2\text{O}$ . (Lowig)

**Thallous bromate**,  $\text{TlBrO}_3$

Sl. sol. in hot  $\text{H}_2\text{O}$ , easily sol. in  $\text{HNO}_3 + \text{Aq}$  (Oettinger.)

Easily sol. in  $\text{H}_2\text{O}$  and dil. acids (Ditte, A. ch. (6) 21, 145)

**Terbium bromate**,  $\text{Tb}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ .

Not deliquescent. (Potratz, C. N. 1905, 92, 3.)

**Thallous bromate**,  $\text{TlBrO}_3$

1 l  $\text{H}_2\text{O}$  at 39.75° dissolves 2.216 x  $10^{-3}$  g. mol. (Noyes and Abbott, Z. phys. Ch. 1895, 16, 130)

Sl. sol. in  $\text{H}_2\text{O}$ . 3.46 x  $10^{-1}$  gram are contained in 1 liter of sat. solution at 20° (Böttger, Z. phys. Ch. 1903, 46, 608.)

**Thalic bromate**,  $\text{Ti}(\text{BrO}_3)_3 \cdot 3\text{H}_2\text{O}$

Very hygroscopic. Easily decomp. by  $\text{H}_2\text{O}$ . (Gewecke, Z. anorg. 1912, 75, 275)

**Thulium bromate**,  $\text{Tm}_2(\text{BrO}_3)_6 \cdot 18\text{H}_2\text{O}$

Pptd. from sat. aqueous solution by 95% alcohol

$\text{NH}_4\text{OH}$  is the best precipitant (James, J. Am. Chem. Soc. 1911, 33, 1342)

**Tin (stannous) bromate (?)**.

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ .

**Uranyl bromate**,  $4\text{UO}_2 \cdot 3\text{Br}_2\text{O}_3 + 16\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Yttrium bromate**,  $\text{Y}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$

More easily sol. in  $\text{H}_2\text{O}$  than  $\text{Y}(\text{IO}_3)_3$ . Sl. sol. in alcohol Insol. in ether. (Cleve.)

Mpt. 74°. 168 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at 25°

Sl. sol. in alcohol (James, J. Am. Chem. Soc. 1909, 31, 916.)

**Zinc bromate**,  $\text{Zn}(\text{BrO}_3)_2 \cdot 6\text{H}_2\text{O}$

Sol. in 1 pt cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 52, 90.)

**Zinc bromate ammonia**,  $\text{Zn}(\text{BrO}_3)_2 \cdot 2\text{NH}_3 + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg, Pogg. 52, 90)  
 $\text{Zn}(\text{BrO}_3)_2 \cdot 4\text{NH}_3$  Ppt. (Ephraim, B. 1915, 48, 51)

**Perbromic acid**.

See Perbromic acid.

**Bromides.**

Most bromides are sol in  $H_2O$ , many in alcohol, and some in ether.

$AgBr$  and  $Hg_2Br_2$  are insol. in  $H_2O$  or acids,  $PbBr_2$  and  $TlBr$  are sl. sol. therein.  $Cu_2Br_2$  is insol. in  $H_2O$ , sol in acids.

See under each element

**Bromine,  $Br_2$** 

1 pt.  $Br$  dissolves at  $15^\circ$  up 33 pts.  $H_2O$ . (Lowig, Pogg 14 485.)

1 pt  $Br$  dissolves at  $15^\circ$  in 31 pts  $H_2O$ . (Dancer, Chem Soc 15. 477.)

Solubility of  $Br$  in 100 pts.  $H_2O$  at  $t^\circ$

$t^\circ$	Pts Br.	$t^\circ$	Pts Br	$t^\circ$	Pts Br
5	3 600	15	3 226	25	3 167
10	3 327	20	3 208	30	3 126

(Dancer, l. c.)

A sat. aqueous solution of  $Br$  contains 4.05%  $Br$  at  $0^\circ$ ; 3.80%  $Br$  at  $3^\circ$ ; 3.33%  $Br$  at  $10^\circ$ . (Roozeboom, R. t e 3. 29, 59, 73, 84.)

1 l.  $H_2O$  dissolves 34 g.  $Br$  at  $25^\circ$ . (Jakowkin, Z phys. Ch. 1896, 20. 25.)

1 pt is sol in 30 pts  $H_2O$ . (Dietze, Chem Soc. 1899, 76 (2) 150.)

100 pts  $H_2O$  dissolve at:  
 $0^\circ$  10 34° 19 96° 30 17° 40 03° 49 85°  
 4 167 3 740 3 578 3 437 3 446 3 522  
 pts. bromine.

Liquid bromine as such is insol in  $H_2O$ ; only the vapor dissolves. (Winkler, Ch. Z 1899, 23. 688.)

1 l.  $H_2O$  dissolves 33.95 g  $Br_2$  at  $25^\circ$ . (Mc-Lauchlan, Z phys. Ch. 1903, 44. 617.)

Solubility of bromine vapor in  $H_2O$  at  $t^\circ$ .

$\alpha$  = coefficient of absorption

$t^\circ$	$\alpha$	$t^\circ$	$\alpha$
0	60.5	42	8.6
2	54.1	44	7.9
4	48.3	46	7.4
6	43.3	48	6.9
8	38.9	50	6.5
10	35.1	52	6.1
12	31.5	54	5.8
14	28.4	56	5.4
16	25.7	58	5.1
18	23.4	60	4.9
20	21.3	62	4.6
22	19.4	64	4.4
24	17.7	66	4.2
26	16.3	68	4.0
28	15.0	70	3.8
30	13.8	72	3.6
32	12.7	74	3.4
34	11.7	76	3.3
36	10.9	78	3.1
38	10.1	80	3.0
40	9.4		

(Winkler, Ch. Z. 1899, 23. 688.)

Solubility of bromine vapor.  
(Mean of many determinations)

Temp	Pressure	Absorption coefficient
0 0	56-13mm.	60 53
9 94°	80-16	35 22
20 46	138-9	20 87
30 38	179-12	18 65
40 31	229-26	9 22
50 25	274-53	6 50
60 04	314-46	4 84
69 98	154-54	3 82
80 22	396-74	2 94

Solubility of liquid bromine.  
(The mean of many determinations)

Temp	$0^\circ$	10.34°	19 96°	30 17°	40 03°	49 85°
Pts $H_2O$ that dissolve 1 pt. $Br_2$	24	0 26	74 27.94	29 10 29	02 28	38

Much less  $Br_2$  is sol in ice cold  $H_2O$  in the presence of bromine hydrate.

Solubility in presence of bromine hydrate.  
(The mean of many determinations)

Temp	$0^\circ$	$5 12^\circ$
Pts $H_2O$ that dissolve 1 pt. $Br_2$	42 39	26 26

(Winkler, Ch Z 1899, 23. 688-689.)

Solubility of  $Br_2$  in  $H_2O$  at  $25^\circ = 0.21$  mols. in 1 l. (Bray, J. Am. Chem. Soc. 1910, 32. 398.)

Sp. gr. of  $Br_2 + Aq$  containing pts.  $Br$  in 1000 pts. solution.

Pts $Br$	Sp gr.	Pts $Br$	Sp gr.
10 72	1.00901	18 74-19.06	1 01491
10 68	1.00631	19 52-20.09	1 01585
12 05	1.00695	20 89-21.55	1 01807
12.21	1.01223	31 02-31 69	1 02367

(Slessor, N. Edin Phil. J. 7. 237.)

Sp gr. of  $Br_2 + Aq$  at  $32.5^\circ$ .

% $Br_2$ by weight	Sp. gr.
0 7214	0.999814
1.1172	1.002520
1.6448	1.006100
1.9856	1.008870
2 5960	1.013200

(Joseph, Chem. Soc. 1915, 107. 3.)

Sol. in conc.  $HCl$ ,  $HBr$ ; conc. solutions of bromides, and in liquid  $SO_2$ . (Sestini, Zeit. Chem. 1868. 718.)

Much more sol in  $HCl + Aq$  than in  $H_2O$ .  
 100 cc.  $HCl + Aq$  of 1.153 sp. gr. dissolve 36.4 g.  $Br$  at  $12^\circ$ .

More sol. in  $SrCl_2$ , and  $BaCl_2 + Aq$  than in  $H_2O$ . (Berthelot, C. R. 100. 761.)

Bromine is not more sol. in  $\text{KBr} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (?). (Balard.)

$\text{KBr} + \text{Aq}$  containing 1 pt.  $\text{KBr}$  to 6 pts  $\text{H}_2\text{O}$  takes up as much  $\text{Br}$  as it already contains; when this solution is heated the dissolved  $\text{Br}$  is separated. 1 pt.  $\text{KBr} + 1$  pt  $\text{H}_2\text{O}$  takes up twice as much  $\text{Br}$  as it already contains, much heat being evolved. This solution loses  $\text{Br}$  on exposure to the air or when heated. (Löwig.)

#### Solubility of $\text{Br}_2$ in $\text{KBr} + \text{Aq}$ .

g. Mols. $\text{KBr}$ per l.	g. at. $\text{Br}$ dissolved per l at 18°	g at $\text{Br}$ dissolved per l at 28.5°
0 00	0.4448	0 4282
0.01	0.4634	0 4490
0.02	0.4823	0 4671
0.03	0 5049	0 4925
0.04	0 5243	0 5101
0.05	0.5431	0 5301
0.06	0 5668	0 5530
0.07	0 5896	0 5636
0.08	0.6059	0 5920
0.09	0.6301	0.5981
0 1	0 6533	0.6488
0 2	0 8718	0.8591
0 3	1 0549	1.0787
0 4	1 3124	1.2704
0.5	1 5436	1.4731
0 6	1 7712	1.6717
0 7	2 0006	1 9197
0 8	2 2354	2 1029
0 9	2.4851	2 3340

The above figures indicate that below a concentration of 0.1 g. mol.  $\text{KBr}$  per l. just enough  $\text{Br}$  is dissolved to form  $\text{KBr}_3$ , while above that concentration somewhat larger amounts of  $\text{Br}$  are dissolved, which is greater at the lower temp.

(Worley, Chem. Soc. 1905, 87. 1109.)

#### Solubility of $\text{Br}_2$ in $\text{NaBr} + \text{Aq}$ at 25°.

g $\text{NaBr}$ per l	g-atoms $\text{Br}$ per l	Sp. gr.
92 6	2.479	1 213
160 5	4 345	1 372
205.8	6.195	1 515
255.8	8 575	1 678
319.7	13 65	1.997
359 0	16 04	2 137
	19 23	2 327
408 3	20 85	2 420

(Bell, J. Am. Chem. Soc. 1912, 34. 14.)

#### Solubility in salts + $\text{Aq}$ .

##### Solubility in 1 liter $\text{K}_2\text{SO}_4 + \text{Aq}$ at 25°.

$\text{K}_2\text{SO}_4 + \text{Aq}$	g Bromine
1-N	25.14
$\frac{1}{2}$ -N	29.44
$\frac{1}{3}$ -N	31.46
$\frac{1}{4}$ -N	32.70
$\frac{1}{16}$ -N	33 10

(Jakowkin, Z. phys. Ch. 1896, 20, 26.)

#### Solubility in 1 liter $\text{Na}_2\text{SO}_4 + \text{Aq}$ at 25°

$\text{Na}_2\text{SO}_4 + \text{Aq}$	g Bromine
1-N	25 07
$\frac{1}{2}$ -N	29 20
$\frac{1}{3}$ -N	31 33
$\frac{1}{4}$ -N	32 94
$\frac{1}{16}$ -N	33 26

(Jakowkin, l. c.)

#### Solubility in 1 liter $\text{NaNO}_3 + \text{Aq}$ at 25°.

$\text{NaNO}_3 + \text{Aq}$	g Bromine
1-N	28 80
$\frac{1}{2}$ -N	31 35
$\frac{1}{3}$ -N	32 62
$\frac{1}{4}$ -N	33 33
$\frac{1}{16}$ -N	33 74

(Jakowkin, l. c.)

#### Solubility in salts + $\text{Aq}$ at 25°.

Salt + $\text{Aq}$	g $\text{Br}_2$ sol. in 1 liter
$\frac{1}{2}$ -N $\text{Na}_2\text{SO}_4$	23 90
$\frac{1}{2}$ -N $\text{K}_2\text{SO}_4$	24 80
$\frac{1}{2}$ -N $(\text{NH}_4)_2\text{SO}_4$	77 7
N $\text{NaNO}_3$	28 00
N $\text{KNO}_3$	28.95
N $\text{NH}_4\text{NO}_3$	55 15
N $\text{NaCl}$	55 90
N $\text{KCl}$	57 40
N $\text{NH}_4\text{Cl}$	82 2

(McLauchlan, Z. phys. Ch. 1903, 44. 617.)

#### Solubility in $\text{HgBr}_2 + \text{Aq}$ at 25°.

10 ccm. of the solution contain:—

Millimols. $\text{Br}_2$	Millimols. $\text{Hg}$
2 125	0.
2 204	0 0560
2 216	0 0793
2 226	0 1284
2 231	0 2120

(Herz and Paul, Z. anorg. 1914, 85. 215.)

1 l.  $\text{N.NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  dissolves 340.5 g.  $\text{Br}_2$  at 25°. (McLauchlan, Z. phys. Ch. 1903, 44. 617.)

Miscible in all proportions with liquid  $\text{NO}_2$ . (Frankland, Chem. Soc. 1901, 79. 1361.)

More sol. in alcohol than in  $\text{H}_2\text{O}$ ; miscible with ether,  $\text{CS}_2$ ,  $\text{CHCl}_3$ . (Sestini, Zeit. Chem. 1868. 718.)

Somewhat soluble in glycerine. (Pelouze.) Sol. in benzene (Manafeld); insol. in benzene (Moride, A. ch. (3) 39. 452). Sol. in warm chloral, bromal, and iodal. (Löwig, Pogg. 14. 485.) Sol. in  $\text{SCl}_2$  (Solly), and  $\text{SBr}_2$ . Sol. in conc.  $\text{HCl}$  +  $\text{Aq}$ . (Balard.) Sol. in aqueous solution of potassium, sodium, or calcium acetates (Cahours.)

Solubility in CS<sub>2</sub>.

100 g of the sat. solution contain at  
 -95° -110 5° -110°  
 45 4 39 0 36 9 g Br<sub>2</sub>

(Arcetowski, Z. anorg 1896, 11. 274.)  
 Cryst from CS<sub>2</sub> at -90° in fine needles.  
 (Arcetowski, Z. anorg 1895, 10. 25)

Sp. gr of Br<sub>2</sub>+CCl<sub>4</sub> at 32 5°% Br<sub>2</sub> by weight

1 5449	Sp gr
1 6454	1 58014
1 7990	1 58060
2 6676	1 58168
3 5833	1 58812
	1 59526

(Joseph, Chem. Soc 1915, 107. 3.)  
 Sp. gr. of Br<sub>2</sub>+nitrobenzene at 32 5°.

% Br<sub>2</sub> by weight

1 5643	Sp gr
3 2323	1 20225
4 6462	1 21449
6 1826	1 22518
	1 23603

(Joseph, Chem. Soc. 1915, 107. 3)  
 Very sol in benzonitrile (Naumann, B. 1914, 47. 1369.)  
 Sol in acetone (Eidmann, C C 1899, II, 1014; Naumann, B. 1904, 37. 4328)

Partition of Br<sub>2</sub> between water and other solvents.

W=millimols Bromine in 10 ccm of the aqueous layer.

G=millimols Bromine in 10 ccm. of the other layer.

Other solvent	G	W	G/W
CCl <sub>4</sub>	1 949	0.0853	22.73
	7 008	0.3085	22.71
	12.171	0.5300	23.13
	39.880	1.3182	30.32
	54 574	1 5560	35 01

75% by vol. CCl<sub>4</sub> 3 587 0.0985 37.06  
 +25% by vol. CS<sub>2</sub> 7.304 0.1910 38.15

10.833 0.2900 37.36  
 13 922 0 3720 37.42  
 17 230 0 4580 37.62  
 25 637 0 6580 38.96  
 40.625 0.9940 40.88  
 54.035 1.2080 44.73

50% by vol. CCl<sub>4</sub>+ 3.592 0.0784 45.82  
 50% by vol. CS<sub>2</sub> 6 820 0 1487 46.85  
 10 148 0.2206 46.01  
 13 886 0.3065 45.24  
 16 616 0 3688 45.05  
 42.975 0 8086 53.15  
 55.965 0 9960 56.19

25% by vol. CCl<sub>4</sub> 5 753 0.0884 65.05  
 +75% by vol. CS<sub>2</sub> 10 902 0.1683 64.82  
 26 724 0 4970 65.65  
 41 314 0 6331 65.26  
 55 526 0.8520 65.17

Partition of Br<sub>2</sub>, etc.—Continued

Other solvent	G	W	G/W
CS <sub>2</sub>	7 750	0 1015	76 35
	10 600	0 1387	76 44
	14 696	0 1910	76 98
	17 999	0 2352	76 54
	26 345	0 3467	75 99
	40 625	0 5194	78 21
	57.038	0 7160	79.66

(Herz, Z. Elektrochem, 1910, 16. 871)

Partition coefficient for bromine between CS<sub>2</sub> and H<sub>2</sub>O at 25°C.

A=concentration of the water layer.

C=concentration of the CS<sub>2</sub> layer

A	C	N=C/A
7 545	691.9	91 71
4 109	338.6	82 41
2 600	217 4	81 72
2 544	207 7	81 66
1 740	140 38	80 67
1 2878	103 7	80 51
0.8073	64 44	79 83
0 5046	39 64	78 38

Partition coefficient for bromine between CHBr<sub>3</sub> and H<sub>2</sub>O at 25°C.

A=concentration of the water layer

C=concentration of the CHBr<sub>3</sub> layer.

A	C	N=C/A
5 424	373 6	68 88
3 838	264 7	68 80
2 368	161 5	68.19
1 348	90 17	66 90
0.766	50 49	65.84
0 366	23.62	64 85

Partition coefficient for bromine between CCl<sub>4</sub> and H<sub>2</sub>O at 25°C.

A=concentration of the water layer

C=concentration of the CCl<sub>4</sub> layer

A	C	N=C/A
14.42	545.2	37 82
10.80	372 2	34 44
7.901	252.8	32 01
7 163	225.8	31.52
6.803	218.5	32.12
5.651	172.6	30 54
3 216	94.84	29 48
2 054	58.36	28 41
1 266	35 92	28 37
0.7711	21.53	27 02
0.5761	15 72	27 26
0 4476	12 09	27 02
0 3803	10 27	27.00
0 2478	6 691	27 00

(Jakowkin, Z. phys. Ch. 1895, 18. 588)

Partition of bromine between  $\text{CCl}_4$  and salts + Aq

A = concentration of  $\text{Br}_2$  in  $\text{H}_2\text{O}$  layer  
C = concentration of  $\text{Br}_2$  in  $\text{CCl}_4$  layer.

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{NaNO}_2$  + Aq at  $25^\circ$

$\text{NaNO}_2$ + Aq	A	C
1-N	7 905	316 7
$\frac{1}{2}$ -N	8 763	319 5
$\frac{1}{4}$ -N	9 033	315 7
$\frac{1}{8}$ -N	9 200	316 7
$\frac{1}{16}$ -N	9 399	319 3

(Jakowkin, Z phys Ch 1896, 20, 25)

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{K}_2\text{SO}_4$  + Aq at  $25^\circ$

$\text{K}_2\text{SO}_4$ + Aq	A	C
1-N	5 982	255 4
$\frac{1}{2}$ -N	6 843	253 4
$\frac{1}{4}$ -N	7 354	252 8
$\frac{1}{8}$ -N	7 585	250 3
$\frac{1}{16}$ -N	7 498	242 3

(Jakowkin, l. c.)

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{Na}_2\text{SO}_4$  + Aq at  $25^\circ$

$\text{Na}_2\text{SO}_4$ + Aq	A	C
1-N	5 934	254 6
$\frac{1}{2}$ -N	6 898	253 4
$\frac{1}{4}$ -N	7 402	254 4
$\frac{1}{8}$ -N	7 609	252 8
$\frac{1}{16}$ -N	7 713	251 2

(Jakowkin, l. c.)

Crystallizes at  $4^\circ$  with  $10\text{H}_2\text{O}$ .

**Bromine chloride,  $\text{BrCl}$ .**

Sol. in  $\text{H}_2\text{O}$ ,  $\text{CS}_2$ , ether, etc

**Bromine fluoride,  $\text{BrF}_3$ .**

Fumes in the air. Decomp. by  $\text{H}_2\text{O}$ . (Lebeau, C. R. 1905, 141, 1019.)

**Bromine oxides.**

No oxides of bromine are known in the free state. See hypobromous, bromic, and perbromic acids

**Bromiridic acid.**

**Ammonium bromiridate,  $(\text{NH}_4)_2\text{IrBr}_5$**

Less sol. in cold  $\text{H}_2\text{O}$  than the K salt (Birnbbaum, Zeit Chem 1865, 22.)

Very sol. in cold  $\text{H}_2\text{O}$  (Guthier, B 1909, 42, 3910)

**Cesium bromiridate,  $\text{Cs}_2\text{IrBr}_6$**

Sol in  $\text{H}_2\text{O}$  (Guthier, B. 1909, 42, 3911)

**Potassium bromiridate,  $\text{K}_3\text{IrBr}_6$ .**

Moderately sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

Insol. in alcohol or ether  
Sol in cold  $\text{H}_2\text{O}$  and in  $\text{HBr}$  + Aq (Guthier, B 1909, 42, 3910)

**Rubidium bromiridate,  $\text{Rb}_2\text{IrBr}_5$**

Very sol. in cold  $\text{H}_2\text{O}$  Sol in hot dil.  $\text{HBr}$  + Aq (Guthier, B 1909, 42, 3911)

**Sodium bromiridate.**

Dehquescient Easily sol in  $\text{H}_2\text{O}$ , alcohol, or ether.

**Bromiridous acid,  $\text{H}_2\text{Ir}_2\text{Br}_{12} + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Birnbbaum, 1864.)

**Ammonium bromiridite,  $(\text{NH}_4)_3\text{Ir}_2\text{Br}_{12} + \text{H}_2\text{O}$ .**

Difficultly sol in  $\text{H}_2\text{O}$ . (Birnbbaum)

**Potassium bromiridite,  $\text{K}_4\text{Ir}_2\text{Br}_{12} + 6\text{H}_2\text{O}$ .**

Efflorescent. Sol in  $\text{H}_2\text{O}$ .

**Silver bromiridite,  $\text{Ag}_3\text{Ir}_2\text{Br}_{12}$ .**

Ppt Insol. in  $\text{H}_2\text{O}$  or acids.

**Sodium bromiridite,  $\text{Na}_3\text{Ir}_2\text{Br}_{12} + 24\text{H}_2\text{O}$ .**

Efflorescent. Very sol. in  $\text{H}_2\text{O}$ .

**Bromocarbonatoplatin diamine carbon-**

**ate,  $\text{CO}_2[\text{Pt}(\text{N}_2\text{H}_5)_2]_2(\text{CO}_3)_2 + 4\text{H}_2\text{O}$ .**

Ppt.

**Bromocarbonatoplatin diamine carbonate**

**bromoplatin diamine nitrate,**

**$\text{CO}_2[\text{Pt}(\text{N}_2\text{H}_5)_2]_2(\text{CO}_3)_2$ ,  $2\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5)_2(\text{NO}_3)_2$ .**

**Bromochloroplatin diamine chloride,**

**$\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{Cl}_2$ .**

Very sl. sol. in  $\text{H}_2\text{O}$  (Cleve.)

**chlorobromide,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{Cl}_2$  (?)**

Very sl. sol. in  $\text{H}_2\text{O}$

**Bromochloroplatinic acid.**

**Potassium bromochloroplatinate,  $\text{K}_2\text{PtCl}_2\text{Br}_2$**

(Pitkin, J. Am. Chem. Soc. 2, 408.)

Mixture. (Herty, J. Am Chem. Soc 1896, 18, 136.)

$\text{K}_2\text{PtCl}_2\text{Br}_2$ . Sl. sol. in cold  $\text{H}_2\text{O}$ ; much more sol. in hot  $\text{H}_2\text{O}$ . (Pitkin.)

Mixture. (Herty.)

$\text{K}_2\text{PtCl}_2\text{Br}_2$ . As above.

$\text{K}_2\text{PtCl}_2\text{Br}_2$ . (Pigeon, A. ch. 1894, (7) 2, 488.)

$\text{K}_2\text{PtCl}_2\text{Br}_2$ . (Pitkin.)

**Bromochromic acid.**

**Potassium bromochromate,  $\text{KCrO}_5\text{Br}_2 = \text{CrO}_5(\text{Br})\text{OK}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Hentze, J. pr (2) 4, 225.)

<b>Dibromochromium chloride</b> , [Cr(H <sub>2</sub> O) <sub>4</sub> Br <sub>2</sub> ]Cl + 2H <sub>2</sub> O. Ppt. Nearly insol. in fuming HCl. (Bjerrum, B 1907, 40. 2918)	<b>Bromomolybdenum phosphate</b> , Br <sub>4</sub> Mo <sub>3</sub> H <sub>4</sub> (PO <sub>4</sub> ) <sub>2</sub> Precipitate Insol. in H <sub>2</sub> O. (Atterberg)
<b>Bromohydroxyloplatindiamine bromide</b> , OH Br Pt(N <sub>2</sub> H <sub>4</sub> Br) <sub>2</sub> . Very sl. sol. in H <sub>2</sub> O (Cleve)	<b>Bromomolybdenum sulphate</b> , Br <sub>4</sub> Mo <sub>3</sub> SO <sub>4</sub> + 3H <sub>2</sub> O Precipitate. Sl. sol. in boiling H <sub>2</sub> SO <sub>4</sub> (Atterberg)
— <b>chloride</b> , OH Br Pt(N <sub>2</sub> H <sub>4</sub> Cl) <sub>2</sub> Sol. in H <sub>2</sub> O (Cleve.)	<b>Dibromomolybdous acid</b> , MoOBr <sub>2</sub> (OH) + 1½H <sub>2</sub> O Sol. in H <sub>2</sub> O. Very hygroscopic (Weinland, Z anorg 1905, 44. 86)
— <b>nitrate</b> , OH Br Pt(N <sub>2</sub> H <sub>4</sub> NO <sub>2</sub> ) <sub>2</sub> . Very sl. sol. in cold, moderately sol. in hot H <sub>2</sub> O. (Cleve)	<b>Tetrabromomolybdous acid</b> , MoBr <sub>4</sub> (OH) + 2H <sub>2</sub> O Sol. in H <sub>2</sub> O. Hygroscopic. (Weinland, l. c.)
<b>Bromohydroxyloplatinmonodiamine nitrate</b> , Br (NH <sub>4</sub> ) <sub>2</sub> NO <sub>2</sub> + H <sub>2</sub> O OH Pt NH <sub>2</sub> NO <sub>2</sub> Easily sol. in H <sub>2</sub> O (Cleve)	<b>Diammonium pentabromomolybdate</b> , MoBr <sub>5</sub> O(NH <sub>4</sub> ) <sub>2</sub> Hygroscopic. Sol. in H <sub>2</sub> O (Weinland, l. c.)
<b>Bromomercurosulphurous acid</b> .	<b>Dicassium pentabromomolybdate</b> , MoBr <sub>5</sub> OCs <sub>2</sub> Hydroscopic Sol. in H <sub>2</sub> O. (Weinland, l. c.)
<b>Ammonium bromomercurosulphate</b> , NH <sub>4</sub> SO <sub>3</sub> HgBr Sol. in H <sub>2</sub> O. (Baith, Z phys Ch. 9. 215)	<b>Calcium tetrabromomolybdate</b> , (MoBr <sub>4</sub> O) <sub>2</sub> Ca + 7H <sub>2</sub> O Hydroscopic Sol. in H <sub>2</sub> O (Weinland, l. c.)
<b>Potassium bromomercurosulphate</b> , KSO <sub>3</sub> HgBr As above. (B)	<b>Monolithium tetrabromomolybdate</b> , MoBr <sub>4</sub> (OLi) + 4H <sub>2</sub> O Hydroscopic. Sol. in H <sub>2</sub> O (Weinland, l. c.)
<b>Bromomolybdenum bromide</b> , Br <sub>4</sub> Mo <sub>3</sub> Br <sub>2</sub> = molybdenum dibromide, MoBr <sub>2</sub> Insol. in H <sub>2</sub> O or acids, or even in boiling aqua regia. Easily sol. in dilute, decomp. by conc. alkalis + Aq (Blomstrand, J. pr. 82. 436.)	<b>Magnesium pentabromomolybdate</b> , MoBr <sub>5</sub> (OMg) + 7H <sub>2</sub> O. Hydroscopic. Sol. in H <sub>2</sub> O (Weinland, l. c.)
<b>Bromomolybdenum chloride</b> , Br <sub>4</sub> Mo <sub>3</sub> Cl <sub>2</sub> + 3H <sub>2</sub> O. Insol. in acids (Blomstrand.)	<b>Monopotassium tetrabromomolybdate</b> , MoBr <sub>4</sub> (OK) + 2H <sub>2</sub> O. Hydroscopic Sol. in H <sub>2</sub> O. (Weinland, l. c.)
<b>Bromomolybdenum chromate</b> , Br <sub>4</sub> Mo <sub>3</sub> CrO <sub>4</sub> + 2H <sub>2</sub> O. Insol. in dil. acids Sol. in hot conc. HCl + Aq Insol. in alkali chromates + Aq. (Atterberg.)	<b>Dipotassium pentabromomolybdate</b> , MoBr <sub>5</sub> OK <sub>2</sub> . Hydroscopic. Sol. in H <sub>2</sub> O (Weinland, l. c.)
<b>Bromomolybdenum fluoride</b> , Br <sub>4</sub> Mo <sub>3</sub> F <sub>2</sub> + 3H <sub>2</sub> O. Insol. in H <sub>2</sub> O. (Atterberg.)	<b>Dirubidium pentabromomolybdate</b> , MoBr <sub>5</sub> ORb <sub>2</sub> . Hydroscopic. Sol. in H <sub>2</sub> O. (Weinland, l. c.)
<b>Bromomolybdenum hydroxide</b> , Br <sub>4</sub> Mo <sub>3</sub> (OH) <sub>2</sub> . Completely sol. in alkalis if not heated over 90°. (Atterberg) + 2H <sub>2</sub> O. + 8H <sub>2</sub> O.	<b>Bromonitratoplatindiamine nitrate</b> , Br N <sub>2</sub> H <sub>4</sub> NO <sub>2</sub> . NO <sub>2</sub> Pt N <sub>2</sub> H <sub>4</sub> NO <sub>2</sub> . Decomp. by H <sub>2</sub> O (Cleve.)
<b>Bromomolybdenum iodide hydroxide</b> , 2Br <sub>4</sub> Mo <sub>3</sub> I <sub>2</sub> , Br <sub>4</sub> Mo <sub>3</sub> (OH) <sub>2</sub> + 8H <sub>2</sub> O. Precipitate (Blomstrand, J. pr. 77. 92)	— <b>sulphate</b> , Br NO <sub>2</sub> Pt(N <sub>2</sub> H <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> + H <sub>2</sub> O. Sl. sol. in H <sub>2</sub> O.
<b>Bromomolybdenum molybdate</b> , Br <sub>4</sub> Mo <sub>3</sub> MoO <sub>4</sub> Precipitate (Atterberg.)	

**Bromonitritoplatin*semidi*amine nitrite,**  
 $\text{NO}_2\text{Br}_2\text{Pt}(\text{NH}_3)_2\text{NO}_2$ .Sl. sol. in  $\text{H}_2\text{O}$ . (Blomstrand.)**Bromonitrous acid.**Platinum silver bromonitrite,  $\text{PtAg}_2\text{Br}_2(\text{NO}_2)_4$ .  
Ppt. (Miolati, Gazz. ch. it. 1900, 30. 588.)**Bromopalladic acid.**Ammonium bromopalladate,  $(\text{NH}_4)_2\text{PdBr}_2$ .Difficultly sol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$  and by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, B. 1905, 38. 1907.)Cesium bromopalladate,  $\text{Cs}_2\text{PdBr}_4$ .Difficultly sol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$  or by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, l. c.)Potassium bromopalladate,  $\text{K}_2\text{PdBr}_4$ .Difficultly sol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$  or by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, l. c.)Rubidium bromopalladate,  $\text{Rb}_2\text{PdBr}_4$ .Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$  or by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, l. c.)**Bromopalladious acid.**Ammonium bromopalladite,  $(\text{NH}_4)_2\text{PdBr}_4$ .Very stable. Sol. in  $\text{H}_2\text{O}$ . (Smith, Z. anorg. 1894, 6. 381.)Very sol. in cold  $\text{H}_2\text{O}$ .Can be cryst. from a very small amount of hot  $\text{H}_2\text{O}$ . (Gutbier, B. 1905, 38. 2387.)**Barium bromopalladite.**Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)Cesium bromopalladite,  $\text{Cs}_2\text{PdBr}_4$ .Very sol. in  $\text{H}_2\text{O}$ . (Gutbier, B. 1905, 38. 2388.)Manganese bromopalladite,  $\text{MnPdBr}_4$ .Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)  
 $+7\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Smith, Z. anorg. 1894, 6. 382.)Potassium bromopalladite,  $\text{K}_2\text{PdBr}_4$ .Easily sol. in  $\text{H}_2\text{O}$ . (Joannes, C. R. 96. 905.)Very stable. Sol. in  $\text{H}_2\text{O}$ . (Smith, Z. anorg. 1894, 6. 381.)  
 $+2\text{H}_2\text{O}$ . Unstable in the air. (Smith, l. c.)Rubidium bromopalladite,  $\text{Rb}_2\text{PdBr}_4$ .Can be cryst. from a very small amount of hot  $\text{H}_2\text{O}$ . (Gutbier, B. 1905, 38. 2388.)Sodium bromopalladite,  $\text{Na}_2\text{PdBr}_4 + 4\frac{1}{2}\text{H}_2\text{O}$ .Very deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Smith, l. c.)Strontium bromopalladite,  $\text{SrPdBr}_4 + 6\text{H}_2\text{O}$ .Stable in the air. Very sol. in  $\text{H}_2\text{O}$ . (Smith, l. c.)

Zinc bromopalladite.

Sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)**Bromophosphatoplatin*di*amine phosphate,**  
 $\text{BrPt}(\text{N}_2\text{H}_5)_2 + 2\text{H}_2\text{O}$  $\text{PO}_4$   
Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Bromophosphoric acid.**Thorium bromophosphate,  $\text{ThBr}_4$ .  
 $3(3\text{ThO}_3, 2\text{P}_2\text{O}_5)$ .Insol. in most acids and in fused alkali carbonates. Decomp. by long boiling with conc.  $\text{H}_2\text{SO}_4$ . (Colani, C. R. 1900, 149. 208.)**Bromoplatinamine bromide,** $\text{Br}_2\text{Pt}(\text{NH}_3\text{Br})_2$ .Sl. sol. in  $\text{H}_2\text{C}$ . (Cleve, Sv. V. A. H. 10, 9. 31)— nitrite,  $\text{Br}_2\text{Pt}(\text{NH}_3\text{NO}_2)_2$ Very sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Bromoplatin*di*amine bromide,** $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{Br}_2$ .Only sl. sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)— chloride,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{Cl}_2$ Very sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)— dichromate,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{Cr}_2\text{O}_7$ .Sl. sol. in  $\text{H}_2\text{O}$ .— nitrate,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5\text{NO}_3)_2$ Sl. sol. in cold, rather easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)— phosphate,  $\text{Br}_2\text{Pt}[\text{N}_2\text{H}_5\text{PO}_3(\text{OH})_2]_2 + 2\text{H}_2\text{O}$ .Rather easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)— sulphate,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{SO}_4$ .Very sl. sol. in  $\text{H}_2\text{O}$ .**Bromoplatin*monodi*amine nitrate,** $\text{Br}_2\text{Pt}(\text{NH}_3)_2\text{NO}_3 + \text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ .— sulphate,  $\text{Br}_2\text{Pt}(\text{NH}_3)_2\text{SO}_4 + \text{H}_2\text{O}$ Moderately sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Bromoplatin*semi*diamine bromide,** $\text{Br}_2\text{Pt}(\text{NH}_3)_2\text{Br}$ Sl. sol. in cold  $\text{H}_2\text{O}$ . (Cleve.)**Bromoplatin*di*amine anhydronitrate,** $\text{Br}_2\text{Pt}_2(\text{N}_2\text{H}_5)_2(\text{NO}_3)_2$ . $(\text{NH}_3\text{NH}_2)_2$ Sol. in  $\text{HNO}_3 + \text{Aq}$ .

**Bromoplatin diamine chloride,**

Ppt (Cleve.)

— nitrate,  $\text{Br}_2\text{Pt}_2(\text{N}_2\text{H}_4)_4(\text{NO}_3)_4 + 2\text{H}_2\text{O}$ .Moderately sol in hot  $\text{H}_2\text{O}$ .— sulphate,  $\text{Br}_2\text{Pt}_2(\text{N}_2\text{H}_4)_4(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ .

Ppt. (Cleve)

**Bromoplatinic acid,  $\text{H}_2\text{PtBr}_6 + 9\text{H}_2\text{O}$ .**Very deliquescent, and sol in  $\text{H}_2\text{O}$ , alcohol, ether, chloroform, or acetic acid. (Topsøe, J B 1888. 273.)**Ammonium bromoplatinate,  $(\text{NH}_4)_2\text{PtBr}_6$ .**Sol in 200 pts  $\text{H}_2\text{O}$  at  $15^\circ$ . (Topsøe)100 pts  $(\text{NH}_4)_2\text{PtBr}_6 + \text{Aq}$  sat. at  $20^\circ$  contain 0.50 pt dry salt. (Halberstadt, B 17. 2965.)**Barium bromoplatinate,  $\text{BaPtBr}_6 + 10\text{H}_2\text{O}$ .**Sl deliquescent. Very sol in  $\text{H}_2\text{O}$ **Cesium bromoplatinate,  $\text{Cs}_2\text{PtBr}_6$ .**Sl. sol. in dil.  $\text{HBr} + \text{Aq}$ . (Obermaier, Dissert.)**Calcium bromoplatinate,  $\text{CaPtBr}_6 + 12\text{H}_2\text{O}$** Sl. deliquescent Very sol. in  $\text{H}_2\text{O}$ .**Cobalt bromoplatinate,  $\text{CoPtBr}_6 + 12\text{H}_2\text{O}$ .**

Deliquescent.

**Copper bromoplatinate,  $\text{CuPtBr}_6 + 8\text{H}_2\text{O}$** Very deliquescent. sol. in  $\text{H}_2\text{O}$ .**Lead bromoplatinate,  $\text{PbPtBr}_6$ .**Easily sol in  $\text{H}_2\text{O}$ , but decomp. by large amount.**Lead tetrabromoplatinate,  $[\text{PtBr}_4(\text{OH})_2]\text{Pb}, \text{PbOH}$ .**Insol in  $\text{H}_2\text{O}$ . (Miolati, C. C. 1900, II. 810.)**Magnesium bromoplatinate,  $\text{MgPtBr}_6 + 12\text{H}_2\text{O}$ .**

Not deliquescent.

**Manganese bromoplatinate,  $\text{MnPtBr}_6 + 6\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$   
+  $12\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .**Mercuric tetrabromoplatinate,  $[\text{PtBr}_4(\text{OH})_2]\text{Hg}$** Insol. in  $\text{H}_2\text{O}$  (Miolati, C C 1900, II. 810.)**Nickel bromoplatinate,  $\text{NiPtBr}_6 + 12\text{H}_2\text{O}$** 

Deliquescent

**Potassium bromoplatinate,  $\text{K}_2\text{PtBr}_6$** Sl sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (v Bonsdorff, Pogg 19. 344.)Sol. in 10 pts. boiling  $\text{H}_2\text{O}$  (Pitkin, C. N. 41. 218)100 pts.  $\text{K}_2\text{PtBr}_6 + \text{Aq}$  sat. at  $20^\circ$  contain 2.02 pts dry salt. (Halberstadt, B. 17. 2962)**Praseodymium bromoplatinate,  $\text{PrBr}_3.\text{PtBr}_3 + 10\text{H}_2\text{O}$ .**Deliquescent, very sol in  $\text{H}_2\text{O}$ , sol. in  $\text{HBr}$ . (Von Schule, Z anorg. 1898, 18. 353.)**Rubidium bromoplatinate,  $\text{Rb}_2\text{PtBr}_6$** Sl. sol. in dil  $\text{HBr} + \text{Aq}$ . (Obermaier, Dissert.)**Silver bromoplatinate,  $\text{Ag}_2\text{PtBr}_6$** Insol. in  $\text{H}_2\text{O}$ . (Miolati, C. C. 1900, II. 810)**Silver tetrabromoplatinate,  $[\text{PtBr}_4(\text{OH})_2]\text{Ag}_2$ .**Ppt, insol. in  $\text{H}_2\text{O}$  (Miolati, l c)**Sodium bromoplatinate,  $\text{Na}_2\text{PtBr}_6 + 6\text{H}_2\text{O}$** Easily sol in  $\text{H}_2\text{O}$  and alcohol.**Strontium bromoplatinate,  $\text{SrPtBr}_6 + 10\text{H}_2\text{O}$ .**Sl. deliquescent Very sol. in  $\text{H}_2\text{O}$ .**Thallium tetrabromoplatinate,**Insol. in  $\text{H}_2\text{O}$  (Miolati, C. C 1900, II. 810.)**Ytterbium bromoplatinate,  $\text{YbBr}_3.3\text{H}_2\text{PtBr}_6 + 30\text{H}_2\text{O}$** 

Ppt. (Cleve, Z anorg 1902, 32. 138)

**Zinc bromoplatinate,  $\text{ZnPtBr}_6 + 12\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ .**Bromoplatinocyanhydric acid,**

See Perbromoplatinocyanhydric acid.

**Potassium bromoplatinocyanide,  $5\text{K}_2\text{Pt}(\text{CN})_6$ ,  $\text{K}_2\text{Pt}(\text{CN})_4\text{Br}_2 + 18\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ **Bromoplatinous acid.****Potassium bromoplatinite,  $\text{K}_2\text{PtBr}_4 + 2\text{H}_2\text{O}$ .**Extremely sol. in  $\text{H}_2\text{O}$ . (Billmann and Andersen, B. 1903, 36. 1566.)**Bromopurpleochromium bromide,**Less sol. in  $\text{H}_2\text{O}$  than chloropurpleochromium chloride (Jørgensen, J. pr. (2) 25. 83.)— bromoplatinate,  $\text{BrCr}(\text{NH}_3)_4\text{PtBr}_3$   
(Jørgensen, l. c.)— chloride,  $\text{BrCr}(\text{NH}_3)_4\text{Cl}_2$ .More sol in  $\text{H}_2\text{O}$  than the bromide.  
(Jørgensen, l. c.)

**Bromopurpleochromium chromate,**  
 $\text{BrCr}(\text{NH}_3)_4\text{CrO}_4$ .Precipitate (Jørgensen, *l. c.*)— nitrate,  $\text{BrCr}(\text{NH}_3)_4(\text{NO}_3)_2$ .More sol than bromide and less than chloride (Jørgensen, *l. c.*)**Bromopurplecobaltic bromide,**  
 $\text{CoBr}(\text{NH}_3)_5\text{Br}_2$ Sol in 530 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ . Insol. in alcohol,  $\text{NH}_4\text{Br}$ ,  $\text{KBr}$ , or  $\text{HBr} + \text{Ag}$ . More sol in hot  $\text{H}_2\text{O}$  containing a little  $\text{HBr}$ . (Jørgensen, *J. pr.* (2) 19 49.)**Bromopurplecobaltic mercuric bromide,**  
 $\text{CoBr}(\text{NH}_3)_5\text{Br}_2, 3\text{HgBr}_2$ More sol in  $\text{H}_2\text{O}$  than the corresponding  $\text{HgCl}_2$  salt. (J.)

— bromoplatinate.

Very sl sol in cold  $\text{H}_2\text{O}$  (J.)— chloride,  $\text{CoBr}(\text{NH}_3)_5\text{Cl}_2$ Difficultly sol in cold  $\text{H}_2\text{O}$ , but much more easily than the bromide. Insol. in dil  $\text{HCl} + \text{Ag}$ , and in alcohol— mercuric chloride,  $\text{CoBr}(\text{NH}_3)_5\text{Cl}_2, 3\text{HgCl}_2$ .Sl sol in  $\text{H}_2\text{O}$ 

— chloroplatinate.

Nearly or quite insol. in  $\text{H}_2\text{O}$  (J.)— chromate,  $\text{CoBr}(\text{NH}_3)_5\text{CrO}_4$ .Nearly insol in  $\text{H}_2\text{O}$ — dithionate,  $\text{CoBr}(\text{NH}_3)_5\text{S}_2\text{O}_6$ .Nearly insol in  $\text{H}_2\text{O}$ — fluosilicate,  $\text{CoBr}(\text{NH}_3)_5\text{SiF}_6$ .Very sl sol in cold  $\text{H}_2\text{O}$ ; insol in alcohol.— nitrate,  $\text{CoBr}(\text{NH}_3)_5(\text{NO}_3)_2$ .More sol in  $\text{H}_2\text{O}$  than the bromide, but less than the chloride. Wholly insol in dil.  $\text{HNO}_3 + \text{Ag}$  or alcohol— oxalate,  $\text{CoBr}(\text{NH}_3)_5\text{C}_2\text{O}_4$ Nearly insol in  $\text{H}_2\text{O}$ — sulphate,  $\text{CoBr}(\text{NH}_3)_5\text{SO}_4$ .Can be crystallized from very dil.  $\text{H}_2\text{SO}_4 + \text{Ag}$ . Insol. in alcohol.+  $6\text{H}_2\text{O}$ . Efflorescent**Bromopurpleorhodium bromide,**  
 $\text{BrRh}(\text{NH}_3)_5\text{Br}_2$ Much less easily sol in  $\text{H}_2\text{O}$  than the chlorochloride. Insol. in dil.  $\text{HBr} + \text{Ag}$  and alcohol (Jørgensen, *J. pr.* (2) 27 433.)— bromoplatinate,  $\text{BrRh}(\text{NH}_3)_5\text{PtBr}_6$ .Almost insol. in  $\text{H}_2\text{O}$ — fluosilicate,  $\text{BrRh}(\text{NH}_3)_5\text{SiF}_6$ Sl sol in  $\text{H}_2\text{O}$ . Sol in boiling  $\text{NaOH} + \text{Ag}$  as roseo salt**Bromopurpleorhodium nitrate,**  
 $\text{BrRh}(\text{NH}_3)_5(\text{NO}_3)_2$ Sl sol in  $\text{H}_2\text{O}$ , but much more sol than the bromide**Bromorhodos acid.****Ammonium bromorhodate,  $(\text{NH}_4)_2\text{RhBr}_4$** Sol in  $\text{H}_2\text{O}$  (Goloubkine, *Chem. Soc.* 1911, 100 (2) 45)Sol. in  $\text{H}_2\text{O}$  (Gutbier, *B.* 1908, 41. 215.)**Barium bromorhodite,  $\text{BaRhBr}_3$** Sol in  $\text{H}_2\text{O}$  (Goloubkine, *l. c.*)**Cesium bromorhodite,  $\text{Cs}_2\text{RhBr}_6$** Difficultly sol in  $\text{H}_2\text{O}$ . (Gutbier, *l. c.*)**Potassium bromorhodite,  $\text{K}_2\text{RhBr}_6$** Very sol. in  $\text{H}_2\text{O}$  (Goloubkine, *l. c.*)Sol in  $\text{H}_2\text{O}$  (Gutbier, *l. c.*)**Rubidium bromorhodite,  $\text{Rb}_2\text{RhBr}_6$** Sol in  $\text{H}_2\text{O}$  (Goloubkine, *l. c.*)Difficultly sol in  $\text{H}_2\text{O}$  (Gutbier, *l. c.*)**Sodium bromorhodite,  $\text{Na}_2\text{RhBr}_6$** Very sol. in  $\text{H}_2\text{O}$ . (Goloubkine, *l. c.*)**Bromoruthenic acid.****Potassium bromoruthenate,  $\text{K}_2\text{RuBr}_6$** Very sol in  $\text{H}_2\text{O}$ . (Howe, *J. Am. Chem. Soc.* 1904, 26. 946)**Potassium aquobromoruthenate,**  
 $\text{K}_2\text{Ru}(\text{H}_2\text{O})\text{Br}_6$ .Ppt. (Howe, *l. c.*)**Rubidium bromoruthenate,  $\text{Rb}_2\text{RuBr}_6$** Sol in  $\text{H}_2\text{O}$  (Howe, *l. c.*)**Rubidium aquobromoruthenate,**  
 $\text{Rb}_2\text{Ru}(\text{H}_2\text{O})\text{Br}_6$ .Ppt. (Howe, *l. c.*)**Bromoruthenious acid.****Cesium bromoruthenite,  $\text{CsRuBr}_6 + \text{H}_2\text{O}$** Ppt. (Howe, *J. Am. Chem. Soc.* 1904, 26. 945)**Potassium bromoruthenite,  $\text{K}_2\text{RuBr}_6$** Very sol. in  $\text{H}_2\text{O}$  with decomp. Very sol. in dil.  $\text{HBr}$  (Howe, *l. c.*)**Rubidium bromoruthenite,  $\text{Rb}_2\text{RuBr}_6 + \text{H}_2\text{O}$** Sol. in dil.  $\text{HBr}$ . (Howe, *l. c.*)**Bromoselenic acid.****Ammonium bromoselenate,  $(\text{NH}_4)_2\text{SeBr}_6$** Sol in  $\text{H}_2\text{O}$  with decomp. (Muthmann and Schäfer, *B.* 26. 1008.)**Cesium bromoselenate,  $\text{Cs}_2\text{SeBr}_6$** Sl sol. in  $\text{H}_2\text{O}$  (Lenher, *J. Am. Chem. Soc.* 1898, 20. 571.)**Potassium bromoselenate,  $\text{K}_2\text{SeBr}_6$** As  $\text{NH}_4$  salt. (M and S.)

<b>Rubidium bromoselenate</b> , $\text{Rb}_2\text{SeBr}_4$ Less sol in $\text{H}_2\text{O}$ than K salt (Lenher, <i>l. c.</i> )	<b>Manganous bromostannate</b> , $\text{MnSnBr}_6 + 6\text{H}_2\text{O}$ Deliquescent (Raymann and Preis.)
<b>Bromopyroselenious acid.</b>	<b>Nickel bromostannate</b> , $\text{NiSnBr}_6 + 8\text{H}_2\text{O}$ Deliquescent (Raymann and Preis.)
<b>Ammonium bromopyroselenite</b> , $\text{NH}_4\text{Br} \cdot 2\text{SeO}_3 + 2\text{H}_2\text{O}$ More easily sol in $\text{H}_2\text{O}$ than corresponding Cl compound (Muthmann and Schafer, B 1893, 26. 1014.)	<b>Potassium bromostannate</b> , $\text{K}_2\text{SnBr}_6$ Sol in $\text{H}_2\text{O}$ (Topsoe)
<b>Potassium bromopyroselenite</b> , $\text{KBr} \cdot 2\text{SeO}_3 + 2\text{H}_2\text{O}$ Sol. in $\text{H}_2\text{O}$ . (Muthmann and Schafer, B. 26. 1008.)	<b>Rubidium bromostannate.</b> Sol in $\text{H}_2\text{O}$ . (Raymann and Preis.)
<b>Bromosmic acid.</b>	<b>Sodium bromostannate</b> , $\text{Na}_2\text{SnBr}_6 + 6\text{H}_2\text{O}$ . Not deliquescent, but extremely sol in $\text{H}_2\text{O}$ (Seubert, B 20. 796.)
<b>Ammonium bromosmate</b> , $(\text{NH}_4)_2\text{OsBr}_4$ Only sl sol in $\text{H}_2\text{O}$ (Rosenheim, Z. anorg. 1899, 21. 135.)	<b>Strontium bromostannate</b> , $\text{SrSnBr}_6 + 6\text{H}_2\text{O}$ . Very hygroscopic, and sol in $\text{H}_2\text{O}$ (Raymann and Preis.)
<b>Cæsium bromosmate</b> , $\text{Cs}_2\text{OsBr}_4$ Nearly insol in $\text{H}_2\text{O}$ and dil. HBr (Gutbier, B. 1913, 46. 2103.)	<b>Bromosulphatoplatindiamine sulphate</b> , $\begin{array}{c} \text{Br} > \text{Pt}(\text{N}_2\text{H}_4)_2\text{SO}_4 \\ \text{SO}_4 > \text{Pt}(\text{N}_2\text{H}_4)_2\text{SO}_4 \\ \text{Br} > \text{Pt}(\text{N}_2\text{H}_4)_2\text{SO}_4 \end{array} + \text{H}_2\text{O}$ Rather easily sol. in hot $\text{H}_2\text{O}$
<b>Potassium bromosmate</b> , $\text{K}_2\text{OsBr}_4$ Only sl. sol in $\text{H}_2\text{O}$ (Rosenheim, <i>l. c.</i> )	<b>Bromosulphobismuthous acid.</b>
<b>Rubidium bromosmate</b> , $\text{Rb}_2\text{OsBr}_4$ Difficultly sol in $\text{H}_2\text{O}$ and in dil. HBr. (Gutbier, <i>l. c.</i> )	<b>Cuprous bromosulphobismuthite</b> , $2\text{Cu}_2\text{S}, \text{Bi}_2\text{S}_3, 2\text{Bi}_2\text{SO}_4$ . Stable in the air and insol in $\text{H}_2\text{O}$ at ord. temp. Partially decomp by boiling $\text{H}_2\text{O}$ . Decomp by mineral acids with the evolution of $\text{H}_2\text{S}$ . (Ducatte, C R. 1902, 134. 1212.)
<b>Silver bromosmate</b> , $\text{Ag}_2\text{OsBr}_4$ Ppt, insol in $\text{H}_2\text{O}$ (Rosenheim, <i>l. c.</i> )	<b>Lead bromosulphobismuthite</b> , $\text{PbS}, \text{Bi}_2\text{S}_3, 2\text{Bi}_2\text{SO}_4$ . Insol. in $\text{H}_2\text{O}$ . Decomp. by boiling $\text{H}_2\text{O}$ . Decomp. by dil. mineral acids with evolution of $\text{H}_2\text{S}$ . (Ducatte, <i>l. c.</i> )
<b>Sodium bromosmate</b> , $\text{Na}_2\text{OsBr}_4 + 4\text{H}_2\text{O}$ . Sol in $\text{H}_2\text{O}$ (Rosenheim, <i>l. c.</i> )	<b>Bromotantalum bromide</b> , $(\text{Ta}_2\text{Br}_{12})\text{Br}_2 + 7\text{H}_2\text{O}$ . Stable in the air when in the solid state. Sol in $\text{H}_2\text{O}$ without decomp. Sol. in propyl alcohol (Chapin, J Am Chem. Soc 1910, 32. 328.)
<b>Bromostannic acid</b> , $\text{H}_2\text{SnBr}_6 + 8\text{H}_2\text{O}$ . Very deliquescent. Sol. in $\text{H}_2\text{O}$ . (Seubert, B 20. 794.)	<b>Bromotantalum chloride</b> , $(\text{Ta}_2\text{Br}_{12})\text{Cl}_2 + 7\text{H}_2\text{O}$ . (Chapin, <i>l. c.</i> )
<b>Ammonium bromostannate</b> , $(\text{NH}_4)_2\text{SnBr}_6$ Very deliquescent, and sol. in $\text{H}_2\text{O}$ . (Raymann and Preis, A. 223. 323.)	<b>Bromotantalum hydroxide</b> , $(\text{Ta}_2\text{Br}_{12})(\text{OH})_2 + 10\text{H}_2\text{O}$ Sl sol. in HCl. Stable in the air below $100^\circ$ . Sol in alcohol. Insol. in ether (Chapin, <i>l. c.</i> )
<b>Cæsium bromostannate.</b> Sol in $\text{H}_2\text{O}$ . (Raymann and Preis.)	<b>Bromotantalum iodide</b> , $(\text{Ta}_2\text{Br}_{12})\text{I}_2 + 7\text{H}_2\text{O}$ . (Chapin, <i>l. c.</i> )
<b>Calcium bromostannate</b> , $\text{CaSnBr}_6 + 6\text{H}_2\text{O}$ . Very deliquescent. Sol. in $\text{H}_2\text{O}$ . (Raymann and Preis.)	<b>Bromotelluric acid.</b>
<b>Cobalt bromostannate</b> , $\text{CoSnBr}_6 + 10\text{H}_2\text{O}$ . Deliquescent (Raymann and Preis.)	<b>Ammonium bromotellurate</b> , $(\text{NH}_4)_2\text{TeBr}_6$ Less sol. in $\text{H}_2\text{O}$ than K salt. (Muthmann and Schmidt, B. 1893, 26. 1011.)
<b>Ferrous bromostannate</b> , $\text{FeSnBr}_6 + 6\text{H}_2\text{O}$ . Deliquescent. (Raymann and Preis.)	
<b>Lithium bromostannate</b> , $\text{Li}_2\text{SnBr}_6 + 6\text{H}_2\text{O}$ . Extremely deliquescent (Leteur, C R. 113. 541.)	
<b>Magnesium bromostannate</b> , $\text{MgSnBr}_6 + 10\text{H}_2\text{O}$ . Deliquescent (Raymann and Preis.)	

**Cæsium bromotellurate, Cs<sub>2</sub>TeBr<sub>6</sub>.**

Decomp. by H<sub>2</sub>O  
 100 pts HBr+Ag (sp. gr 1.49) dissolve  
 0.02 pt. at 22°  
 100 pts HBr+Ag (sp. gr. 1.08) dissolve  
 0.13 pt. at 22°  
 Insol. in alcohol. (Wheeler, Sill Am J. 145. 267.)

**Potassium bromotellurate, K<sub>2</sub>TeBr<sub>6</sub>+3H<sub>2</sub>O.**

Sol. in little, decomp by much H<sub>2</sub>O (v. Hauer.)  
 Contains 2H<sub>2</sub>O (Wheeler, Sill. Am. J. 145. 267.)  
 Efflorescent.  
 100 pts. HBr+Ag (sp. gr 1.49) dissolve  
 6.57 pts at 22°  
 100 pts. HBr+Ag (sp. gr 1.08) dissolve  
 62.90 pts. at 22°  
*Anhydrous* Stable on air (Wheeler.)

**Rubidium bromotellurate, Rb<sub>2</sub>TeBr<sub>6</sub>.**

Sol in a little hot H<sub>2</sub>O, but H<sub>2</sub>TeO<sub>5</sub> separates on cooling  
 100 pts HBr+Ag (sp. gr 1.49) dissolve  
 0.26 pt. at 22°  
 100 pts HBr+Ag (sp. gr. 1.08) dissolve  
 3.88 pts at 22°. (Wheeler.)

**Bromotetramine chromium bromide, CrBr(NH<sub>3</sub>)<sub>4</sub>Br<sub>2</sub>+H<sub>2</sub>O.**

Easily sol in H<sub>2</sub>O (Cleve.)

**— chloride, CrBr(NH<sub>3</sub>)<sub>4</sub>Cl<sub>2</sub>+H<sub>2</sub>O.**

Sol in H<sub>2</sub>O. (Cleve.)

**— sulphate, CrBr(NH<sub>3</sub>)<sub>4</sub>SO<sub>4</sub>+H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O. (Cleve.)

**Bromotetramine cobaltic sulphate,**

BrCo(NH<sub>3</sub>)<sub>4</sub>SO<sub>4</sub>, or Br<sub>2</sub>Co<sub>2</sub>(NH<sub>3</sub>)<sub>4</sub>(SO<sub>4</sub>)<sub>2</sub>.

Sol. in H<sub>2</sub>O. (Vortmann and Blasberg, B. 22. 2852.)

**Cadmium, Cd.**

Not attacked by H<sub>2</sub>O. Sol. in HCl, or dil. H<sub>2</sub>SO<sub>4</sub>+Ag, but more easily in HNO<sub>3</sub>+Ag  
 Sol. in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Ag

Chemically pure Cd like Zn is almost insol. in dil acids, with the exception of HNO<sub>3</sub>. (Weeren, B. 1891, 24. 1798.)

Sol. in HClO<sub>3</sub>+Ag without evolution of H. (Hendrixson, J. Am. Chem. Soc. 1904, 26. 256.)

Cadmium is sol. in molten CdCl<sub>2</sub> and can be recryst. therefrom. (Auerbach, Z. anorg. 1901, 28. 42.)

From 4 g. Cd in 32 g molten CdCl<sub>2</sub> at 650°, 2.197 g. were dissolved in ½ hr. (Helfenstein, Z. anorg. 1900, 23. 295.)

Moderately quickly sol. in K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>+Ag  
 More slowly sol. in (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub>+Ag. (Levi, Gazz. ch. it. 1908, 38 (1) 683.)

Sol. in (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub>+Ag without evolution of gas. (Turrentine, J. phys. Chem. 1907, 11. 627.)

Sol. in sulphostannates+Ag (Storch, B. 1883, 18. 2015)

½ com. oleic acid dissolves 0.0293 g. Cd in 6 days (Gates, J. phys. Chem 1911, 15. 143.)

Not attacked by sugar solution. (Klein and Berg, C R. 102. 1170.)

**Cadmium amalgam, Cd<sub>2</sub>Hg.**

Stable from 0°–44°. Can be cryst from Hg without decomp. if temp. does not exceed 44° (Kerp Z. anorg. 1900, 25. 68.)

**Cadmium amide, Cd(NH<sub>2</sub>)<sub>2</sub>.**

Decomp. by H<sub>2</sub>O. (Bohart, J. phys. Chem. 1915, 19. 543)

**Cadmium arsenide, Cd<sub>2</sub>As.**

(Descamps, C. R. 85. 1022)  
 Cd<sub>2</sub>As<sub>2</sub>. Sol in dil cold HNO<sub>3</sub>. Attacked by aqua regia. (Granger, C. R. 1904, 138. 575.)

**Cadmium azoimide, Cd(N<sub>3</sub>)<sub>2</sub>.**

Ppt. (Curtius, J pr. 1898, (2) 58. 294.)

**Cadmium subbromide, Cd<sub>2</sub>Br<sub>3</sub>.**

Decomp. by H<sub>2</sub>O (Morse and Jones, Am. Ch J. 1890, 12. 460.)

**Cadmium bromide, CdBr<sub>2</sub>.**

Deliquescent. Very sol in H<sub>2</sub>O.

Solubility in H<sub>2</sub>O at t°

t°	% CdBr <sub>2</sub>	t°	% CdBr <sub>2</sub>
—4	32.0	48	60.0
—1	34.7	71	61.2
+1	36.3	104	61.8
2	36.0	155	63.7
9	41.9	170	65.2
14	46.0	215	69.9
25	52.6	232	70.1
35	59.6	245	71.5

Solid phase above 100° is CdBr<sub>2</sub>+½H<sub>2</sub>O. (Etard, A. ch. 1894, (7) 2. 541)

See also under CdBr<sub>2</sub>+H<sub>2</sub>O and CdBr<sub>2</sub>+4H<sub>2</sub>O

Sp. gr. of CdBr<sub>2</sub>+Ag at 19.5° containing:

	5	10	15	20	25 % CdBr <sub>2</sub>
1.043	1.090	1.141	1.199	1.260	
30	35	40	45	50 % CdBr <sub>2</sub>	
1.326	1.400	1.481	1.578	1.680	

(Kremers, calculated by Gerlach, Z. anal. 8. 280.)

CdBr<sub>2</sub>+Ag containing 18.06% CdBr<sub>2</sub> has sp. gr 20°/20°=1.1378.

CdBr<sub>2</sub>+Ag containing 21.39% CdBr<sub>2</sub> has sp. gr. 20°/20°=1.1866.

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 282.)

Sp. gr. of CdBr<sub>2</sub>+Ag containing 35.84% CdBr<sub>2</sub>=1.4231 at 19.4°/4°. (Hallwachs, W. Ann. 1899, 68. 27)

Sp. gr. of $\text{CdBr}_2 + \text{Aq}$ at $18^\circ/4^\circ$			
$\rho_{\text{CdBr}_2}$	33.289	23.973	20.552 11.983
Sp. gr.	1.384	1.252	1.209 1.112
$\rho_{\text{CdBr}_2}$	6.543	3.734	1.927
Sp. gr.	1.106	1.030	1.017
(de Murynek, W. Ann. 1894, 53. 561.)			

Sp. gr. of $\text{CdBr}_2 + \text{Aq}$ at $18^\circ$ .			
$\rho_{\text{CdBr}_2}$	1	5	10 15 20
Sp. gr.	1.0072	1.0431	1.0907 1.1432 1.1991
$\rho_{\text{CdBr}_2}$	25	30	35 40 43
Sp. gr.	1.2605	1.3296	1.4052 1.4915 1.5467
(Grottrian, W. Ann. 1883, 18. 193)			

Sp. gr. of $\text{CdBr}_2 + \text{Aq}$			
$\rho_{\text{CdBr}_2}$	$t^\circ$	Sp. gr. at $t^\circ$	Sp. gr. at $18^\circ$
0.0324	17 90	0.99901	0.99900
	22 75	0.99702	
0.0748	17 23	0.99949	0.99935
	21 50	0.99863	
0.154	17 67	1.00008	1.00002
	23 10	0.99896	
0.253	17 23	1.00119	0.00100
	22 95	0.99986	
0.506	18 07	0.00308	1.00310
	22 65	1.00212	
1.013	18 00		1.00750

(Wershofen, Z. phys. Ch. 1890, 5. 493.)

Sp. gr. of  $\text{CdBr}_2 + \text{Aq}$  at  $20^\circ$

Normality of $\text{CdBr}_2 + \text{Aq}$	$\rho_{\text{CdBr}_2}$	Sp. gr.
2.774	46.574	1.6198
1.997	37.53	1.4469
0.973	22.53	1.2293
0.5138	12.46	1.1211

(Forehheimer, Z. phys. Ch. 1900, 34. 29)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84. 27)

Sol. in  $\text{HCl} + \text{Aq}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , alcohol, or ether (Beuthemot, A. ch. 44. 387)

Sol. in 0.94 pt.  $\text{H}_2\text{O}$ , 3.4 pts. abs. alcohol, 250 pts. ether, and 18 pts. alcohol-ether (1:1) (Eder, Dingl. 221. 89.)

Anhydrous  $\text{CdBr}_2$  is sol. in acetone (Krug and M'Elroy)

1 g.  $\text{CdBr}_2$  is sol. in 64.5 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 0.8073$  (Naumann, B. 1904, 37. 4337.)

Sol. in acetone (Eidmann, C. C. 1899, II, 1014)

Insol. in mustard oil. (Mathews, J. phys. Chem. 1905, 9. 647.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in ethyl acetate (Naumann, B. 1910, 43. 314)

Sol. in chinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236)

100 g. benzonitrile dissolve 0.857 g.  $\text{CdBr}_2$  at  $18^\circ$ . (Naumann, B. 1914, 47. 1370.)

Mol. weight determined in pipondine. (Ferehland, Z. anorg. 1897, 15. 17.)

+  $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

$35^\circ$   $40^\circ$   $45^\circ$   $60^\circ$   $80^\circ$   $100^\circ$   
60.29 60.65 60.75 61.10 61.29 61.63 g.  $\text{CdBr}_2$ .  
(Diets, Z. anorg. 1899, 20. 261)

+  $1\frac{1}{2}\text{H}_2\text{O}$  (Fetard, A. ch. 1894, (7) 2. 541.)

+  $4\text{H}_2\text{O}$  Efflorescent (Rammelsberg, Pogg. 56. 241.)

Solubility in  $\text{H}_2\text{O}$

100 g. of the sat. solution contain at:

$0^\circ$   $18^\circ$   $30^\circ$   $38^\circ$   
37.92 48.90 56.90 61.84 g.  $\text{CdBr}_2$ .

Sp. gr. of sat. solution at  $18^\circ = 1.683$ .

(Diets, Z. anorg. 1899, 20. 261.)

100 g. sat. solution of  $\text{CdBr}_2 + 4\text{H}_2\text{O}$  in absolute alcohol contain 20.93 g.  $\text{CdBr}_2$  at  $15^\circ$ .

100 g. sat. solution of  $\text{CdBr}_2 + 4\text{H}_2\text{O}$  in absolute ether contain 0.4 g.  $\text{CdBr}_2$  at  $15^\circ$ . (Eder, Dingl. 221. 89.)

Cadmium hydrogen bromide.

Decomp. by  $\text{H}_2\text{O}$ . (Berthelot, C. R. 91. 1024.)

Cadmium caesium bromide,  $\text{CdBr}_2, \text{CsBr}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Wells and Walden, Z. anorg. 5. 270.)

$\text{CdBr}_2, 2\text{CsBr}$ . Decomp. by  $\text{H}_2\text{O}$  into above comp. (W. and W.)

$\text{CdBr}_2, 3\text{CsBr}$ . Decomp. by  $\text{H}_2\text{O}$  into  $\text{CdBr}_2, \text{CsBr}$ . (W. and W.)

Cadmium potassium bromide,  $\text{CdBr}_2, \text{KBr} + \frac{1}{2}\text{H}_2\text{O}$ .

Sol. in 0.79 pt.  $\text{H}_2\text{O}$  at  $15^\circ$ ; pptd. by alcohol and ether (Eder, Dingl. 221. 89.)

+  $\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  without decomp. from  $0.4^\circ$  to  $-112.5^\circ$ . (Rimbach, B. 1905, 38, 1554.)

100 pts. of the solution contain at:

$0.4^\circ$   $15.8^\circ$   $50^\circ$   $112.5^\circ$   
53.75 58.68 68.25 78.10 pts. of the salt.

$\text{CdBr}_2, 4\text{KBr}$ . Sol. in 1.40 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ ; pptd. by alcohol and ether. (Eder, Dingl. 221. 89.)

Cannot be prepared in a pure state as it is decomp. by  $\text{H}_2\text{O}$  below  $160^\circ$ . (Rimbach, B. 1905, 38. 1560.)

Cadmium rubidium bromide,  $\text{CdBr}_2, \text{RbBr}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. from  $0.4^\circ$  to  $-107.5^\circ$ .

100 pts. of the solution contain at:

$0.4^\circ$   $14.5^\circ$   $49.2^\circ$   $107.5^\circ$   
32.65 41.87 58.54 75.77 pts. of the salt..

(Rimbach, B. 1905, 38. 1556.)

$\text{CdBr}_2, 4\text{RbBr}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. from  $0.5^\circ$  to  $114.5^\circ$ .

100 pts. of the solution contain at:

$0.5^\circ$   $13.5^\circ$   $51.5^\circ$   $114.5^\circ$   
47.95 55.17 68.82 79.04 pts. of the salt.

(Rimbach, B. 1905, 38. 1561.)

Cadmium sodium bromide,  $\text{CdBr}_2$ ,  $\text{NaBr} + 2\frac{1}{2}\text{H}_2\text{O}$

Sol. at  $15^\circ$  in 104 pts  $\text{H}_2\text{O}$ , 37 pts abs. alcohol, and 190 pts ether (sp. gr. 0.729). (Eder, Dingl. 221. 89.)

$3\text{CdBr}_2$ ,  $2\text{NaBr} + 6\text{H}_2\text{O}$ . Stable in conc. solutions and decomp. only by great dilution (Jones and Knight, Am. Ch. J. 1899, 22. 134.)

Cadmium bromide ammonia,  $\text{CdBr}_2 \cdot 2\text{NH}_3$

Can be crystallized out of warm  $\text{NH}_4\text{OH} + \text{Aq.}$  (Croft, Phil. Mag. 21. 355.)

$\text{CdBr}_2 \cdot 3\text{NH}_3$ . (Tassaly, C. R. 1897, 124. 1023.)

$\text{CdBr}_2 \cdot 4\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Croft.)

Cadmium bromide cupric oxide,  $\text{CdBr}_2$ ,  $3\text{CuO} + 3\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 383.)

Cadmium bromide hydrazine,  $\text{CdBr}_2 \cdot 2\text{N}_2\text{H}_4$

Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Fianzen, Z. anorg. 1908, 60. 280.)

Cadmium bromide hydroxylamine,  $\text{CdBr}_2 \cdot 2\text{NH}_2\text{OH}$

Sol. in hot  $\text{H}_2\text{O}$  with formation of a basic salt. Sol. in dil. acids. Insol. in alcohol and ether. (Adams, Am. Ch. J. 1902, 28. 218.)

Cadmium subchloride,  $\text{Cd}_2\text{Cl}_3$

Decomp. by  $\text{H}_2\text{O}$  and by acids. (Morse and Jones, Am. Ch. J. 1890, 12. 490.)

Cadmium chloride,  $\text{CdCl}_2$

Sol. at  $20^\circ$   $40^\circ$   $60^\circ$   $80^\circ$   $100^\circ$

in 0.71 0.72 0.72 0.70 0.67 pts  $\text{H}_2\text{O}$ .

(Kremers Pogg. 103. 57.)

Sat.  $\text{CdCl}_2 + \text{Aq}$  contains %  $\text{CdCl}_2$  at  $t^\circ$ .

$t^\circ$	% $\text{CdCl}_2$	$t^\circ$	% $\text{CdCl}_2$
-7	43.5	120	63.0
+1	47.6	150	64.8
6	49.7	165	68.2
7	51.3	170	68.4
10	51.6	180	70.1
19	52.7	190	71.9
25	52.9	200	72.0
61	57.9	235	76.0
82	58.8	270	77.7

(Etard, A. ch. 1894, (7) 2. 536.)

100 mol.  $\text{H}_2\text{O}$  dissolve at:

$19.3^\circ$   $29.7^\circ$   $40.1^\circ$   $54.5^\circ$

10.94 12.74 13.15 13.16 mol.  $\text{CdCl}_2$ .

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, 37. 19.)

See also under  $\text{CdCl}_2 + \text{H}_2\text{O}$ ,  $\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$ , and  $\text{CdCl}_2 + 4\text{H}_2\text{O}$ .

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  containing pts.  $\text{CdCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ .

13 26.9 41 pts  $\text{CdCl}_2$ ,

1.1068 1.2106 1.3100

55.8 72.5 114.2 pts.  $\text{CdCl}_2$ .

1.4060 1.5060 1.7266

(Kremers, Pogg. 103. 57.)

$\text{CdCl}_2 + \text{Aq}$  containing 8.91%  $\text{CdCl}_2$  has sp. gr.  $20^\circ/20^\circ = 1.0715$  (Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 282.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at room temp containing.

%  $\text{CdCl}_2$  11.09 16.30 24.786

Sp. gr. 1.1093 1.1813 1.3199

(Wagner, W. Ann. 1883, 18. 266.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at  $18^\circ/4^\circ$

%  $\text{CdCl}_2$  57.524 41.547 29.977

Sp. gr. 1.852 1.515 1.330

%  $\text{CdCl}_2$  21.431 14.761

Sp. gr. 1.210 1.142

(de Mynck, W. Ann. 1894, 53. 561.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at  $18^\circ$ .

%  $\text{CdCl}_2$  1 5 10 15

Sp. gr. 1.0063 1.0436 1.0919 1.1443

%  $\text{CdCl}_2$  20 25 30 35

Sp. gr. 1.2007 1.2620 1.3305 1.4075

%  $\text{CdCl}_2$  40 45 50

Sp. gr. 1.4878 1.5775 1.6790

(Grotrian, W. Ann. 1883, 18. 193.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at  $25^\circ$

Concentration of  $\text{CdCl}_2 + \text{Aq}$  Sp. gr.

1-normal 1.0779

$\frac{1}{2}$ -normal 1.0394

$\frac{1}{4}$ -normal 1.0197

$\frac{1}{8}$ -normal 1.0008

(Wagner, Z. phys. Ch. 1890, 5. 36.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$

% $\text{CdCl}_2$	$t^\circ$	Sp. gr. at $t^\circ$	Sp. gr. at $18^\circ$
0.0503	17.59	0.99920	0.99910
	24.27	0.99781	
0.0999	17.70	0.99964	0.99968
	22.06	0.99833	
0.2004	18.31	1.00038	1.00044
	24.00	0.99920	
0.399	16.86	1.00239	1.0022
	24.21	1.00083	
0.599	17.49	1.00406	1.0039
	25.12	1.00238	
0.769	17.58	1.00580	1.0057
	21.76	1.00496	
0.997	17.55	1.00754	1.0075
	19.65	1.00713	

(Wershofen, Z. phys. Ch. 1890, 5. 492.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	Normality of $\text{CdCl}_2 + \text{Aq}$	g $\text{CdCl}_2$ in 100 g of solution	Sp. gr. $t^\circ/4^\circ$
20.5	3.80	44.42	1.5645
"	2.61	34.22	1.3941
"	1.76	25.90	1.2435
"	1.29	19.91	1.1977
"	0.93	14.88	1.1404
"	0.52	8.84	1.0801

(Oppenheimer, Z. phys. Ch. 1898, 27. 464.)

Sp gr. of  $\text{CdCl}_2 + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	Concentration of $\text{CdCl}_2 + \text{Aq}$	Sp gr.
22	1 pt $\text{CdCl}_2$ in 1.3458 pts. $\text{H}_2\text{O}$	1.6128
18 7	1 " " " 2.7005 " "	1.2896
17 2	1 " " " 53.988 " "	1.0155
16	1 " " " 54.18 " "	1.0152
17	1 " " " 57.479 " "	1.0136
22	1 " " " 77.232 " "	1.0076

(Hittorf, Z phys Ch. 1002, 39. 628.)

Solubility in  $\text{KCl} + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	100 g $\text{H}_2\text{O}$ dissolve g $\text{CdCl}_2$	g $\text{KCl}$	Solid phase
19 3	111 30 59 59	6 70	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$ $\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ $\text{KCl} + \text{H}_2\text{O}$ $\text{CdCl}_2, \text{KCl} + \text{H}_2\text{O}$ $\text{CdCl}_2, \text{KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ 4KCl $\text{CdCl}_2, 4\text{KCl} + \text{KCl}$ KCl
29 7	129 65 97 62 68 23 47 12 32 67 24 26 15 99 15 47	0 70 7 08 9 89 13 06 16 10 25 97 33 58	$\text{CdCl}_2 + 3\frac{1}{2}\text{H}_2\text{O}$ $\text{CdCl}_2 + 3\frac{1}{2}\text{H}_2\text{O}$ $\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ $\text{KCl} + \text{H}_2\text{O}$ $\text{CdCl}_2, \text{KCl} + \text{H}_2\text{O}$ " " " " " " $\text{CdCl}_2, \text{KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ 4KCl $\text{CdCl}_2, 4\text{KCl} + \text{KCl}$ KCl
40 1	133 85 92 15 51 90 37 91 24 46 18 97 19.92	2 70 11 50 15 21 21 73 35 51 37 63	$\text{CdCl}_2 + \text{H}_2\text{O}$ $\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ $\text{KCl} + \text{H}_2\text{O}$ $\text{CdCl}_2, \text{KCl} + \text{H}_2\text{O}$ " " " " " " $\text{CdCl}_2, \text{KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ 4KCl $\text{CdCl}_2, 4\text{KCl} + \text{KCl}$ KCl
54.5	133 90 102 15 44 01 26 13	2 32 18.39 43 78	$\text{CdCl}_2 + \text{H}_2\text{O}$ $\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ $\text{KCl} + \text{H}_2\text{O}$ $\text{CdCl}_2, \text{KCl} + \text{H}_2\text{O}$ $\text{CdCl}_2, \text{KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ 4KCl $\text{CdCl}_2, 4\text{KCl} + \text{KCl}$ KCl

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, 37. 34.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	100 g $\text{H}_2\text{O}$ dissolve g $\text{CdCl}_2$	g $\text{NaCl}$	Solid phase
19 3	111 30 116 64	7 52	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$ $\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ $2\text{NaCl} + 3\text{H}_2\text{O}$ $\text{CdCl}_2, 2\text{NaCl} + 3\text{H}_2\text{O}$ " " $\text{CdCl}_2, 2\text{NaCl} + 3\text{H}_2\text{O} + \text{NaCl}$ NaCl
29 7	129 65 132 67 123 54 106 16 91 10 13 74 9 43	9 63 10 10 12 92 15 41 27 46 37 54	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$ $\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ $2\text{NaCl} + 3\text{H}_2\text{O}$ $\text{CdCl}_2, 2\text{NaCl} + 3\text{H}_2\text{O}$ " " " " $\text{CdCl}_2, 2\text{NaCl} + 3\text{H}_2\text{O} + \text{NaCl}$ NaCl
40 1	133 85 137 08 48 17 13 31	15 14 29 50 38 16	$\text{CdCl}_2 + \text{H}_2\text{O}$ $\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ $2\text{NaCl} + 3\text{H}_2\text{O}$ $\text{CdCl}_2, 2\text{NaCl} + 3\text{H}_2\text{O}$ $\text{CdCl}_2, 2\text{NaCl} + 3\text{H}_2\text{O} + \text{NaCl}$ NaCl
54 5	133 90 140 42 52 76 22 53	19 10 32 97 39 07 36.82	$\text{CdCl}_2 + \text{H}_2\text{O}$ $\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ $2\text{NaCl} + 3\text{H}_2\text{O}$ $\text{CdCl}_2, 2\text{NaCl} + 3\text{H}_2\text{O}$ $\text{CdCl}_2, 2\text{NaCl} + 3\text{H}_2\text{O} + \text{NaCl}$ NaCl

At  $34.5^\circ$ ,  $\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} \rightarrow \text{CdCl}_2 + \text{H}_2\text{O}$  and water.  
(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, 37. 28.)Insol. in  $\text{SbCl}_3$ . (Klemenstewicz, C. A. 1909, 269.)Insol in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. or al. sol in ethyl alcohol, furfural, acetophenone, ethyl monochloracetate, ethyl cyanacetate, ethyl oxalate, ethyl nitrate, amyl nitrate, o-nitrotoluene, pyridine, piperidine, and quinoline. Sol in salicylic aldehyde. (Lincoln, J. phys. Chem. 1899, 3. 461.)

Insol. in anhydrous ether. (Hampe, Ch. Z. 1887, II, 847.)

Readily sol in alcohol

100 pts. absolute methyl alcohol dissolve 1.71 pts.  $\text{CdCl}_2$  at  $15.5^\circ$ .100 pts. absolute ethyl alcohol dissolve 1.52 pts.  $\text{CdCl}_2$  at  $15.5^\circ$  (de Bruyn, Z. phys. Ch. 10. 783.)100 g.  $\text{CdCl}_2 + \text{CH}_3\text{OH}$  contain 1.5 g.  $\text{CdCl}_2$ .

at the critical temp. (Centnerswer, Z phys Ch. 1910, 72, 437)

Somewhat sol in acetone. (Krug and M'Elroy.)

Sol in acetone; insol in methylal (Eidmann, C C 1899, II, 1014)

Insol in methyl acetate (Naumann, B 1909, 42, 3790)

Sol in ethyl acetate. (Naumann, B. 1904, 37, 3601.)

Difficultly sol in ethylacetate. (Naumann, B 1910, 43, 314)

Sol in urethane (Castoro, Z anorg. 1899, 20, 61.)

At 18°, 100 g. benzonitrile dissolve 0.06332 g. CdCl<sub>2</sub> (Naumann, B 1914, 47, 1370.)

Insol in toluene. (Baxter and Hines, Am. Ch. J. 1904, 31, 222.)

Sol in chinolin. (Beckmann and Gabel, Z anorg 1906, 51, 236)

+H<sub>2</sub>O Solubility in H<sub>2</sub>O

100 g. of the sat. solution contain at

10°	20°	40°	60°
37.47	57.35	57.51	57.77

80° 100°

58.41 59.52 g CdCl<sub>2</sub>

110° is bpt of the sat. solution.

(Dietz, Z anorg 1899, 20, 257)

+2½H<sub>2</sub>O Solubility in H<sub>2</sub>O

100 g. of the sat. solution contain at.

-10°	0°	18°	30°	36°
44.35	47.37	52.53	56.27	57.91 g CdCl <sub>2</sub>

Sp gr of sat. solution = 1.741

(Dietz, Z anorg 1899, 20, 257)

+4H<sub>2</sub>O Solubility in H<sub>2</sub>O

100 g. of the sat. solution contain at.

-9°	0°	+10°	+15°
43.58	49.39	55.58	59.12 g CdCl <sub>2</sub>

(Dietz, Z anorg. 1899, 20, 257.)

+5H<sub>2</sub>O. (Worobieff, Z. anorg. 1898, 18, 386.)

**Cadmium hydrogen chloride, CdCl<sub>2</sub>, 2HCl + 7H<sub>2</sub>O.**

Decomp in air. (Berthelot, C. R. 91, 1024)

**Cadmium caesium chloride, CdCl<sub>2</sub>, 2CsCl.**

Easily sol. in H<sub>2</sub>O and dil. HCl + Aq; insol. in conc. HCl + Aq. (Godefroy, B. 8, 9.)

Nearly insol. in CsCl + Aq (Wells and Walden, Z. anorg. 5, 286.)

CdCl<sub>2</sub>, CsCl. Sl. sol. in H<sub>2</sub>O, nearly insol. in CdCl<sub>2</sub> + Aq. (Wells and Walden)

**Cadmium calcium chloride, 2CdCl<sub>2</sub>, CaCl<sub>2</sub> + 7H<sub>2</sub>O**

Rather deliquescent, and very sol. in H<sub>2</sub>O. When ignited is only sl. sol. in H<sub>2</sub>O with evolution of heat. (v. Hauer, J pr. 63, 432.)

CdCl<sub>2</sub>, 2CaCl<sub>2</sub> + 12H<sub>2</sub>O. Very deliquescent. (v. Hauer.)

**Cadmium cobaltous chloride, 2CdCl<sub>2</sub>, CoCl<sub>2</sub> + 12H<sub>2</sub>O**

Deliquescent Sol in H<sub>2</sub>O. (v. Hauer, W A B. 17, 331)

**Cadmium cupric chloride, CdCl<sub>2</sub>, CuCl<sub>2</sub> + 4H<sub>2</sub>O.**

Sol in H<sub>2</sub>O (v. Hauer, W A B 17, 331.)

**Cadmium hydrazine chloride, CdCl<sub>2</sub>, N<sub>2</sub>H<sub>4</sub>.HCl.**

Unstable in the air when moist Very sol. in H<sub>2</sub>O, sl. sol. in alcohol; sol in NH<sub>3</sub> + Aq.

(Curtius, J. pr 1894, (2) 50, 334.)

CdCl<sub>2</sub>.2N<sub>2</sub>H<sub>4</sub>.HCl + 4H<sub>2</sub>O Very sol in H<sub>2</sub>O, sl sol in alcohol (Curtius, J pr. 1894, (2) 50, 335)

**Cadmium iron (ferrous) chloride, 2CdCl<sub>2</sub>, FeCl<sub>2</sub> + 12H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O (v Hauer, W. A. B 17, 331)

**Cadmium lithium chloride, CdCl<sub>2</sub>, LiCl + 3½H<sub>2</sub>O.**

Very deliquescent Decomp by solution in H<sub>2</sub>O, but not in alcohol. (Chassevant, A. ch. (6) 30, 39)

**Cadmium magnesium chloride, 2CdCl<sub>2</sub>, MgCl<sub>2</sub> + 12H<sub>2</sub>O.**

Deliquescent in moist, stable in dry air. Easily sol in H<sub>2</sub>O with absorption of heat. Much more sol. in hot than in cold H<sub>2</sub>O. (v. Hauer)

Solubility in H<sub>2</sub>O at t°

t°	G Cd <sub>2</sub> MgCl <sub>2</sub> in 100 g solution	G Cd <sub>2</sub> MgCl <sub>2</sub> in 100 g H <sub>2</sub> O
2 4	45 61	83 86
20. 2	49 69	98 77
45. 5	53 51	115. 10
67 2	58 14	138. 90
121 8	65 48	189. 69

(Rimbach, B. 1897, 30, 3084.)

**CdCl<sub>2</sub>, 2MgCl<sub>2</sub> + 12H<sub>2</sub>O** Very deliquescent. (v Hauer.)

**Cadmium manganese chloride, 2CdCl<sub>2</sub>, MnCl<sub>2</sub> + 12H<sub>2</sub>O.**

Deliquescent in moist, efflorescent in dry air. Sol in H<sub>2</sub>O. (v Hauer)

**Cadmium nickel chloride, CdCl<sub>2</sub>, 2NiCl<sub>2</sub> + 12H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (v Hauer, W. A. B 20, 40.)

2CdCl<sub>2</sub>, NiCl<sub>2</sub> + 12H<sub>2</sub>O Sol. in H<sub>2</sub>O. (v. Hauer.)

**Cadmium potassium chloride, CdCl<sub>2</sub>, KCl + ½H<sub>2</sub>O**

Sol. in H<sub>2</sub>O without decomp. (v. Hauer.)

+H<sub>2</sub>O 100 mol H<sub>2</sub>O dissolve at  
19.3° 29.7° 40.1° 54.5°  
2.65 3.21 3.72 4.33 mol CdCl<sub>2</sub>, KCl+H<sub>2</sub>O.  
(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, 37, 26)

Solubility in H<sub>2</sub>O at t°.

t°	G CdCl <sub>2</sub> in 100 g solution	G CdCl <sub>2</sub> in 100 g H <sub>2</sub> O
2 6	21 87	27 99
15 9	26 60	36. 4
41 5	35.66	55.34
60 6	40 67	68 55
105 1	51 67	106 91

(Rimbach, B. 1897, 30. 3079)

CdCl<sub>2</sub>, 2KCl. 100 pts. H<sub>2</sub>O at 15.5° dissolve 33.45 pts. Sl. sol. in alcohol (Croft, Phil Mag. (3) 21. 356.)

Solubility in salts +Aq at 16°.

CdCl<sub>2</sub>, 2KCl is sol without decomp. in the following salt solutions at 16°.

Salt	Mols salt in 100 mole H <sub>2</sub> O	In 1 litre of the solution mole			Sp. gr. of the solution
		CdCl <sub>2</sub>	KCl	RCl	
LiCl	9 3	0 166	0 663	4 483	1 1380
CaCl <sub>2</sub>	3 8	0.270	1 080	1 887	1.2333
KCl	2 378	0.507	3 195		1.214

(Rimbach, B. 1905, 38. 1568.)

CdCl<sub>2</sub>, 4KCl. More sol. in H<sub>2</sub>O than CdCl<sub>2</sub>, KCl (v. Hauer.)  
100 g H<sub>2</sub>O dissolve at.

19.3° 29.7° 40.1° 54.5°  
41.65 49.05 57.55 69.91 g. CdCl<sub>2</sub>, 4KCl  
(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, 37, 24.)

Solubility in H<sub>2</sub>O at t°.

t°	100 pts solution contain pts		
	Cd	Cl	K
4 0	3 64	9 84	8 31
23.6	5 66	14 02	11 52
50 2	9.10	18 09	13 60
108 8	11 97	23 08	17 10
109 0	11 91	23 15	17 22

(Rimbach, B. 1897, 30. 3080.)

Decomp. by H<sub>2</sub>O.

Can be recryst. without decomp. from LiCl, CaCl<sub>2</sub>, or MgCl<sub>2</sub>+Aq. (Rimbach, B. 1905, 38. 1565.)

The salt is sol. without decomp. in HCl+Aq containing 19.8 mole HCl per 100 mole H<sub>2</sub>O at 16°

1 l. of the solution contains 0.033 mole CdCl<sub>2</sub>, 0.132 mole KCl and 8.828 mole HCl; sp. gr. of the solution = 1.1403 (Rimbach, B. 1905, 38. 1568.)

Cadmium rubidium chloride, CdCl<sub>2</sub>, 2RbCl  
Sol in H<sub>2</sub>O and HCl+Aq. (Godeffroy, B. 8. 9.)

CdCl<sub>2</sub>, RbCl Solubility in H<sub>2</sub>O at t°.  
100 pts by wt. of the solution contain pts by wt. RbCl, CdCl<sub>2</sub>.

t°	Pts. RbCl, CdCl <sub>2</sub>
1 2	12 97
14.5	16 80
41 4	25 31
57 6	30 83
103 9	46 62

CdCl<sub>2</sub>, RbCl is sol. in H<sub>2</sub>O without decomp from 0-104° (Rimbach, B. 1902, 35. 1303)

CdCl<sub>2</sub>, 4RbCl.

Solubility of CdCl<sub>2</sub>, 4RbCl and CdCl<sub>2</sub>, RbCl in H<sub>2</sub>O at t°.

t°	In 100 pts by wt. of the solution			Composition of the solid phase	
	Pts by wt Cd	Pts by wt Cl	Pts. by wt Rb	Mol.-% mono-salt	Mol.-% tetra-salt
0.7	0 65	6.52	14 73	30	70
8.8	1 07	7 37	16 13	24	76
13.8	1.32	7 86	16 93	16	84
42 4	3.21	11 35	22 45	14	86
59 0	4 61	13 41	25 31	33	67
108 4	8 94	18 57	31.15		..

(Rimbach, B. 1902, 35. 1305.)

Decomp. by H<sub>2</sub>O between 0° and 108°.  
(Rimbach, B. 1905, 38. 1571.)

Sol in conc. HCl without decomp. (Rimbach, B. 1905, 38. 1571.)

Not sol. in CaCl<sub>2</sub>+Aq and LiCl+Aq without decomp. (Rimbach, B. 1905, 38. 1571.)

Cadmium sodium chloride, CdCl<sub>2</sub>, 2NaCl+3H<sub>2</sub>O

Sol in 1.4 pts. H<sub>2</sub>O at 16° (Croft)  
100 mol. H<sub>2</sub>O dissolve at

19.3° 29.7° 40.1° 54.5°  
3.93 4.29 4.73 5.18 mol. CdCl<sub>2</sub>, 2NaCl+3H<sub>2</sub>O.

Stable between 19° and 55°  
(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, 37, 25.)

Sl sol in alcohol or wood alcohol (Croft.)

Cadmium strontium chloride, 2CdCl<sub>2</sub>, SrCl<sub>2</sub>+7H<sub>2</sub>O

Sol in H<sub>2</sub>O (v. Hauer)

Cadmium chloride ammonia, CdCl<sub>2</sub>, 2NH<sub>3</sub>.

Nearly insol. in H<sub>2</sub>O. (v. Hauer.)

CdCl<sub>2</sub>, 3NH<sub>3</sub>+ $\frac{1}{2}$ H<sub>2</sub>O.

CdCl<sub>2</sub>, 4NH<sub>3</sub>+ $\frac{1}{2}$ H<sub>2</sub>O.

CdCl<sub>2</sub>, 6NH<sub>3</sub>. (André, C. R. 104. 908)

CdCl<sub>2</sub>, 6NH<sub>3</sub>. Difficultly sol. in cold H<sub>2</sub>O.  
(Schuler, A. 87. 34.)

**Cadmium chloride cupric oxide,  $\text{CdCl}_2$ ,  $3\text{CuO} + 3\text{H}_2\text{O}$ .**

Not decomp. by  $\text{H}_2\text{O}$  (Mailhe, A. ch. 1902, (7) 27. 378 and 174.)

**Cadmium chloride hydrazine,  $\text{CdCl}_2$ ,  $2\text{N}_2\text{H}_4$ .**

Insol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z anorg 1908, 60. 279.)

+  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Curtius, J pr. 1894, (2) 50. 345)

**Cadmium chloride hydroxylamine,  $\text{CdCl}_2$ ,  $2\text{NH}_2\text{OH}$**

Sl sol in cold, somewhat more in warm  $\text{H}_2\text{O}$ . Very sol in hydroxylamine +  $\text{Aq}$ . Very sl sol. in alcohol and other organic solvents (Cusmer, Bull. Soc. (3) 3. 116)

Aq solution sat. at  $20^\circ$  contains about 1%. (Antonoff, C. C. 1905, II. 810)

**Cadmium fluoride,  $\text{CdF}_2$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HF} + \text{Aq}$ . (Berzelius, Pogg. 1. 28)

Very sol in  $\text{H}_2\text{O}$ , insol. in 95% alcohol, sol. in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq}$  with evolution of  $\text{HF}$ . (Pouleno, C. R. 116. 582)

1 l  $\text{H}_2\text{O}$  dissolves 0.289 mol  $\text{CdF}_2$  at  $25^\circ$ , or 100 cc. sat. aqueous solution contains 4.36 g.  $\text{CdF}_2$  at  $25^\circ$ . (Jaeger, Z anorg. 1901, 27. 35.)

1 l. of 1.08-N  $\text{HF}$  dissolves 0.372 mol.  $\text{CdF}_2$  at  $25^\circ$ . (Jaeger, Z anorg 1901, 27. 35)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827)

**Cadmium ceric fluoride,  $\text{CdF}_2 \cdot 2\text{CeF}_4 \cdot 7\text{H}_2\text{O}$**

Ppt. Decomp by  $\text{H}_2\text{O}$ . (Rambach, A. 1909, 368. 106.)

**Cadmium columbium fluoride.**

See Fluocolumbate, cadmium.

**Cadmium molybdenyl fluoride.**

See Fluoxymolybdate, cadmium.

**Cadmium silicon fluoride.**

See Fluosilicate, cadmium.

**Cadmium stannic fluoride.**

See Fluostannate, cadmium.

**Cadmium titanium fluoride.**

See Fluotitanate, cadmium.

**Cadmium zirconium fluoride.**

See Fluozirconate, cadmium.

**Cadmous hydroxide,  $\text{CdOH}$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp by acids into cadmic salt (Morse and Jones, Am. Ch. J. 12. 488)

**Cadmium hydroxide,  $\text{CdO}_2\text{H}_2$**

Insol. in  $\text{H}_2\text{O}$ .

1 l.  $\text{CdO}_2\text{H}_2 + \text{Aq}$  contains 0.0026 g.  $\text{CdO}_2\text{H}_2$

at  $25^\circ$  (Bodlander, Z. phys. Ch. 1898, 27. 66)

Solubility in  $\text{H}_2\text{O} = 2.6 \times 10^{-4}$  (Herz, Z. anorg. 1900, 24. 126.)

Sol in acids; very sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ .

Easily sol in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , and  $\text{NH}_4$  succinate +  $\text{Aq}$ . (Wittstein)

Freshly pptd  $\cdot \text{CdO}_2\text{H}_2$  is sol in alkali haloids +  $\text{Aq}$ . (Bersch, Z. phys. Ch. 1891, 8. 392)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  increases with increase in concentration of  $\text{NH}_4\text{OH}$  (Euler, B. 1903, 36. 3401)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

$\text{NH}_3$ norm	$\mu$ . $\text{CdO}$ per l
0.5	0.24
1.0	0.62
1.8	1.33
4.6	4.92

(Bonsdorff, Z. anorg. 1904, 41. 187)

Insol in ethyl, and methyl amine +  $\text{Aq}$ . (Wurtz)

Very sl. sol in  $\text{HCN} + \text{Aq}$  even when freshly pptd (Schuler, A. 87. 48.)

Not pptd in presence of  $\text{Na}$  citrate (Spiller), and many non-volatile organic substances (Rose)

**Cadmium iodide,  $\text{CdI}_2$**

Sol. in 113 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Eder, Dingl. 221. 89.)

Sol at  $20^\circ$   $40^\circ$   $60^\circ$   $80^\circ$   $100^\circ$   
in 1.08 1.00 0.93 0.86 0.75 pts  $\text{H}_2\text{O}$ .

(Kremers, Pogg. 103. 57.)

Sat.  $\text{CdI}_2 + \text{Aq}$  contains at

$-4^\circ$	$+2^\circ$	$+10^\circ$	$13^\circ$	$24^\circ$	$32^\circ$
42.4	43.7	45.2	44.8	46.5	47.4% $\text{CdI}_2$
54.4	64.4	76.4	94.4	95.4	135.4
49.5	50.1	52.4	55.1	54.7	62.9% $\text{CdI}_2$
140.4	165.4	185.4	202.4	202.4	255.4
63.1	68.1	70.7	73.4	73.2	84.5% $\text{CdI}_2$

(Étard, A. ch. 1894, (7) 2. 545.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

$0^\circ$	$18^\circ$	$50^\circ$	$75^\circ$	$100^\circ$
44.39	46.02	49.35	52.65	56.08 g $\text{CdI}_2$

(Diets, Z. anorg. 1899, 20. 262)

Sp gr. of  $\text{CdI}_2 + \text{Aq}$  containing pts.  $\text{CdI}_2$  to 100 pts.  $\text{H}_2\text{O}$ .

21.4	43.7	88.5 pts $\text{CdI}_2$
1.1681	1.328	1.6139

(Kremers, Pogg. 111. 80.)

Sp. gr. of  $\text{CdI}_2 + \text{Aq}$  at  $19.5^\circ$  containing:

5	10	15	20	25 % $\text{CdI}_2$
1.044	1.088	1.138	1.194	1.253

\* 30 35 40 45 50 %  $\text{CdI}_2$   
 1.319 1.395 1.476 1.575 1.680  
 (Kiemers, calculated by Gerlach, Z. anal. 8. 285.)

Sp. gr. of  $\text{CdI}_2 + \text{Aq}$  at  $18^\circ$ .

% $\text{CdI}_2$	1	5	10	15	20
Sp. gr.	1.0071	1.0425	1.0883	1.1392	1.1943

%  $\text{CdI}_2$  25 30 35 40 45  
 Sp. gr. 1.2550 1.3228 1.4000 1.4816 1.5741  
 (Grottrian, W. Ann. 1883, 18. 193.)

Sp. gr. of  $\text{CdI}_2 + \text{Aq}$ .

g $\text{CdI}_2$ per l	Sp. gr.	g $\text{CdI}_2$ per l	Sp. gr.
98.85	1.08	289.5	1.237
197.7	1.162	400	1.328

(Barbier and Roux, Bull. Soc. 1890, (3) 3. 425)

Sp. gr. of  $\text{CdI}_2 + \text{Aq}$ .

% $\text{CdI}_2$	$t^\circ$	Sp. gr. at $t^\circ$	Sp. gr. at $18^\circ$
0.0420	17.68	0.99915	0.99908
	22.88	0.99807	
0.100	17.55	0.99965	0.99956
	22.91	0.99363	
0.204	17.78	1.00052	1.0005
	22.79	0.99948	
0.399	17.40	0.00223	1.0021
	24.30	1.00082	
0.600	18.00		1.0038
0.800	17.44	1.00564	1.0056
	23.11	1.00442	
1.00	18.00		1.0072

(Wershofen, Z. phys. Ch. 1890, 5. 493.)

Sp. gr.  $\text{CdI}_2 + \text{Aq}$  at  $18^\circ/4^\circ$  containing:

31.123	13.677	9.559 % $\text{CdI}_2$
1.338	1.125	1.086

(de Mynck, W. Ann. 1894, 53. 561)

$\text{CdI}_2 + \text{Aq}$  containing 10.97 %  $\text{CdI}_2$  has sp. gr.  $20^\circ/20^\circ = 1.0982$ .

$\text{CdI}_2 + \text{Aq}$  containing 16.53 %  $\text{CdI}_2$  has sp. gr.  $20^\circ/20^\circ = 1.1562$   
 (Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 282)

Sp. gr. of  $\text{CdI}_2 + \text{Aq}$  at  $20^\circ$ .

Normality of $\text{CdI}_2 + \text{Aq}$	% $\text{CdI}_2$	Sp. gr.
1.924	44.53	1.5807
0.951	27.07	1.2837
0.447	14.40	1.1355
0.211	7.26	1.0630

(Forehheimer, Z. phys. Ch. 1900, 34. 29.)

$\text{CdI}_2 + \text{Aq}$  containing 1 pt.  $\text{CdI}_2$  in 2.2691 pts.  $\text{H}_2\text{O}$  at  $17^\circ$  has sp. gr. = 1.3341. (Hittorf, Z. phys. Ch. 1902, 39. 628.)

Sol. in sat.  $\text{HI} + \text{Aq}$ .  
 Sol. in warm  $\text{NH}_4\text{OH} + \text{Aq}$ .

Insol. in liquid  $\text{NH}_3$ . (Goie, Am. Ch. J. 1898, 20. 827)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Sol. in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 217.)

Difficultly sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25. 212)

Nearly insol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Sol. in  $\text{SO}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 215.)

Sol. in 15 pts. alcohol. (Vogel, N. Rep. Pharm. 12. 393.)

Sol. in 0.98 pt. abs. alcohol. (Eder, Dingl. 221. 89.)

Sp. gr. of  $\text{CdI}_2 + \text{alcohol}$ .

% $\text{CdI}_2$	Sp. gr. $20^\circ/20^\circ$
0	0.7949
7.28	0.8470

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 284.)

Sol. in 5.2 mols. methyl, 7 mols. ethyl, and 9.8 mols. propyl alcohol at  $20^\circ$ . (Timofejew, C. R. 112. 1224.)

Sol. in 3.6 pts. ether. (Eder, l. c.)

Sol. in 2.0 pts. alcohol-ether (1:1). (Eder, l. c.)

Very sl. sol. in anhydrous abs. ether. (Hampe, Ch. Z. 1887, 11. 847.)

100 g. of sat. solution in abs. ether contain 0.143 g.  $\text{CdI}_2$  at  $12^\circ$ . (Tyrer, Proc. Chem. Soc. 1911, 27. 142)

Solubility in ether +  $\text{Aq}$  at  $12^\circ$ .

% $\text{H}_2\text{O}$ in ether	% $\text{CdI}_2$	% $\text{H}_2\text{O}$ in ether	% $\text{CdI}_2$	% $\text{H}_2\text{O}$ in ether	% $\text{CdI}_2$
0.0	0.143	0.50	3.36	1.00	7.30
0.10	0.78	0.70	4.77	1.10	8.27
0.30	2.07	0.90	6.46	1.14	8.68

(Tyrer, Proc. Chem. Soc. 27. 142.)

Solubility in benzene at  $16^\circ$ . = 0.01 %  
 " 35° = 0.02 %

Solubility in ethyl ether at  $0^\circ$  = 0.03 %  
 " 15.5° = 0.04 %  
 " 20.3° = 0.05 %

(Linebarger, Am. J. Sci. 1895, (3) 49. 52)

Sol. in acetone. (Eidmann, C. C. 1899, II., 1014.)

1 g.  $\text{CdI}_2$  is sol. in 4 g. acetone at  $18^\circ$ .

Sp. gr. of sat. solution  $18^\circ/4^\circ = 0.994$ . (Naumann, B. 1904, 37. 4338.)

Sp. gr. of  $\text{CdI}_2 + \text{acetone}$ .

% $\text{CdI}_2$	Sp. gr. $20^\circ/20^\circ$
0	0.7998
12.02	0.8929

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 284)

Sol. in chinolin (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)  
 100 g. benzonitrile dissolve 1.6295 g.  $\text{CdI}_2$  at  $18^\circ$  (Naumann, B 1914, 47. 1370.)  
 Insol. in methylene iodide. (Retgers, Z anorg 3. 343.)  
 Sl. sol. in ethylamine. (Shunn, J phys Chem 1907, 11. 538.)  
 Insol. in  $\text{CS}_2$  (Arcetowski, Z. anorg 1849, 6. 357.)  
 Solubility in methyl acetate = 0.7–1.5%; 2.1% at bpt. (Schneider and Steiner, J pr 1909, (2) 79. 49.)  
 Sol. in methyl acetate (Naumann, B 1909, 42. 3790.)  
 1 pt. is sol. in 54.3 pts. ethyl acetate at  $18^\circ$   
 The sat. solution has  $D_{18^\circ/4^\circ} = 0.9145$ . (Naumann, B 1910, 43. 318.)  
 Insol. in mustard oil. (Mathews, J. phys. Chem 1905, 9. 647.)  
 Mol. weight determined in piperidine, pyridine, methyl and ethyl sulphide. (Werner, Z anorg 1897, 15. 17.)

**Cadmium hydrogen iodide,  $\text{CdI}_2 \cdot \text{HI} + 3\text{H}_2\text{O}$ .**  
 Decomp. in air (Dobroserdow, C C 1900, II. 527.)

**Cadmium caesium iodide,  $\text{CdI}_2 \cdot \text{CsI} + \text{H}_2\text{O}$ .**  
 Sol. in  $\text{H}_2\text{O}$  without decomp. (Wells and Walden, Z anorg. 5. 271.)  
 $\text{CdI}_2 \cdot 2\text{CsI}$ . As above.  
 $\text{CdI}_2 \cdot 3\text{CsI}$ . Decomp. by  $\text{H}_2\text{O}$  into the above salt.

**Cadmium hydrazine iodide,  $\text{CdI}_2 \cdot 2\text{N}_2\text{H}_4\text{HI}$**   
 Sol. in  $\text{H}_2\text{O}$  (Ferratini, C A. 1912. 1612.)

**Cadmium mercuric iodide.**  
 Very sol. in  $\text{H}_2\text{O}$ . (Berthelot, J Pharm 14. 613.)  
 $\text{CdI}_2 \cdot 3\text{HgI}_2$ . Sol. in  $\text{H}_2\text{O}$ . Can be recrystallized in alcohol. (Clarke and Kebler, Am. Ch. J. 5. 235.)

**Cadmium potassium iodide,  $\text{CdI}_2 \cdot \text{KI} + \text{H}_2\text{O}$**   
 Sol. in 0.94 pt  $\text{H}_2\text{O}$  at  $15^\circ$ . (Eder, Dingl. 221. 89.)  
 $\text{CdI}_2 \cdot 2\text{KI} + 2\text{H}_2\text{O}$ . Deliquescent. Extremely sol. in  $\text{H}_2\text{O}$ . Sol. at  $15^\circ$  in 0.73 pt  $\text{H}_2\text{O}$ . Sl. sol. in alcohol and wood spirit, but less than  $\text{CdI}_2$ . (Croft.)  
 • Sol. at  $15^\circ$  in 1.4 pts. absolute alcohol, 24.5 pts. ether (0.729 sp gr), and 4.5 pts. alcohol-ether (1 : 1). (Eder, l. c.)

Sp. gr. of  $\text{K}_2\text{CdI}_4 + \text{Aq}$  at  $18^\circ$ .

% $\text{K}_2\text{CdI}_4$	1	5	10	15	20
Sp. gr.	1.0065	1.0384	1.0808	1.1269	1.1770

% $\text{K}_2\text{CdI}_4$	25	30	35	40	45
Sp. gr.	1.2313	1.2890	1.3557	1.4282	1.5065

(Grotrian, W. Ann. 1883, 18. 193.)

Sp. gr. of $\text{K}_2\text{CdI}_4 + \text{Aq}$			
% $\text{K}_2\text{CdI}_4$	$t^\circ$	Sp. gr. at $t^\circ$	Sp. gr. at $18^\circ$
0.0328	18		0.99895
0.0596	18		0.99921
0.0804	18		0.99938
0.100	17 12	0.99962	0.99945
	21 82	0.99872	
0.250	18		1.0007
0.500	18		1.0027
1.003	17 32	1.0068	1.0067
	20 63	1.0061	

(Wershofen, Z phys Ch. 1890, 5. 493.)

Sol. in ethyl acetate. (Naumann, B 1904, 37. 3601.)

**Cadmium sodium iodide,  $\text{CdI}_2 \cdot 2\text{NaI} + 6\text{H}_2\text{O}$**

Deliquescent (Croft.)  
 Sol. at  $15^\circ$  in 0.63 pt  $\text{H}_2\text{O}$ , 0.86 pt abs alcohol, and 10.1 pts. ether (sp. gr. 0.729) (Eder, Dingl. 221. 89.)

**Cadmium strontium iodide,  $\text{CdI}_2 \cdot \text{SrI}_2 + 8\text{H}_2\text{O}$**

Deliquesces in moist, effloresces in dry air, sol. in  $\text{H}_2\text{O}$  (Croft.)

**Cadmium iodide ammonia,  $\text{CdI}_2 \cdot 2\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rammelsberg.)  
 $\text{CdI}_2 \cdot 4\text{NH}_3$ . (Dawson and McCrae, Chem Soc. 1900, 77. 1246.)  
 $\text{CdI}_2 \cdot 6\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ ; sol. in warm, less sol. in cold  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rammelsberg.)

**Cadmium iodide hydrazine,  $\text{CdI}_2 \cdot 2\text{N}_2\text{H}_4$**

Easily sol. in warm  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z anorg 1903, 60. 281.)

**Cadmium iodide hydroxylamine,  $\text{CdI}_2 \cdot 3\text{NH}_2\text{OH}$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol. Insol. in ether. (Adams, Am Ch. J 1902, 28. 218.)

**Cadmium iodide selenide,  $\text{CdI}_2 \cdot 3\text{CdSe}$ .**

Easily decomp. (Fonzes-Diacon, C. R 1900, 131. 897.)

**Cadmium iodosulphide,  $\text{CdI}_2 \cdot 2\text{CdS}$ .**

Ppt. (Naumann, B. 1904, 37. 4338.)

**Cadmium suboxide,  $\text{Cd}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ , acids and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Tanatar, Z anorg. 1901, 27. 433.)  
 $\text{Cd}_2\text{O}$ . Properties as cadmium hydroxide (Morse and Jones.)

**Cadmium oxide,  $\text{CdO}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Easily sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ , less in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett, 1837.)

Insol in KOH, NaOH,  $K_2CO_3$ , and  $Na_2CO_3$  + Aq.

See also Cadmium hydroxide.

Solubility in (calcium sulcrate+sugar)+Aq

1 l solution containing 418.6 g. sugar and 34.3 g.  $CaO$  dissolves 0.22 g.  $CdO$ .

1 l. solution containing 174.4 g. sugar and 14.1 g.  $CaO$  dissolves 0.43 g.  $CdO$

(Bodenbender, J. B. 1865. 600)

Insol in acetone (Naumann, B. 1904, 37. 4329)

Insol in methyl acetate (Naumann, B. 1909, 42. 3790.)

Insol in ethyl acetate (Naumann, B. 1904, 37. 3801.)

Cadmium peroxide,  $Cd_2O_3$  or  $Cd_2O_2(?)$ .

(Haas)

$CdO_2$ ,  $Cd(OH)_2$ . (Kouriloff, A. ch. (6) 23. 431)

Very stable towards  $H_2O$  Insol in  $NH_4OH$  + Aq (Haas, B. 1884, 17. 2253)

$4CdO_2$ ,  $Cd(OH)_2$ . Ppt Insol in  $NaOH$  + Aq (Eykmann, C. C. 1905, I 1629)

$5CdO_2$ ,  $CdO + 3H_2O$  Ppt. (Teletow, C. A. 1912, 43)

Cadmium oxybromide,  $CdO$ ,  $CdBr_2 + H_2O$ .

Decomp. by  $H_2O$  (Tassily, C. R. 1897, 124. 1023.)

+  $2H_2O$ . Stable in dry air; insol. in  $H_2O$ . (Tassily, C. R. 1897, 124. 1022)

+  $3H_2O$ . Slowly decomp. by  $H_2O$ . (Tassily, C. R. 1897, 124. 1022)

+  $7H_2O$  (Mailhe, C. R. 1901, 132. 1561.)

Cadmium oxychloride,  $CdCl_2$ ,  $CdO + H_2O$

Sl. sol. in hot  $H_2O$  (Habermann, M. Ch. 5. 432)

+  $7H_2O$  (Mailhe, Bull Soc 1901, (3) 25. 791)

$2CdO$ ,  $CdCl_2$  Insol in  $H_2O$ , but slowly decomp. thereby. (Canzoneri, Gazz. ch. it. 1897, 27. (2) 488)

Cadmium oxyiodide,  $CdO$ ,  $CdI_2 + H_2O$

Decomp. by  $H_2O$ . (Tassily, C. R. 1897, 124. 1023.)

+  $3H_2O$ . Stable in dry air, insol. in  $H_2O$ . (Tassily, C. R. 1897, 124. 1022.)

Cadmium phosphide,  $Cd_3P_2$ .

Sol. in  $HCl$  + Aq with evolution of  $PH_3$ . (Stromeyer.)

$Cd_3P_2$ . Sol. in conc.  $HCl$  + Aq. (Emmerling, B. 12. 152.)

Easily decomp. by acids. (Kulsch, A. 231. 327.)

$CdP_2$ . Decomp. by boiling conc.  $HCl$  + Aq. (Renault, C. R. 76. 283)

Cadmium selenide,  $CdSe$ .

Sol in  $HCl$  + Aq. (Uelsmann, A. 116. 122)

Easily decomp. by acids. (Fonze-Diacon, C. R. 1900, 131. 897.)

Cadmium sulphide,  $CdS$

Insol in  $H_2O$

Solubility in  $H_2O$  at  $16-18^\circ = 6.6 \times 10^{-6}$  mols. per l (Biltz, Z. phys. Ch. 1907, 58. 291.)

1 l  $H_2O$  dissolves  $900 \times 10^{-6}$  mols  $CdS$  (artificial greenockite) at  $18^\circ$ .

1 l  $H_2O$  dissolves  $8.86 \times 10^{-4}$  mols. pptd.  $CdS$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294)

Difficultly sol in hot dil  $HCl$  + Aq. Easily sol. in conc.  $HCl$  + Aq (Stromeyer.) Sol in  $HNO_3$  + Aq (Messner), and boiling dil.  $H_2SO_4$  + Aq (1.6). (A. W. Hoffmann, A. 115. 286.) Very sl. sol in  $NH_4OH$  + Aq. (Wackenroder, Report 46. 226) Insol in  $KOH$ , or  $(NH_4)_2S$  + Aq. Appreciably sol. in an acid solution of  $NH_4Cl$ . (Baxter and Hines, Z. anorg. 1905, 44. 160)

Much more sol. in  $(NH_4)_2S$  + Aq than usually supposed. (Ditte, C. R. 35. 402.) Solubility increases by warming, and at  $68^\circ$  is twice that at ordinary temperatures. A sat. solution of  $(NH_4)_2S$  dissolves about 2 g  $CdS$  to a litre. Alkali sulphides dissolve much less (Ditte.)

Fresenius (Z. anal. 20. 236) could not confirm the above. According to Fresenius,  $CdS$  is not appreciably sol in  $(NH_4)_2S$  + Aq

Insol in  $Na_2SO_3$  or  $KCN$  + Aq (Fresenius.)

Insol. in  $NH_4Cl$  or  $NH_4NO_3$  + Aq. (Brett.)

Sol in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, -stannates + Aq (Storch, B. 18. 2015.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 827)

Insol in acetone (Naumann, B. 1904, 37. 4329, Eidmann, C. C. 1899, II 1014.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314)

Min Greenockite. Sol in  $HCl$  + Aq

Colloidal.—Solution of 4 g. colloidal C in a litre  $H_2O$  remains transparent several days. If it contains 11 g.  $CdS$  in a litre, it is completely coagulated in 24 hours. Solutions of salts of the following concentration cause an immediate coagulation in an aqueous solution of  $CdS$  containing 3.52 g in a litre.

KCl	1	1615
KBr	1	727
KI	1	57
KCN	1	160
KClO <sub>3</sub>	1	1666
KNO <sub>3</sub>	1	1000
K <sub>2</sub> S <sub>2</sub> O <sub>8</sub>	1	5000
K <sub>2</sub> SO <sub>4</sub>	1	833
K <sub>3</sub> Fe(CN) <sub>6</sub>	1	166
K <sub>4</sub> Fe(CN) <sub>6</sub>	<1	100
K <sub>2</sub> CrO <sub>4</sub>	1	400
K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>	1	3571
NaCl	1	2666
Na <sub>2</sub> S <sub>2</sub> O <sub>8</sub>	1	98
NaHCO <sub>3</sub>	1	333
Na <sub>2</sub> CO <sub>3</sub>	1	166
Na <sub>2</sub> HPO <sub>4</sub>	1	202

$\text{NaC}_2\text{H}_3\text{O}_2$	1	2451
Na benzoate	1	10,000
$(\text{NH}_4)_2\text{C}_2\text{O}_4$	1	588
$\text{BaCl}_2$	1	11,764
$\text{Ba}(\text{NO}_3)_2$	1	8032
$\text{BaS}_2\text{O}_6$	1	5617
$\text{MgSO}_4$	1	41,666
$\text{MnSO}_4$	1	22,222
$\text{CdSO}_4$	1	250,000
$\text{Cd}(\text{NO}_3)_2$	1	285,714
$\text{Pb}(\text{ClO}_3)_2$	1	209
$\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$	1	147,058
$\text{Hg}(\text{CN})_2$	<1	20
$\text{Al}_2(\text{SO}_4)_3$	1	232,558
Alum	1	192,377
Chrome alum	1	42,555
$\text{HCl}$	1	4807
$\text{H}_2\text{SO}_4$	1	8000
$\text{HC}_2\text{H}_3\text{O}_2$	1	15
$\text{H}_2\text{C}_4\text{O}_4$	1	23,255
Succinic acid	<1	100
Tartaric acid	1	333

(Prost, Belg Acad Bull (3) 14. 312, J B. 1887. 537)

#### Cadmium pentasulphide, $\text{CdS}_5$

Insol. in  $\text{H}_2\text{O}$  (Schuff, A. 115. 74)  
Mixture of  $\text{CdS}$  and  $\text{S}$  (Follenius, Z anal 13. 412)

#### Cadmium potassium sulphide, $\text{K}_2\text{CdS}_4$

(Milbauer, Z. anorg. 1904, 42. 439)

#### Cadmium sodium sulphide, $3\text{CdS}, \text{Na}_2\text{S}$

Decomp. by  $\text{H}_2\text{O}$  (Schneider, J. pr (2) 8. 29)

#### Cadmium sulphoiodide.

See Cadmium iodosulphide.

#### Cadmium telluride, $\text{CdTe}$

Not attacked by dil acids. Attacked in the cold only by  $\text{HNO}_3$ . (Tibbals, J. Am. Chem Soc. 1909, 31. 908)

#### Cadmic acid.

#### Potassium cadmate.

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. when in contact therewith (Meunier, C. R. 63. 330)

#### Cæsium, $\text{Cs}$ .

• Decomp.  $\text{H}_2\text{O}$  with great violence (Setterberg, A. 211. 100.)  
Very sol. in liqnd  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 827)

#### Cæsium acetylide acetylene, $\text{Cs}_2\text{C}_2, \text{C}_2\text{H}_2$ .

Insol. in  $\text{C}_2\text{H}_6$  and in  $\text{CHCl}_3$  (Moussan, C. R. 1903, 136. 1218.)

#### Cæsium amide, $\text{CsNH}_2$

Decomp. by  $\text{H}_2\text{O}$  Very sol. in liqnd  $\text{NH}_3$ . (Rengade, C. R. 1905, 140. 1185)

#### Cæsium ammonia, $\text{Cs}_3\text{NH}_3$ .

Sol. in liqnd  $\text{NH}_3$  (Moussan, C. R. 1903, 136. 1177)

#### Cæsium azoimide, $\text{CsN}_3$ .

Deliquescent Stable in aq solution  
224.2 pts sol. in 100 pts  $\text{H}_2\text{O}$  at  $0^\circ$   
307.4 " " 100 "  $\text{H}_2\text{O}$  "  $16^\circ$   
1.0366 " " 100 " abs. alcohol "  $16^\circ$   
Insol in puræther (Curtius, J pr 1898, (2) 58. 283.)

#### Cæsium bromide, $\text{CsBr}$ .

Ppt (Chabrie, C. R. 1901, 132. 679)  
Sat.  $\text{CsBr} + \text{Aq}$  at  $25^\circ$  contains 55.23%  $\text{CsBr}$ . (Foote, Am. Ch. J. 1907, 37. 125)

#### Cæsium tribromide, $\text{CsBr}_3$

Sol in  $\text{H}_2\text{O}$ , decomp by alcohols. (Wells, Sil. Am J 143. 17.)

#### Cæsium pentabromide, $\text{CsBr}_5$

Very unstable (Wells and Wheeler, Sil. Am J 144. 42.)

#### Cæsium cobalt bromide, $\text{Cs}_2\text{CoBr}_4$ .

Decomp. by  $\text{H}_2\text{O}$  (Campbell, Z anorg. 1894, 8. 128.)

Decomp. by  $\text{H}_2\text{O}$  and by alcohol (Campbell, Am J Sci 1894, (3) 48. 418)  
 $\text{Cs}_2\text{CoBr}_4$  Decomp. by  $\text{H}_2\text{O}$  (Campbell, Z. anorg. 1894, 8. 126)

Decomp. by  $\text{H}_2\text{O}$  and by alcohol (Campbell, Am J. Sci. 1894, (3) 48. 418.)

#### Cæsium copper bromide, $\text{CsBr}, \text{CuBr}_2$ .

Sol in  $\text{H}_2\text{O}$  without decomp (Wells and Walden, Z. anorg 5. 304.)  
2  $\text{CsBr}, \text{CuBr}_2$ . (W and W.)

#### Cæsium iridium bromide.

See Bromiridate, cæsium.

#### Cæsium iron (ferric) bromide, $\text{Cs}_2\text{FeBr}_4$

Sol in  $\text{H}_2\text{O}$  (Walden, Z. anorg. 1894, 7. 332.)

$\text{Cs}_2\text{FeBr}_4 + \text{H}_2\text{O}$  (Walden, Z. anorg 1894, 7. 332)

#### Cæsium lead bromide, $\text{CsBr}, 2\text{PbBr}_2$

Nearly stable in aqueous solution. (Walden, Sil. Am J. 145. 127.)

$\text{CsBr}, \text{PbBr}_2$  Decomp by  $\text{H}_2\text{O}$ . (Walden.)

4 $\text{CsBr}, \text{PbBr}_2$  As above.

Solubility determinations show that the double salts formed by cæsium and lead bromides at  $25^\circ$  are  $\text{CsPb}_2\text{Br}_3$ ,  $\text{CsPbBr}_3$  and  $\text{Cs}_2\text{PbBr}_4$ . (Foote, Am. Ch. J. 1907, 37. 125.)

#### Cæsium magnesium bromide, $\text{CsBr}, \text{MgBr}_2 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wheeler and Campbell, Z. anorg 5. 275)

**Cæsium mercuric bromide, CsBr, 2HgBr<sub>2</sub>.**

Not decomp by H<sub>2</sub>O. 100 pts solution sat. at 16° contain 0.807 pt CsBr, 2HgBr<sub>2</sub>. Sl. sol. in hot strong alcohol, from which CsBr, HgBr<sub>2</sub>, separates on cooling. (Wells, Sil. Am. J. 144. 221)

CsBr, HgBr<sub>2</sub>. Decomp by H<sub>2</sub>O into above salt. Sol in alcohol without decomp. (Wells)

2CsBr, HgBr<sub>2</sub>. Decomp. by H<sub>2</sub>O into CsBr, 2HgBr<sub>2</sub>

3CsBr, HgBr<sub>2</sub> As above

**Cæsium molybdenyl bromide, 2CsBr, MoOBr<sub>2</sub>.**

(Weinland and Knoll, Z. anorg. 1905, 44. 107)

**Cæsium nickel bromide, CsNiBr<sub>2</sub>**

Decomp by H<sub>2</sub>O (Campbell, Z. anorg. 1894, 8. 126)

Decomp. by H<sub>2</sub>O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) 48. 418.)

**Cæsium osmium bromide.**

See Bromosmate, cæsium.

**Cæsium palladium bromide.**

See Bromopalladate, cæsium and bromopalladate, cæsium.

**Cæsium platinum bromide.**

See Bromoplatinate, cæsium.

**Cæsium ruthenium bromide.**

See Bromoruthenite, cæsium.

**Cæsium selenium bromide.**

See Bromoselenate, cæsium.

**Cæsium tellurium bromide.**

See Bromotellurate, cæsium.

**Cæsium thallic bromide, CsBr, TlBr<sub>2</sub>.**

Sol. in H<sub>2</sub>O with decomp. (Pratt, Z. anorg. 1895, 9. 19)

By recryst. from H<sub>2</sub>O, forms 3CsBr, 2TlBr<sub>2</sub>. (Pratt, Am. J. Sci. 1895, (3) 49. 403.)

3CsBr, 2TlBr<sub>2</sub>. Can be recryst. unchanged from H<sub>2</sub>O. (Pratt, Am. J. Sci. 1895, (3) 49. 402.)

**Cæsium tin (stannic) bromide.**

See Bromostannate, cæsium.

**Cæsium zinc bromide, 3CsBr, ZnBr<sub>2</sub>.**

Sol. in H<sub>2</sub>O. (Wells and Campbell, Z. anorg. 5. 275)

2CsBr, ZnBr<sub>2</sub>. As above

**Cæsium bromide columbium oxybromide, 2CsBr, CoOBr<sub>2</sub>**

Unstable in moist air. Decomp. by H<sub>2</sub>O. (Weinland, B. 1906, 39. 3059.)

**Cæsium bromochloride, CsBr<sub>2</sub>Cl.**

Properties as CsBr<sub>2</sub> (Wells)  
CsBrCl<sub>2</sub> As above (Wells.)

**Cæsium mercuric bromochloride, Cs<sub>2</sub>HgCl<sub>2</sub>Br<sub>2</sub>**

Decomp. by H<sub>2</sub>O finally to HgBr<sub>2</sub> (Wells, Sil. Am. J. 144. 121)

Cs<sub>2</sub>HgCl<sub>2</sub>Br. As above.

CsHgClBr<sub>2</sub>. As above.

CsHg<sub>2</sub>ClBr<sub>2</sub>. As above

CsHg<sub>3</sub>ClBr<sub>2</sub>. As above

**Cæsium bromochloroiodide, CsBrClI**

More sol. in H<sub>2</sub>O than in alcohol. Not decomp. at once by ether (Wells.)

**Cæsium bromiodide, CsBrI<sub>2</sub>**

Decomp. by H<sub>2</sub>O. Sol. in alcohol. Decomp. by ether with residue of CsBr (Wells, Sil. Am. J. 143. 17)

CsBr<sub>2</sub>I. More sol. in H<sub>2</sub>O than in alcohol. Not decomp by ether

CsBr<sub>2</sub>I + Aq sat. at 20° contains about 4.45% CsBr<sub>2</sub>I. (Wells)

**Cæsium carbide, Cs<sub>2</sub>C<sub>2</sub>**

Decomp. by cold H<sub>2</sub>O. (Moissan, C. R. 1903, 136. 1221)

**Cæsium chloride, CsCl.**

Very deliquescent, sol. in H<sub>2</sub>O and alcohol

Solubility of CsCl at t°

t°	Pts by wt of CsCl in 100 pts solution
0	3
10	61.9
20	63.5
30	64.9
40	66.3
50	67.4

(Hinrichsen, Z. phys. Ch. 1904, 50. 99)

Solubility of CsCl at t°.

t°	% CsCl	t°	% CsCl
0	61.7	60	69.7
10	63.6	70	70
20	65.1	80	71.4
30	66.4	90	72.2
40	67.5	100	73.0
50	68.0	119.4	74.4

(Berkeley, Trans. Roy. Soc. 1904, 203. A. 208)

A normal solution of CsCl has sp. gr. at 25° = 1.1076 (Wagner, Z. phys. Ch. 1890, 5. 36)

Sp. gr. at 20°/4° of a normal solution of CsCl = 1.125815. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151)

Sp. gr. of CsCl+Ag.			
CsCl equiv per 1 at 18°	Sp. gr. at 0°/10°	Sp. gr. at 18°/18°	Sp. gr. at 30°/30°
0.504	1.06556	1.06483	1.06452
1.002	1.12962	1.12825	1.12750
2.007	1.25705	1.25452	1.25307
3.994	1.50514	1.50100	1.49859

(Clausen, W. Ann. 1914, (4) 44. 1071.)

Solubility of CsCl+FeCl<sub>3</sub> in H<sub>2</sub>O at 21°

Substance added		Pts. by weight in 100 pts. of solution	
FeCl <sub>3</sub> grams	CsCl grams	FeCl <sub>3</sub>	CsCl
0	65	0	65.0
0.6	11.6	0.45	55.18
1.4	10.2	2.1	52.38
2.2	8.8	5.24	51.44
2.0	7.4	7.8	47.70
3.8	6.0	8.93	41.15
4.6	4.6	15.34	25.25
5.4	2.8	21.65	14.96
6.2	1.4	27.96	8.42
8.5	0.2	48.71	0.94
8.5	0	83.89	0

(Himmichsen, Z. phys. Ch. 1904, 50. 96.)

Solubility of CsCl+HgCl<sub>2</sub> in H<sub>2</sub>O at 25°

Solution contains		Solid phase
% CsCl	% HgCl <sub>2</sub>	
65.61	0.00	CsCl
65.78	0.215	CsCl+Cs <sub>2</sub> HgCl <sub>3</sub>
62.36	0.32	Cs <sub>2</sub> HgCl <sub>3</sub>
57.01	0.64	"
52.35	1.23	"
51.08	1.44	Cs <sub>2</sub> HgCl <sub>3</sub> +Cs <sub>2</sub> HgCl <sub>4</sub>
49.30	1.49	Cs <sub>2</sub> HgCl <sub>4</sub>
45.95	1.69	"
45.23	1.73	Cs <sub>2</sub> HgCl <sub>4</sub> +CsHgCl <sub>3</sub>
38.63	1.32	CsHgCl <sub>3</sub>
17.03	0.51	"
1.53	0.42	"
0.61	2.64	CsHgCl <sub>3</sub> +CsHg <sub>2</sub> Cl <sub>5</sub>
0.49	2.91	CsHg <sub>2</sub> Cl <sub>5</sub>
0.40	3.78	CsHg <sub>2</sub> Cl <sub>5</sub> +CsHg <sub>3</sub> Cl <sub>7</sub>
0.44	4.63	"
0.41	4.68	CsHg <sub>3</sub> Cl <sub>7</sub>
0.25	5.65	"
0.18	7.09	CsHg <sub>3</sub> Cl <sub>7</sub> +HgCl <sub>2</sub>
0.00	6.90	HgCl <sub>2</sub>

(Foote, Am. Ch. J. 1903, 30. 340.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

100 g. solution in acetone sat. at 25° contain 0.032 g. CsCl (Foote and Haigh, J. Am. Chem. Soc. 1911, 33. 461.)

Solubility of CsCl+HgCl<sub>2</sub> in acetone at 25°.

Solution contains		Solid phase
% HgCl <sub>2</sub>	% CsCl	
57.74	0.00	HgCl <sub>2</sub>
57.79	0.13	HgCl <sub>2</sub> +CsHg <sub>2</sub> Cl <sub>5</sub>
57.74	0.20	CsHg <sub>2</sub> Cl <sub>5</sub>
52.54	0.22	"
49.83	0.32	"
44.32	0.50	CsHg <sub>2</sub> Cl <sub>5</sub> +CsHg <sub>3</sub> Cl <sub>7</sub>
44.46	0.44	"
39.65	0.48	CsHg <sub>3</sub> Cl <sub>7</sub>
28.48	0.48	"
20.96	0.52	CsHg <sub>3</sub> Cl <sub>7</sub> +CsHgCl <sub>3</sub>
27.32	0.61	"
21.50	0.46	CsHgCl <sub>3</sub>
13.08	0.45	"
0.16	0.19	Mixtures of salts
0.17	0.25	"
0.02	0.11	"
0.00	0.032	CsCl

(Foote and Haigh, J. Am. Ch. Soc. 1911, 33. 461.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Solubility in glycol at ord. temp. = 10.6-10.8% (de Coninck, Belg. Acad. Bull. 1905. 359.)

Insol. in anhydrous pyridine and in 97% pyridine+Ag. Sol. in 95% pyridine+Ag. and in 93% pyridine+Ag. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

Caesium chromium chloride, 2CsCl.CrCl<sub>3</sub>+H<sub>2</sub>O

Stable in the air. Sol. in H<sub>2</sub>O. (Wells, Z. anorg. 1895, 10. 182.)  
2CsCl.CrCl<sub>3</sub>+4H<sub>2</sub>O; hygroscopic; very sol. in H<sub>2</sub>O. (Wells, l. c.)

Caesium tetra-aquochromium chloride, CrCl<sub>3</sub>(OH<sub>2</sub>)<sub>4</sub>.Cl, 2CsCl.

Ppt (Werner, B. 1901, 34. 1602.)

Caesium cobalt chloride, CsCoCl<sub>3</sub>+2H<sub>2</sub>O.

Decomp. by H<sub>2</sub>O and alcohol. (Campbell, Z. anorg. 1894, 8. 126.)  
Cs<sub>2</sub>CoCl<sub>5</sub>. Decomp. by H<sub>2</sub>O and by alcohol. (Campbell, Z. anorg. 1894, 8. 126.)  
Cs<sub>2</sub>CoCl<sub>5</sub>. Decomp. by H<sub>2</sub>O and by alcohol. (Campbell, Z. anorg. 1894, 8. 126.)

Caesium cuprous chloride, CsCl, Cu<sub>2</sub>Cl<sub>2</sub>.

Decomp. by H<sub>2</sub>O into CuCl<sub>2</sub>, CsCl. (Wells, Z. anorg. 5. 306.)  
3CsCl, Cu<sub>2</sub>Cl<sub>2</sub>. (Wells.)  
6CsCl, Cu<sub>2</sub>Cl<sub>2</sub>. (Wells.)

Caesium cupric chloride, 2CsCl, CuCl<sub>2</sub>.

Easily sol. in H<sub>2</sub>O and dil. HCl+Ag; insol. in conc. HCl+Ag (Godeffroy, B. 8. 9.)

Sol in small amount  $H_2O$  without decomp. (Wells and Dupee, Z. anorg. 5. 300)  
 $+2H_2O$  Efflorescent (W. and D.)  
 $3CsCl, 2CuCl_2 + 2H_2O$   
 $CsCl, CuCl_2$ . Sol in  $H_2O$  without decomp (W. and D.)

**Cæsius gold chloride.**

See Chloraurate, cæsius.

**Cæsius iridium tetrachloride.**

See Chloriridate, cæsius.

**Cæsius iron (ferric) chloride,  $CsFeCl_4 + \frac{1}{2}H_2O$ .**

Sol in  $H_2O$ . Decomp in the air (Walden, Z. anorg. 1894, 7. 332)  
 $Cs_2FeCl_6 + H_2O$  Sol. in  $H_2O$  (Walden)  
 $Cs_3FeCl_6 + H_2O$ . Sol in  $H_2O$  (Walden)

**Cæsius lanthanum chloride,  $Cs_3LaCl_6 + 4H_2O$**

Very hygroscopic. Easily sol in  $H_2O$  (R. J. Meyer, Z. anorg. 1914, 86. 273.)

**Cæsius lead chloride,  $CsCl, 2PbCl_2$**

Nearly stable in aqueous solution (Campbell, Silf. Am. J. 145. 126)

$CsCl, PbCl_2$ . Decomp by  $H_2O$ . (Campbell)  
 $4CsCl, PbCl_2$ . As above (Campbell.)

**Cæsius lead tetrachloride.**

See Chloroplumbate, cæsius.

**Cæsius magnesium chloride,  $CsCl, MgCl_2 + 6H_2O$**

Sol. in  $H_2O$  (Wells and Campbell, Z. anorg. 5. 275)

**Cæsius manganous chloride,  $CsCl, MnCl_2 + 2H_2O$ .**

Not deliquescent; sol in  $H_2O$ . (Saunders, Am Ch J 14. 143)

$2CsCl, MnCl_2$ . (Godeffroy.)  
 $+2\frac{1}{2}H_2O$ . (Godeffroy.)  
 $+3H_2O$  Sol in  $H_2O$  Conc  $HCl + Aq$  precipitates anhydrous salt from aqueous solution. (Godeffroy, B 8. 9.)

The only salt which exists contains  $2H_2O$ . (Saunders, Am Ch. J 14. 143)

**Cæsius manganic chloride,  $2CsCl, MnCl_2$ .**

Easily decomp. (Meyer and Best, Z. anorg 1899, 22. 187)

**Cæsius mercuric chloride,  $CsCl, HgCl_2$ .**

100 pts. solution sat. at  $17^\circ$  contain 1.406 pts.  $CsHgCl_3$ . Not decomp by  $H_2O$  Insol. in absolute alcohol, but sol. on diluting with  $\frac{1}{2}$  vol  $H_2O$ . (Wells, Silf. Am. J 144. 221.)

$2CsCl, HgCl_2$  Easily sol. in  $H_2O$  and dil.  $HCl + Aq$ ; insol. in conc  $HCl + Aq$ . (Godeffroy)

$3CsCl, HgCl_2$ . Decomp. by  $H_2O$ , on recrystallizing from  $H_2O$ ,  $CsCl, HgCl_2$  is finally formed (Wells, Silf. Am. J. 144. 221.)

$CsCl, 5HgCl_2$  Decomp by  $H_2O$  (Wells)  
 Solubility determinations show that the only double salts of  $CsCl$  and  $HgCl_2$  which exist at  $25^\circ$  are  $Cs_3HgCl_6, Cs_2HgCl_4, CsHgCl_3, CsHg_2Cl_3, CsHg_3Cl_{11}$ . (Foote, Am Ch. J. 1903, 30. 340)

**Cæsius molybdenum chloride,  $Cs_2MoCl_6 + H_2O$ .**

Sol in  $H_2O$ . Nearly insol in alcohol and ether. (Chilesotti, C. C 1903, II. 652)

**Cæsius molybdenyl chloride,  $CsCl, MoO_2Cl_2 + H_2O$**

Hygroscopic. Decomp by  $H_2O$  (Weinland and Knoll, Z. anorg. 1905, 44. 93)

$2CsCl, MoO_2Cl_2$  Hygroscopic. Decomp. by  $H_2O$  (Weinland and Knoll, Z. anorg. 1905, 44. 92.)

$2CsCl, 6MoO_2Cl_2 + 22H_2O$ . Very hygroscopic. Decomp. by  $H_2O$ . (Weinland and Knoll, Z. anorg. 1905, 44. 94.)

$2CsCl, MoOCl_3$  Only sl. sol in  $H_2O$  (Nordenskjöld, B. 1901, 34. 1573.)

**Cæsius neodymium chloride,  $Cs_3NdCl_6 + 5H_2O$**

Very hygroscopic. Easily sol in  $H_2O$  (R. J. Meyer, Z. anorg 1914, 86. 273)

**Cæsius nickel chloride,  $2CsCl, NiCl_2$**

As the corresponding Cu salt  
 $CsNiCl_3$ . Decomp by  $H_2O$  and by alcohol (Campbell, Am. J. Sci. 1894, (3) 48. 418)

**Cæsius palladium dichloride.**

See Chloropalladate, cæsius.

**Cæsius palladium tetrachloride.**

See Chloropalladate, cæsius.

**Cæsius praseodymium chloride,  $Cs_3PrCl_6 + 5H_2O$ .**

Very hygroscopic. Easily sol. in  $H_2O$ . (R. J. Meyer, Z. anorg. 1914, 86. 273.)

**Cæsius rhodium chloride.**

See Chlororhodite, cæsius.

**Cæsius ruthenium chloride.**

See Chlororuthenite, cæsius and chlororuthenate, cæsius.

**Cæsius oxyruthenium chloride,  $Cs_3RuO_2Cl_4$ .**

Ppt; decomp. by  $H_2O$ ; sol in cold  $HCl$ . (Howe, J. Am. Chem. Soc 1901, 23. 779.)

**Cæsius samarium chloride,  $Cs_3SmCl_6 + 5H_2O$ .**

Very hygroscopic. Easily sol in  $H_2O$ . (R. J. Meyer, Z. anorg 1914, 86. 273.)

**Cæsium silver chloride,  $2\text{CsCl}$ ,  $\text{AgCl}$**   
Easily decomp by  $\text{H}_2\text{O}$  (Wells and Wheeler, *Sill. Am. J.* 144. 155)

**Cæsium tellurium chloride.**  
*See* Chlorotellurate, cæsium.

**Cæsium thalic chloride,  $2\text{CsCl}$ ,  $\text{TiCl}_3$**   
By recryst. from  $\text{H}_2\text{O}$  forms  $3\text{CsCl}$ ,  $2\text{TiCl}_3$  (Pratt, *Am. J. Sci.* 1895, (3) 49. 398.)

+ $\text{H}_2\text{O}$  Readily sol in hot  $\text{H}_2\text{O}$  but  $3\text{CsCl}$ ,  $2\text{TiCl}_3$  cryst. from the solution (Pratt, *Am. J. Sci.* 1895, (3) 49. 399.)

$3\text{CsCl}$ ,  $2\text{TiCl}_3$  Can be recryst. from  $\text{H}_2\text{O}$  without change. (Pratt, *Am. J. Sci.* 1895, (3) 49. 401)

$3\text{CsCl}$ ,  $\text{TiCl}_3$  +  $2\text{H}_2\text{O}$  Sol in 36.4 pts.  $\text{H}_2\text{O}$  at  $17^\circ$  and 3 pts. at  $100^\circ$ . (Godefroy, *Zeitsch. d. allgem. oesterr. Apothekerv.* 1880. No. 9)

**Cæsium tin (stannic) chloride.**  
*See* Chlorostannate, cæsium.

**Cæsium titanium chloride,  $\text{TiCl}_3$ ,  $2\text{CsCl}$  +  $\text{H}_2\text{O}$ .**

Difficultly sol in  $\text{H}_2\text{O}$ . (Stahler, B 1904, 37. 4409)

**Cæsium tungsten chloride,  $\text{Cs}_2\text{W}_2\text{Cl}_9$**   
Nearly insol. in cold  $\text{H}_2\text{O}$ .  
Sol. in a hot mixture of equal pts  $\text{H}_2\text{O}$  and conc  $\text{HCl}$

Nearly insol. in conc  $\text{HCl}$   
Sol. in very dil.  $\text{NaOH}$  +  $\text{Aq}$   
Nearly insol. in most organic solvents. (Olsson, B. 1913, 46. 574.)

**Cæsium uranous chloride,  $\text{Cs}_2\text{UCl}_6$ .**  
As K salt. (Aloy, *Bull. Soc.* 1899, (3) 21. 264.)

**Cæsium uranyl chloride,  $2\text{CsCl}$ ,  $(\text{UO}_2)\text{Cl}_2$ .**  
Sol in  $\text{H}_2\text{O}$ . (Wells, *Z. anorg.* 1895, 10. 183)

100 pts of the solution contain at  $20.75^\circ$ , 56.07 pts.  $\text{UO}_2\text{Cl}_2$ ,  $2\text{CsCl}$ . (Rambach, B. 1904, 37. 468)

Pptd. from aq. solution by gaseous  $\text{HCl}$  (Wells, *Am. J. Sci.* 1894, (3) 50. 251.)

**Cæsium vanadium chloride,  $\text{Cs}_2\text{VdCl}_5$  +  $\text{H}_2\text{O}$ .**  
Difficultly sol. in  $\text{H}_2\text{O}$  and alcohol. (Stahler, B 1904, 37. 4412.)

**Cæsium zinc chloride,  $3\text{CsCl}$ ,  $\text{ZnCl}_2$ .**  
Sol. in  $\text{H}_2\text{O}$ . (Wells and Campbell, *Z. anorg.* 5. 275.)

$2\text{CsCl}$ ,  $\text{ZnCl}_2$ . Easily sol in  $\text{H}_2\text{O}$  and dil  $\text{HCl}$  +  $\text{Aq}$ . Insol. in conc.  $\text{HCl}$  +  $\text{Aq}$ . (Godefroy)

**Cæsium chloride chromic oxychloride,  $2\text{CsCl}$ ,  $\text{CrOCl}_3$ .**  
Decomp. in the air  
Sol in conc  $\text{HCl}$  without decomp (Wenland, B 1906, 39. 4045)

**Cæsium chloride columbium oxychloride,  $2\text{CsCl}$ ,  $\text{CbOCl}_3$ .**  
Decomp. by  $\text{H}_2\text{O}$  (Wenland, B 1906, 39. 3057)

**Cæsium chloroiodide,  $\text{CsCl}_2\text{I}$**   
Properties as  $\text{CaBiClI}$ . (Wells)  
 $\text{CsCl}_2\text{I}$  Sol. in  $\text{H}_2\text{O}$ , from which it can be recrystallized without decomp (Wells and Wheeler)

**Cæsium mercuric chloroiodide,  $\text{Cs}_2\text{HgCl}_2\text{I}_2$**   
Decomp. instantly by  $\text{H}_2\text{O}$  to  $\text{HgI}_2$  (Wells.)

**Cæsium fluoride,  $\text{CsF}$ .**  
Ppt (Chabré, C. R 1901, 132. 680.)  
+  $1\frac{1}{2}\text{H}_2\text{O}$ . 100 g.  $\text{H}_2\text{O}$  dissolve 366.5 g  $\text{CsF}$  at  $15^\circ$ . (de Forcrand, C. R 1911, 152. 1210.)

**Cæsium hydrogen fluoride,  $\text{CsHF}_2$ .**  
Ppt (Chabré, C. R 1901, 132. 680)

**Cæsium tantalum fluoride.**  
*See* Fluotantalate, cæsium.

**Cæsium tellurium fluoride,  $\text{CsF}_2\text{TeF}_6$ .**  
Decomp. by  $\text{H}_2\text{O}$  (Wells, *Am. J. Sci.* 1901, (4) 12. 190)

**Cæsium titanium fluoride.**  
*See* Fluotitanate, cæsium.

**Cæsium zirconium fluoride.**  
*See* Fluozirconate, cæsium.

**Cæsium hydride,  $\text{CsH}$**   
Decomp. by  $\text{H}_2\text{O}$  with evolution of  $\text{H}_2$  (Moissan, C. R. 1903, 136. 589)

**Cæsium hydroxide,  $\text{CsOH}$ .**  
Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol.  
79.41%  $\text{CsOH}$  is contained in a sat. aq. solution at  $15^\circ$  (de Forcrand, C. R. 1909, 149. 1844.)

75.08%  $\text{CsOH}$  is contained in sat aq. solution at  $30^\circ$ . (Schreinemakers, C. C 1909, I 11)

**Cæsium iodide,  $\text{CsI}$ .**  
Sol in  $\text{H}_2\text{O}$   
100 pts  $\text{H}_2\text{O}$  dissolve 44 pts  $\text{CsI}$  at  $0^\circ$ ; 66.3 pts at  $14.5^\circ$ ; 160 pts. at  $61^\circ$ .  
Sp. gr of  $\text{CsI}$  +  $\text{Aq}$  sat. at  $14^\circ$  = 1.393. (Betekoff, *Bull. Soc. Pétersb.* (4) 2. 197.)

**Cæsium periodide.**

Solubility determinations show that  $\text{CsI}_2$  and  $\text{CsI}_4$  are the only periodides of cæsium existing between  $-4^\circ$  and  $+73^\circ$  (Foote, *Am. Ch. J.* 1903, 29. 203)

**Cæsium triiodide,  $\text{CsI}_3$** 

1 ccm. sat.  $\text{CsI} + \text{Aq}$  dissolves 0.0097 g.  $\text{CsI}_3$ , and sp. gr. of solution is 1.154. Only sl. decomp. by solution in  $\text{H}_2\text{O}$ . Much more sol. in alcohol than in  $\text{H}_2\text{O}$ . Not immediately decomp. by ether. (Wells, *Sill. Am. J.* 143. 17)

**Cæsium pentafluoride,  $\text{CsI}_5$** **Cæsium cobalt iodide,  $\text{Cs}_2\text{CoI}_4$** 

Decomp. by  $\text{H}_2\text{O}$  (Campbell, *Z. anorg.* 1894, 8. 12)

Deliquescent; decomp. by  $\text{H}_2\text{O}$  and by alcohol. (Campbell, *Am. J. Sci.* 1894, (3) 48. 418.)

**Cæsium lead iodide,  $\text{CsPbI}_2$** 

Sl. sol. in hot  $\text{CsI} + \text{Aq}$  (Wheeler, *Sill. Am. J.* 145. 129)

**Cæsium mercuric iodide,  $\text{CsI}, 2\text{HgI}_2$** 

Decomp. by  $\text{H}_2\text{O}$  finally into  $\text{HgI}_2$ . (Wells, *Sill. Am. J.* 144. 221)

$2\text{CsI}, 3\text{HgI}_2$ . Decomp. by  $\text{H}_2\text{O}$  finally into  $\text{HgI}_2$

$\text{CsI}, \text{HgI}_2$ . As above.

$2\text{CsI}, \text{HgI}_2$ . Decomp. by  $\text{H}_2\text{O}$ ; insol. in alcohol

$3\text{CsI}, \text{HgI}_2$ . As above

**Cæsium silver iodide,  $\text{CsI}, \text{AgI}$** 

(Penfield, *Z. anorg.* 1. 100)

$\text{CsI}, 2\text{AgI}$ . More sol. in hot than in cold acetone. (Marsh, *Chem. Soc.* 1913, 103. 782.)

**Cæsium tellurium iodide.**

See Iodotellurate, cæsium.

**Cæsium thallium iodide,  $\text{CsI}, \text{TlI}_3$** 

Decomp. by  $\text{H}_2\text{O}$ . (Pratt, *Am. J. Sci.* 1895, (3) 49. 403.)

**Cæsium zinc iodide,  $3\text{CsI}, \text{ZnI}_2$** 

Sol. in  $\text{H}_2\text{O}$ . (Wells and Campbell, *Z. anorg.* 5. 275)

$2\text{CsI}, \text{ZnI}_2$ . As above.

**Cæsium oxide,  $\text{Cs}_2\text{O}$** 

Absorbs  $\text{H}_2\text{O}$  and  $\text{CO}_2$  from the air. Decomp. by  $\text{H}_2\text{O}$  and by liquid  $\text{NH}_3$ . (Rengade, *C. R.* 1906, 143. 593.)

**Cæsium dioxide,  $\text{Cs}_2\text{O}_2$** 

Decomp. by  $\text{H}_2\text{O}$ . (Rengade, *C. R.* 1905, 140. 1537.)

**Cæsium trioxide,  $\text{Cs}_2\text{O}_3$** 

Decomp. by  $\text{H}_2\text{O}$  (Rengade, *C. R.* 1905, 140. 1537.)

**Cæsium tetroxide,  $\text{Cs}_2\text{O}_4$** 

Decomp. by  $\text{H}_2\text{O}$  (Rengade, *C. R.* 1905, 140. 1538)

**Cæsium sulphide,  $\text{Cs}_2\text{S} + 4\text{H}_2\text{O}$** 

Deliquescent, very sol. in  $\text{H}_2\text{O}$ . (Biltz, *Z. anorg.* 1906, 48. 300.)

**Cæsium disulphide,  $\text{Cs}_2\text{S}_2$** 

Anhydrous Sol. in  $\text{H}_2\text{O}$ . Hygroscopic. (Biltz, *Z. anorg.* 1906, 50. 72.)

$+\text{H}_2\text{O}$  From  $\text{Cs}_2\text{S}_2 + \text{Aq}$ . Hygroscopic. (Biltz, *Z. anorg.* 1906, 50. 72)

**Cæsium trisulphide,  $\text{Cs}_2\text{S}_3$** 

Anhydrous Sol. in  $\text{H}_2\text{O}$ . Not hygroscopic (Biltz, *Z. anorg.* 1906, 50. 75.)

$+\text{H}_2\text{O}$ . From  $\text{Cs}_2\text{S}_3 + \text{Aq}$ . (Biltz, *Z. anorg.* 1906, 50. 76.)

**Cæsium tetrasulphide,  $\text{Cs}_2\text{S}_4$** 

Sol. in  $\text{H}_2\text{O}$ . Insol. in abs. alcohol (Biltz, *Z. anorg.* 1906, 48. 305)

**Cæsium pentasulphide,  $\text{Cs}_2\text{S}_5$** 

Mpt.  $2^\circ$ . Not hygroscopic. Very sol. in cold 70% alcohol. (Biltz, *B.* 1905, 88. 120.)

**Cæsium hydrogen sulphide,  $\text{CsHS}$** 

Deliquescent, very sol. in  $\text{H}_2\text{O}$ . (Biltz, *Z. anorg.* 1906, 48. 300.)

**Cæsium copper tetrasulphide,  $\text{CsCuS}_4$** 

Sl. sol. in cold  $\text{H}_2\text{O}$ .

Decomp. by conc. and dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ .

Sl. sol. in alcohol. (Biltz, *B.* 1907, 40. 978.)

**Calcium, Ca**

Decomp.  $\text{H}_2\text{O}$  violently. Slowly attacked by cold  $\text{H}_2\text{SO}_4$ . Dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  or  $\text{HCl} + \text{Aq}$  attack violently and dissolve. Dil.  $\text{HNO}_3 + \text{Aq}$  oxidises, but fuming  $\text{HNO}_3$  scarcely attacks even on boiling. (Bunsen and Matthiessen.) Not attacked by anhydrous alcohol. (Lies-Bodart and Jobin, *A. ch.* (3) 54. 364.)

Pure Ca is only very slowly decomp. by  $\text{H}_2\text{O}$  at ordinary temp., sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ . (Moissan, *C. R.* 1898, 129. 589)

Insol. in liquid  $\text{NH}_3$ . (Gore, *Am. Ch. J.* 1898, 20. 827)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0334 g. Ca in 6 days. (Gates, *J. phys. Chem.* 1911, 15. 143.)

**Calcium amalgam,  $\text{Ca}_2\text{Hg}$** 

Decomp.  $\text{H}_2\text{O}$  readily. (Féré, *C. R.* 1898, 127. 619)

$\text{CaHg}$ . Rapidly decomp. in moist air. (Echurgen, *Z. anorg.* 1900, 25. 425.)

Calcium amide,  $\text{Ca}(\text{NH}_2)_2$ .

(Moissan, A. ch 1899, (7) 18. 326.)

Calcium ammonia,  $\text{Ca}, 4\text{NH}_3$

Decomp. at ordinary temp; takes fire in contact with the air, sl. sol in liquid  $\text{NH}_3$  (Moissan, C. R. 1898, 127. 691)

$\text{Ca}, 8\text{NH}_3$  (Kraus, J. Am. Chem. Soc 1908, 30. 665.)

Calcium arsenide,  $\text{Ca}_3\text{As}_2$ .

Decomp by cold  $\text{H}_2\text{O}$ ; insol in cold fuming  $\text{HNO}_3$ , very sol. in hot  $\text{HNO}_3$  (Lebeau, C. R. 1899, 128. 98.)

Calcium azoimide,  $\text{Ca}(\text{N}_3)_2$

Hydroscopic; explosive \*

38 l pts. sol. in 100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$   
45 0 " " " 100 "  $\text{H}_2\text{O}$  " 15.2  
0 211 " " " 100 " abs alcohol " 16

Sol in  $\text{H}_2\text{O}$ , decomp when heated and on standing in the air. (Dennis, Z anorg 1898, 17. 21.)

Insol in pure ether. (Curtius, J. pr. 1898, (2) 58. 286.)

Calcium boride,  $\text{CaB}_2$

Not decomp by  $\text{H}_2\text{O}$  at  $250^\circ$ ; sol. in fused oxidizing agents.

Insol. in aq. acids, sl. sol. in conc  $\text{H}_2\text{SO}_4$ ; sol. in dil. or conc.  $\text{HNO}_3$  (Moissan, C. R. 1897, 126. 631-32)

Calcium bromide,  $\text{CaBr}_2$

Very deliquescent. 100 pts  $\text{H}_2\text{O}$  dissolve—  
at  $0^\circ$  20° 40° 60° 105°  
125 143 213 278 312 pts  $\text{CaBr}_2$   
(Kremers, Pogg. 103. 65.)

Sat.  $\text{CaBr}_2 + \text{Aq}$  contains at  
—22° —22° —14° —7° —5°  
50 5 50 2 52 5 52 6 52 6%  $\text{CaBr}_2$

+8° 9° 11° 20° 50°  
53 1 55 1 55 7 57 1 62 6%  $\text{CaBr}_2$   
(Étard, A. ch 1894, (7) 2. 540)

Sp. gr. of  $\text{CaBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing.  
5 10 15 20 25 %  $\text{CaBr}_2$ ,  
1.044 1.089 1.139 1.194 1.252

30 35 40 45 50 %  $\text{CaBr}_2$ .  
1.315 1.385 1.461 1.549 1.641  
(Kremers, Pogg. 99. 444, calculated by Gerlach, Z. anal. 8. 285.)

Sl. sol in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827)

Very sol. in alcohol (Henry).  
Sol in acetone. (Eidmann, C. C 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

Sol in methyl acetate. (Naumann, B. 1909, 42. 3790)

Sol. in ethyl acetate (Naumann, B. 1910, 43. 314)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370)  
+4 $\text{H}_2\text{O}$  (Kuznetsov, C. A. 1911. 842.)  
+6 $\text{H}_2\text{O}$

Calcium manganous bromide,  $\text{CaMnBr}_4 + 4\text{H}_2\text{O}$

Sl. hydroscopic Unstable. (Ephraim, Z. anorg 1910, 67. 377)

Calcium mercuric bromide.

Decomp by  $\text{H}_2\text{O}$  (v. Bonsdorff)

Calcium molybdenyl bromide,  $\text{CaBr}_2, 2\text{MoOBr}_2 + 7\text{H}_2\text{O}$ .

(Weinland and Knoll, Z. anorg. 1905, 44. 112)

Calcium stannic bromide.

See Bromostannate, calcium.

Calcium bromide ammonia,  $\text{CaBr}_2, 6\text{NH}_3$ .

Sol in  $\text{H}_2\text{O}$  (Raunmelsberg, Pogg. 55. 230)

Calcium bromide hydrazine,  $\text{CaBr}_2, 3\text{N}_2\text{H}_4$

Easily sol in  $\text{H}_2\text{O}$ . (Franzen, Z. anorg. 1908, 60. 288)

Calcium bromofluoride,  $\text{CaBr}_2, \text{CaF}_2$

Decomp by  $\text{H}_2\text{O}$ . (Defacqz, A. ch 1904, (8) 1. 357.)

Calcium carbide,  $\text{CaC}_2$

Sp. gr. 2.22 at  $18^\circ$ . Insol in fuming  $\text{HNO}_3$  and conc.  $\text{H}_2\text{SO}_4$ , but readily decomp. by dil. acids and  $\text{H}_2\text{O}$  (Moissan, Bull. Soc. 1894, (3) 11. 1005.)

Insol. in  $\text{HCl}$  in the cold, but decomp. at red heat. Strong min. acids do not act in the cold; sol. in glacial acetic in the cold; sol. in fused alkali (Venable, J. Am. Chem. Soc. 1895, 17. 307-310)

Calcium chloride,  $\text{CaCl}_2$

Very deliquescent Very sol. in  $\text{H}_2\text{O}$  with evolution of heat.

Anhydrous  $\text{CaCl}_2$  is sol in 1 459 pts  $\text{H}_2\text{O}$  (Gerlach)  
Anhydrous  $\text{CaCl}_2$  is sol in 1 58 pts  $\text{H}_2\text{O}$  at  $10.2^\circ$  (Kremers, Pogg. 103. 65.)

Anhydrous  $\text{CaCl}_2$  is sol in 1 36 pts  $\text{H}_2\text{O}$  at  $20^\circ$ , 0.83 pt  $\text{H}_2\text{O}$  at  $40^\circ$ , 0.72 pt  $\text{H}_2\text{O}$  at  $60^\circ$ .  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  is sol. in 0.5 pt  $\text{H}_2\text{O}$  at  $0^\circ$ , and 2.05 pt at  $18^\circ$  (Gmelin)

$\text{CaCl}_2$  is sol. in 1.5 pts cold, and 0.8 pt boiling  $\text{H}_2\text{O}$  (Foureroy)

$\text{CaCl}_2 + \text{Aq}$  sat in the cold contains 40.7%  $\text{CaCl}_2$ . (Foureroy)

$\text{CaCl}_2 + \text{Aq}$  sat at  $12.5^\circ$  contains 53.8%  $\text{CaCl}_2$  (Hassensfratz)

100 pts  $\text{H}_2\text{O}$  dissolve 165.7 pts.  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  at  $0^\circ$ ; 71.41 pts. at  $40^\circ$ . (Tilden, Chem. Soc. 45. 409.)

100 pts  $\text{H}_2\text{O}$  dissolve 60.3 pts.  $\text{CaCl}_2$  from  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  at  $0^\circ$ , and solution has sp. gr. = 1.367. (Engel, Bull. Soc. (2) 47. 318.)

Solubility of  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Sat. solution contains % $\text{CaCl}_2$	Sat. solution contains % $\text{CaCl}_2 + 6\text{H}_2\text{O}$
-22	32 24	63 61
0	36 91	72 82
+ 7 39	38 77	76 49
13 86	41 03	80 95
19 35	42 50	83 85
23 46	44 15	87 11
24.47	45 33	89 44
27 71	46 30	91 35
29 53	50 67	99 97

(Hammerl, W A B 72, 2 287.)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
0	59 39	13 86	69 49
5	64 83	19 35	73 91
7 88	66 20	21 89	79 77

(Hammerl, calculated by Bakhuis Roozeboom, R. t. c. 8. 5)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
0	49 6	19	72	38	108
1	50	20	74	39	109
2	51	21	75	40	110
3	52	22	77	41	111
4	53	23	79	42	112
5	54	24	80	43	113
6	55	25	82	44	114
7	56	26	84	45	115
8	57	27	87	46	116
9	58	28	89	47	117
10	60	29	91	48	118
11	61	30	93	49	119
12	62	31	96	50	120
13	63	32	98	51	121
14	65	33	100	52	122
15	66	34	103	53	123
16	68	35	104	54	124
17	69	36	105	55	125
18	71	37	107	56	126
57	127	72	137	87	145
58	128	73	138	88	146
59	129	74	138	89	147
60	129	75	139	90	147
61	130	76	139	91	148
62	131	77	140	92	149
63	131	78	141	93	150
64	132	79	141	94	150
65	133	80	142	95	151
66	133	81	142	96	152
67	134	82	143	97	152
68	135	83	143	98	153
69	135	84	144	99	154
70	136	85	144	179.5	325
71	136	86	145		

(Mulder, Scheik. Verhandel. 1864. 107.)

If solubility  $S$  = pts. anhydrous  $\text{CaCl}_2$  in 100 pts solution,  $S = 32 + 0.2148t$  from  $-18^\circ$  to  $+6^\circ$ ;  $S = 54.5 + 0.0755t$  from  $50^\circ$  to  $120^\circ$ . (Etard, C R. 98. 1432)

According to Bakhuis Roozeboom, the solubility of  $\text{CaCl}_2$  varies according to the hydrate employed, and the following data were obtained as the result of very exact experiments.

Solubility of  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
20 4	75 1	28 0	88 8	29 5	96 07
25 05	81 67	28 9	92 05	30 2	102.7

There are two modifications of  $\text{CaCl}_2 + 4\text{H}_2\text{O}$ ,  $\alpha$  and  $\beta$

Solubility of  $\text{CaCl}_2 + 4\text{H}_2\text{O}\beta$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
18 4	103 8	35 0	122.74
25 0	108 8	38 4	127.50
30 0	114 1		

Solubility of  $\text{CaCl}_2 + 4\text{H}_2\text{O}\alpha$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
22.0	92 67	35 95	107.21
24 7	95 59	40 00	115 3
29 8	100 6	45 00	129.9

Solubility of  $\text{CaCl}_2 + 2\text{H}_2\text{O}$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
40	128 1	95 8	156.5	139	191.0
45	129 9	115	169.5	155	214 3
50	132 3	124	176.0	165	236 2
59 5	136 5	137	187.6	174	275 7
80 5	145.3		...	...	

Solubility of  $\text{CaCl}_2 + \text{H}_2\text{O}$  in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts. $\text{CaCl}_2$
191	306
235	331

(Bakhuis Roozeboom, R. t. c. 8.1.)

Sp gr of $\text{CaCl}_2 + \text{Aq}$					
% $\text{CaCl}_2$	Sp gr	% $\text{CaCl}_2$	Sp gr	% $\text{CaCl}_2$	Sp gr
3.95	1.03	20.85	1.18	34.57	1.33
7.66	1.06	23.83	1.21	36.49	1.36
11.23	1.09	26.86	1.24	38.31	1.39
14.42	1.12	29.67	1.27	40.43	1.42
17.60	1.15	32.35	1.30	41.91	1.45

(Richter)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$  at 19.5° containing pts  $\text{CaCl}_2$  to 100 pts  $\text{H}_2\text{O}$ 

Pts $\text{CaCl}_2$	Sp gr	Pts $\text{CaCl}_2$	Sp gr
0.97	1.0515	36.33	1.2469
12.58	1.0954	50.67	1.3234
23.33	1.1681	62.90	1.3806

(Kremer, Pogg 99 444)

Sp. gr of  $\text{CaCl}_2 + \text{Aq}$   $G = \text{sp. gr. at } 15^\circ \text{ if } \% \text{ is } \text{CaCl}_2$ , according to Gerlach;  $S = \text{sp. gr. at } 18.3^\circ \text{ if } \% \text{ is } \text{CaCl}_2 + 6\text{H}_2\text{O}$ , according to Schiff

%	G	S	%	G	S
1	1.00852	1.0039	36	1.35610	1.1575
2	1.01704	1.0079	37	1.36790	1.1622
3	1.02555	1.0119	38	1.37970	1.1671
4	1.03407	1.0159	39	1.39150	1.1719
5	1.04259	1.0200	40	1.40330	1.1768
6	1.05146	1.0241	41		1.1816
7	1.06033	1.0282	42		1.1865
8	1.06921	1.0323	43		1.1914
9	1.07808	1.0365	44		1.1963
10	1.08695	1.0407	45		1.2012
11	1.09628	1.0449	46		1.2062
12	1.00581	1.0491	47		1.2112
13	1.10404	1.0534	48		1.2162
14	1.12427	1.0577	49		1.2212
15	1.13360	1.0619	50		1.2262
16	1.14332	1.0663	51		1.2312
17	1.15305	1.0706	52		1.2363
18	1.16277	1.0750	53		1.2414
19	1.17250	1.0794	54		1.2465
20	1.18222	1.0838	55		1.2516
21	1.19251	1.0882	56		1.2567
22	1.20279	1.0927	57		1.2618
23	1.21308	1.0972	58		1.2669
24	1.22336	1.1017	59		1.2721
25	1.23365	1.1062	60		1.2773
26	1.24450	1.1107	61		1.2825
27	1.25535	1.1153	62		1.2877
28	1.26619	1.1199	63		1.2929
29	1.27704	1.1246	64		1.2981
30	1.28789	1.1292	65		1.3034
31	1.29917	1.1339	66		1.3087
32	1.31045	1.1386	67		1.3140
33	1.32174	1.1433	68		1.3193
34	1.33602	1.1480	69		1.3246
35	1.34430	1.1527	70		1.3300

(Calculated by Gerlach, Z. anal. 8, 283)

Sp gr. of  $\text{CaCl}_2 + \text{Aq}$   $a = \text{no. of half molecules in grammes dissolved in } 1000 \text{ g. } \text{H}_2\text{O}$ ;  $b = \text{sp. gr. at } 24.3^\circ \text{ when } a = \text{CaCl}_2 + 6\text{H}_2\text{O}$  ( $\frac{1}{2}$ -mol = 109.5 g.),  $c = \text{sp. gr. at } 24.3^\circ \text{ when } a = \text{CaCl}_2$  ( $\frac{1}{2}$ -mol = 55.5 g.)

a	b	c	a	b	c
1	1.041	1.043	7	1.198	1.258
2	1.076	1.084	8	1.214	
3	1.106	1.122	9	1.229	
4	1.133	1.159	10	1.242	
5	1.157	1.193	11	1.255	
6	1.179	1.227			

(Favre and Valson, C. R. 79. 968)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$  at 18°

% $\text{CaCl}_2$	Sp gr.	% $\text{CaCl}_2$	Sp gr.
5	1.0409	25	1.2305
10	1.0852	30	1.2841
15	1.1311	35	1.3420
20	1.1794		

(Kohlrausch, W. Ann. 1879. 1.)

$\text{CaCl}_2 + \text{Aq}$  sat. at  $0^\circ$  has sp. gr. = 1.367. (Engel, Bull. Soc. 1887, (2) 47. 318)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq}$  at 9.5°C

Mass of salt per unit mass of solution	Density of solution (g. per cc.)
0.00191	1.00168
0.00381	1.00317
0.00570	1.00465
0.00759	1.00615
0.00947	1.00765
0.01320	1.01060

(McGregor, C. N. 1887, 55. 6)

Sp gr. of  $\text{CaCl}_2 + \text{Aq}$  at 25°

Concentration of $\text{CaCl}_2 + \text{Aq}$	Sp gr.
1-normal	1.0446
$\frac{1}{2}$ -"	1.0218
$\frac{1}{4}$ -"	1.0105
$\frac{1}{8}$ -"	1.0050

(Wagner, Z. phys. Ch. 1890, 5. 36.)

Sp gr. at  $16^\circ/4'$  of  $\text{CaCl}_2 + \text{Aq}$  containing 12.1638%  $\text{CaCl}_2 = 1.10489$ . (Schonrock, Z. phys. Ch. 1893, 11. 768)

Sp gr. of  $\text{CaCl}_2 + \text{Aq}$  at 17 925°C

$\frac{\text{CaCl}_2}{\text{Aq}}$	Sp gr	$\frac{\text{CaCl}_2}{\text{Aq}}$	Sp gr	$\frac{\text{CaCl}_2}{\text{Aq}}$	Sp gr
0 0	0 99809	13	1 11206	33	1 31562
0 1	0 99954	14	1 12130	34	1 32689
0 2	1 00037	15	1 13067	35	1 33821
0 3	1 00116	16	1 14016	36	1 34956
0 4	1 00201	17	1 14969	37	1 36100
0 6	1 00371	18	1 15926	38	1 37242
0 8	1 00539	19	1 16920	39	1 38400
1 0	1 00703	20	1 17910	40	1 39489
1 5	1 01127	21	1 18897	41	1 40641
2	1 01548	22	1 19901	42	1 41770
3	1 02386	23	1 20901	43	1 42882
4	1 03238	24	1 21918	44	1 44007
5	1 04089	25	1 22941	45	1 45124
6	1 04951	26	1 23969	46	1 46238
7	1 05822	27	1 25030	47	1 47329
8	1 06680	28	1 26092	48	1 48450
9	1 07569	29	1 27182	49	1 49573
10	1 08467	30	1 28271	50	1 50676
11	1 09373	31	1 29360	51	1 51778
12	1 10288	32	1 30461		

(Pickering, B. 1894, 27. 1385.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq}$  at t°

t°	Concentration of $\text{CaCl}_2 + \text{Aq}$	Sp gr.
20	1 pt $\text{CaCl}_2$ in 7.1045 pts $\text{H}_2\text{O}$	1 1062
20	1 " " " 164 25 " "	1 0032

(Hittorf, Z phys Ch. 1902, 39. 628)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$  at 20°.

g mols $\text{CaCl}_2$ per l.	Sp. gr.
0 010	1 000982
0 025	1 002539
0 050	1 004874
0 075	1 006814
0 10	1 008971
0 25	1 02267
0 50	1 04451
0 75	1 06641
1 00	1 08744

(Jones and Pearce, Am. Ch. J 1907, 38. 606)

Sat.  $\text{CaCl}_2 + \text{Aq}$  forms a crust at 150°, and contains 178 pts.  $\text{CaCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ . (Gerlach)

Sat  $\text{CaCl}_2 + \text{Aq}$  boils at 180° (Rudorff.)

B-pt of  $\text{CaCl}_2 + \text{Aq}$  containing pts  $\text{CaCl}_2$  to 100 pts  $\text{H}_2\text{O}$  G=according to Gerlach (Z. anal 26. 440); L=according to Le-grand (A ch (2) 39. 43)

B-pt	G	L	B-pt	G	L
101°	6 0	10	134°		117 2
102	11 5	16 5	135	119	
103	16 5	21 6	136		123 5
104	21 0	25 8	138		129 9
105	25 0	29 4	140	137 5	136 3
106	29 0	32 6	142		142 8
107	32 5	35 6	144		149 4
108	35 5	38 5	145	157	
109	38 5	41 3	146		156 2
110	41 5	44 0	148		163 2
111		46 8	150	178	170 5
112		49 7	152		178 1
113		52 6	154		186 0
114		55 6	155	200	
115	55 0	58 6	156		194 3
116		61 6	158		203 0
117		64 6	160	222	212 1
118		67 6	162		221 6
119		70 6	164		231 5
120	69 0	73 6	165	245	
121		76 7	166		241 9
122		79 8	168		252 8
123		82 9	170	268	264 2
124		86 0	172		276 1
125		89 1	174		285 5
126		92 2	175	292	
128		98 4	176		301 4
130	101	104 6	178	305	314 8
130 4	102 67		179 5		325 0
132		110 9			

B-pt. of  $\text{CaCl}_2 + \text{Aq}$ 

% $\text{CaCl}_2$	B-pt.	% $\text{CaCl}_2$	B-pt
5 6	101°	17 5	104°
10 3	102	20 0	105
14 5	103		

(Skinner, Chem. Soc 61. 340)

Less sol in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ .  $\text{HCl} + \text{Aq}$  sat. at 12° dissolves 27%  $\text{CaCl}_2$ , which crystallizes out with  $2\text{H}_2\text{O}$  (Ditte, C R 92. 242.)

Solubility of  $\text{CaCl}_2$  in  $\text{HCl} + \text{Aq}$  at 0°

Sp gr. of solutions	g per 100 cc solution	
	$\text{CaCl}_2$	$\text{HCl}$
1 367	51 45	0 0
1 344	46 45	3 32
1 326	42 80	5 83
1 310	36 77	10 66
1 283	29 84	15 84
1 250	20 12	23 05
1 238	11 29	34 62

(Engel, C R. 1887, 104, 434)

$\text{CaCl}_2 + \text{CaO}_2\text{H}_2$ . Solubility of  $\text{CaCl}_2 + \text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

% $\text{CaCl}_2$	% $\text{CaO}_2\text{H}_2$	Solid phase
5.02	0.101	$\text{CaO}_2\text{H}_2$
10.00	0.115	"
12.94	0.128	"
15.14	0.140	"
17.20	0.145	"
18.15	0.148	$\text{CaO}_2\text{H}_2 + \text{CaCl}_2, 4\text{CaO } 14\text{H}_2\text{O}$
18.01	0.152	$\text{CaCl}_2, 4\text{CaO } 14\text{H}_2\text{O}$
21.02	0.147	"
23.80	0.146	"
24.33	0.147	"
28.37	0.170	"
29.54	0.180	"
32.87	0.225	$\text{CaO}_2\text{H}_2(?)$
33.21	0.245	$\text{CaCl}_2, 4\text{CaO } 14\text{H}_2\text{O}$
33.72	0.254	$\text{CaCl}_2, 4\text{CaO } 14\text{H}_2\text{O} + \text{CaCl}_2, \text{CaO } 2\text{H}_2\text{O}$
34.36	0.173	$\text{CaCl}_2, \text{CaO } 2\text{H}_2\text{O}$
38.61	0.060	"
41.32	0.048	"
44.30	0.030	"
44.60	0.029	$\text{CaCl}_2, 6\text{H}_2\text{O} + \text{CaCl}_2, \text{CaO } 2\text{H}_2\text{O}$
44.77		$\text{CaCl}_2, 6\text{H}_2\text{O}$

(Schreinemakers and Figuee, Chem Weekbl. 1911, 8, 685.)

See also under Calcium hydroxide

$\text{CaCl}_2 + \text{KCl}$ . 100 pts  $\text{H}_2\text{O}$  dissolve 56 pts  $\text{CaCl}_2$  at  $7^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 31 pts  $\text{KCl}$  at  $7^\circ$ ; 100 pts  $\text{H}_2\text{O}$  dissolve 63.5 pts  $\text{CaCl}_2 + 4.9$  pts  $\text{KCl}$  at  $7^\circ$ . (Mulder, J. B. 1866, 67.)

$\text{CaCl}_2 + \text{NaCl}$ . 100 pts  $\text{H}_2\text{O}$  dissolve 53 pts  $\text{CaCl}_2$  at  $4^\circ$ , and 56 pts. at  $7^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 35.7 pts.  $\text{NaCl}$  at  $4^\circ$ , and 35.7 pts. at  $7^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 57.6 pts.  $\text{CaCl}_2 + 2.4$  pts  $\text{NaCl}$  at  $4^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 59.5 pts.  $\text{CaCl}_2 + 4.6$  pts  $\text{NaCl}$  at  $7^\circ$  (Mulder, l. c.)

100 g.  $\text{H}_2\text{O}$  dissolve 72.6 g  $\text{CaCl}_2 + 16.0$  g.  $\text{NaCl}$  at  $15^\circ$ . (Rüdorff.)

Sol. in sat  $\text{KNO}_3 + \text{Aq}$  (Fourcroy)

Insol. in liquid  $\text{CO}_2$ . (Buchner, Z. phys. Ch. 1908, 54, 674.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Sol. in 1 pt. strong boiling alcohol (Wenzel.)

Sol. in 8 pts alcohol at  $15^\circ$ , and in 1 pt spirits of wine. (Bergman.)

Sol. in 0.7 pt. boiling absolute alcohol (Otto.)

Sol. in 1.43 pts. boiling absolute alcohol at  $78.3^\circ$ . (Graham.)

Solubility of  $\text{CaCl}_2$  in methyl alcohol.

$\text{CaCl}_2$  forms with methyl alcohol two complexes.  $\text{CaCl}_2 \cdot 4\text{CH}_3\text{OH}$  and  $\text{CaCl}_2 \cdot 3\text{CH}_3\text{OH}$

Solubility of  $\text{CaCl}_2, 4\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$

$t^\circ$	% by weight of $\text{CaCl}_2, 4\text{CH}_3\text{OH}$
0	33.3
10	37.6
20	42.2
30	47.0
40	52.0
50	57.3
55	60.0
56	61.3

Solubility of  $\text{CaCl}_2, 3\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$ .

$t^\circ$	% by weight of $\text{CaCl}_2, 3\text{CH}_3\text{OH}$
55	60.5
75	63.1
95	66.3
115	70.3
135	75.2
155	81.8
165	86.2
170	89.5
174	93.5
177 (mpt.)	100

(Menschutkin, Z. anorg. 1907, 52, 21.)

Solubility of  $\text{CaCl}_2$  in ethyl alcohol.

$\text{CaCl}_2$  forms with ethyl alcohol a complex,  $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$

Solubility of  $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$	$t^\circ$	% by weight of $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$
0	34.8	80	86.8
20	46.0	85	89.2
40	58.7	90	91.9
60	73.0	95	96.2
70	80.8	97 mpt.	100

(Menschutkin, Z. anorg. 1907, 52, 23.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{CaCl}_2$  + alcohol containing 5.668%  $\text{CaCl}_2 = 0.83636$ . (Schönrock, Z. phys. Ch. 1893, 11, 708.)

B-pt. of an alcoholic solution of  $\text{CaCl}_2$ .

% $\text{CaCl}_2$	B-pt.
2.4	$78.43^\circ + 0.70^\circ$
5.39	$78.43^\circ + 2.15^\circ$
8.01	$78.32^\circ + 4.18^\circ$
9.93	$78.43^\circ + 5.55^\circ$
15.94	$78.43^\circ + 11.75^\circ$

(Skinner, Chem. Soc. 61, 340.)

Sl sol in propyl alcohol. (Berthelot.)

100 g. propyl alcohol dissolve 10.75 g.  $\text{CaCl}_2$  (Schlamp, Z. phys. Ch. 1894, 14, 276.)

Sl sol. in amyl alcohol. (Bouis.)

Pptd. from alcoholic solution by ether. (Dobberiner.)

Sol. in wood-spirit; sol. in lignone (Liebig);  
insol. in lignone (Gmelin)

Insol. in acetone, sol. in butyl alcohol.  
(Wurts.)

\*Very sl. sol. in acetone. (Krug and  
M'Elroy, J. Anal. Ch. 6. 184.)

Solubility in acetone + Aq at 20°

CaCl<sub>2</sub> will salt out acetone from aqueous  
solution. The table shows the composition  
of the solutions at the points at  
which inhomogeneous solutions of CaCl<sub>2</sub>,  
acetone and H<sub>2</sub>O just become homogen-  
eous at 20° 100 g. of the solution contain

g CaCl <sub>2</sub>	g H <sub>2</sub> O	g acetone
13.03	52.49	34.48
8.5	45.37	46.15
6.38	39.51	54.11
5.35	35.95	58.70
4.11	31.8	64.09
3.58	29.88	66.54
3.31	28.59	68.10
3.04	27.03	69.93
2.77	26.67	70.56
13.90	53.47	32.63
10.12	48.86	41.02
8.47	45.59	45.94
6.92	41.24	51.84
6.31	39.15	54.54
5.28	36.09	58.63
4.94	34.72	60.34
4.37	33.8	61.83
1.99	23.38	74.63
1.6	21.4	77.00
1.35	19.92	78.73
18.787	55.301	25.913
12.443	52.153	35.404
10.70	49.61	39.69
9.59	47.75	42.66
8.82	46.04	45.14
7.48	42.75	49.77
7.07	41.54	51.39
6.72	40.48	52.8
30.04	49.39	20.57
18.23	55.01	26.76
15.49	54.00	30.51
13.18	52.52	34.3
11.40	50.20	38.40
28.09	51.71	20.20
26.81	52.01	21.18
22.67	55.66	21.67
18.189	56.21	25.60
31.21	48.00	20.81
2.23	24.93	72.84
1.82	22.27	75.89
0.68	15.87	83.44
0.58	14.93	84.49
0.45	13.55	86.00
0.48	14.49	85.13
0.27	12.31	87.42
0.20	9.95	89.85
0.15	9.05	90.81

(Frankforter, J. Am. Chem. Soc. 1914, 36.  
1125.)

Sol. in many compound ethers, as ethyl  
acetate (Liebig), ethyl lactate (Strecker)

Sol. in considerable quantity in amyl sul-  
phocyanide. (Medlock, Chem. Soc. 1. 374)

Sol. in valyl (Kolbe)

Very sol. in conc. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>. (Liebig.)

Solubility of CaCl<sub>2</sub> in acetic acid.

CaCl<sub>2</sub> forms with acetic acid a complex,  
CaCl<sub>2</sub>·4CH<sub>3</sub>COOH

Solubility of CaCl<sub>2</sub>·4CH<sub>3</sub>COOH in  
CH<sub>3</sub>COOH at t°

t°	% by wt. CaCl <sub>2</sub> ·4CH <sub>3</sub> COOH
11.1	42.0
30	47.6
35	50.0
40	54.7
45	63.0
50	69.5
60	79.5
65	84.5
70	91.2
73	100.0

(Menschutkin, Z. anorg. 1907, 54. 95.)

Insol. in benzonitrile (Naumann, B. 1914,  
47. 1370)

Insol. in ethyl acetate (Naumann, B.  
1910, 43. 314.)

Sl. sol. in anhydrous pyridine.

Sol. in 97%, 95% and 93% pyridine + Aq  
(Kahlenberg, J. Am. Chem. Soc. 1908, 30.  
1107)

100 g. sat. solution of CaCl<sub>2</sub> in sat. sugar +  
Aq at 31.25° contain 42.84 g. sugar + 25.25 g.  
CaCl<sub>2</sub>, or 100 g. H<sub>2</sub>O dissolve 135.1 g. sugar  
+ 79.9 g. CaCl<sub>2</sub> at 31.25°. (Köhler, Z. Ver.  
Zuckerind, 1907, 47. 447.)

+H<sub>2</sub>O. (Bakhuys Roozeboom.) See above.

+2H<sub>2</sub>O. (Bakhuys Roozeboom.) See above.

+4H<sub>2</sub>O. Two modifications. (Bakhuys  
Roozeboom.) See above.

$\alpha$  and  $\beta$  modifications ( $\alpha$ =stable form)  
(Kuznetsov, C. A. 1911, 842)

+6H<sub>2</sub>O. Very deliquescent. Sol. in H<sub>2</sub>O  
with absorption of much heat.

250 pts. CaCl<sub>2</sub> + 6H<sub>2</sub>O with 100 pts. H<sub>2</sub>O  
at 10.5° lower the temp. 23.2°. (Rüdorff, B.  
2. 68.)

Melts in crystal H<sub>2</sub>O at 28° (Tilden, Chem.  
Soc. 45. 409); at 30.2° (Bakhuys Roozeboom.)

Sat. solution in H<sub>2</sub>O contains at:

-22°	-17°	-5°	-5°	+4°
31.5	32.4	35.1	35.2	36.5% salt,
8°	22°	29°	35°	49°
37.9	42.1	46.1	49.0	55.1% salt,
63°	80°	104°	115°	
55.9	57.5	58.5	58.6% salt.	

(Étaud, A. ch. 1894, (7) 2. 532.)

Sat. solution of CaCl<sub>2</sub> + 6H<sub>2</sub>O contains

44.77 g.  $\text{CaCl}_2$  at  $25^\circ$ . (Schneinemakers and Figuee, Chem Weekbl. 1911, 8. 685)  
*See also above*

Solubility of  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  in ethyl alcohol + Aq under addition of increasing amounts of  $\text{CaCl}_2$

Percent of alcohol by volume	G $\text{CaCl}_2$ added	Grams $\text{CaCl}_2$ in 5 cc of solution
92 3		1 430
97 3		1 409
99 3		1 429
"	1	1 529
"	2	1 561
"	3	1 590
"	4	1 641
"	5	1 709

(Bodtke, Z. phys Ch 1897, 22. 510)

Calcium hydroxylamine chloride,  $\text{CaCl}_2$ ,  
 $3\text{NH}_2\text{OH}$ , HCl

(Antonow, J. Russ Phys Chem. Soc. 1905, 37. 479.)

Calcium iodine trichloride,  $2\text{ICl}_3$ ,  $\text{CaCl}_2 + 8\text{H}_2\text{O}$ .

Hydroscopic. (Weinland, Z anorg. 1902, 30. 142.)

Calcium mercuric chloride,  $\text{CaCl}_2$ ,  $5\text{HgCl}_2 + 8\text{H}_2\text{O}$ .

Decomp by cold  $\text{H}_2\text{O}$ , which dissolves out  $\text{CaCl}_2$ , but all dissolves on heating. (v. Bonsdorff, 1829.)

$\text{CaCl}_2$ ,  $2\text{HgCl}_2 + 6\text{H}_2\text{O}$  Deliquescent. Very sol in  $\text{H}_2\text{O}$ . (v. Bonsdorff)

$\text{CaCl}_2$ ,  $6\text{HgCl}_2 + 6\text{H}_2\text{O}$  Very deliquescent. Decomp by  $\text{H}_2\text{O}$  (Stromholm, J. pr 1902, (2) 66. 521.)

Calcium lead chloride, basic.

*See Calcium lead oxychloride.*

Calcium magnesium chloride,  $\text{CaCl}_2$ ,  $2\text{MgCl}_2 + 12\text{H}_2\text{O}$

Min *Tachhydrite*. Deliquescent 100 pts  $\text{H}_2\text{O}$  dissolve 160 3 pts at  $18.75^\circ$ . By dissolving 20 pts in 80 pts.  $\text{H}_2\text{O}$  the temp is raised  $7.75^\circ$ . (Bischof)

Calcium mercuric chloride, basic,  $\text{CaCl}_2$ ,  $2\text{HgO} + 4\text{H}_2\text{O}$ .

*See Calcium mercuric oxychloride.*

Calcium thallic chloride,  $2\text{TiCl}_3$ ,  $\text{CaCl}_2 + 6\text{H}_2\text{O}$ .

Can be cryst from  $\text{H}_2\text{O}$ . (Gewecke A. 1909, 366. 222.)

Calcium tin (stannic) chloride.

*See Chlorostannate, calcium.*

Calcium uranium chloride,  $\text{CaCl}_2$ ,  $\text{UCl}_4$

Decomp by  $\text{H}_2\text{O}$  (Aloy, Bull. Soc. 1899, (3) 21. 265)

Calcium zinc chloride.

$\text{CaZnCl}_4 + 5\frac{1}{2}\text{H}_2\text{O}$ , and  $\text{Ca}_2\text{ZnCl}_6 + 6\text{H}_2\text{O}$  Very hygroscopic (Ephraim, Z. anorg 1910, 67. 379)

Calcium chloride ammonia,  $\text{CaCl}_2$ ,  $8\text{NH}_3$

Sol in  $\text{H}_2\text{O}$  with decomp. (Faraday.)

Calcium chloride hydrazine,  $\text{CaCl}_2$ ,  $2\text{N}_2\text{H}_4$ (?)

Ppt (Franzen, Z. anorg 1908, 60. 288)

Calcium chloride hydroxylamine,  $\text{CaCl}_2$ ,  $\text{NH}_2\text{OH} + 5\text{H}_2\text{O}$

Not hygroscopic (Antonow, J. Russ. Phys Chem. Soc 1905, 37. 479.)

$\text{CaCl}_2$ ,  $2\text{NH}_2\text{OH}$

+  $\text{H}_2\text{O}$ . Aqueous solution sat. at  $20^\circ$  contains 56.6 pts salt.

+  $2\text{H}_2\text{O}$  (Antonow, l. c)

$2\text{CaCl}_2$ ,  $3\text{NH}_2\text{OH} + 6\text{H}_2\text{O}$ . (Antonow, l. c.)

$2\text{CaCl}_2$ ,  $5\text{NH}_2\text{OH} + 4\text{H}_2\text{O}$  (Antonow, l. c.)

Calcium chloride lead oxide,  $\text{CaCl}_2$ ,  $3\text{PbO} + 3\text{H}_2\text{O}$ .

*See Calcium lead oxychloride.*

Calcium chloroferrite,  $\text{CaO}$ ,  $\text{CaCl}_2$ ,  $\text{Fe}_2\text{O}_3$

Insol in  $\text{H}_2\text{O}$  (le Chatelier, C. R. 99. 276.)

Calcium chlorofluoride,  $\text{CaF}_2$ ,  $\text{CaCl}_2$

Decomp. by  $\text{H}_2\text{O}$ , by very dil. HCl,  $\text{HNO}_3$  or acetic acid, by hot dil or conc.  $\text{H}_2\text{SO}_4$ . Sol. in conc. HCl or  $\text{HNO}_3$ . Insol. in, and not decomp by cold or boiling alcohol. (Defacqz, A. ch. 1904, (8) 1. 355)

Calcium cyanamide, basic,  $\text{CN}_2(\text{CaOH})_2 + 6\text{H}_2\text{O}$

Sl. sol. in  $\text{H}_2\text{O}$ . (Meyer, J. pr 1878, (2) 18. 425)

Calcium cyanamide,  $\text{CaCN}_2$

Decomp. by  $\text{H}_2\text{O}$ . (Meyer, J. pr 1878, (2) 18. 425.)

Calcium subfluoride,  $\text{CaF}$ .

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in hot dil. HCl and somewhat sol. in dil. acetic acid.

Somewhat sol. in boiling absolute alcohol. (Wohler, Z. anorg. 1909, 61. 81)

Calcium fluoride,  $\text{CaF}_2$

Sol in 26,923 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  (Wilson, Ch. Gaz 1860. 366)

1 l.  $\text{H}_2\text{O}$  dissolves 16 mg.  $\text{CaF}_2$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 60. 356.)

16.3 mg in 1 l. of sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys Ch. 1908, 64. 168)

When pptd. not completely insol in  $H_2O$ ; scarcely sol in dil., more sol. in conc.  $HCl + Aq$ , decomp. by conc.  $H_2SO_4$ , not decomp. by dil. alkaline solutions. (Fresenius)

Not decomp. by conc.  $H_2SO_4$  below  $40^\circ$ , but forms a transparent syrup.  $CaF_2$  is pptd. from this solution by addition of  $H_2O$ .

Sol. in conc.  $HCl$ , and  $HNO_3 + Aq$  in the same way, but the liquid is not viscid. Very sl. sol. in  $HF$ . Boiling  $HCl + Aq$  dissolves slightly. Decomp. by boiling  $HNO_3 + Aq$ . Sol. in  $NH_4$  salts +  $Aq$ . (Rose.)

Partly decomp. by boiling  $K_2CO_3$ , and  $Na_2CO_3 + Aq$ . (Dulong, A. ch. 82. 278.)

Insol. in liquid  $HF$ . (Franklin, Z. anorg. 1905, 46. 2)

Insol. in acetone (Naumann, B. 1904, 37. 4329)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate (Naumann, B. 1910, 43. 314.)

Min. Fluoride (*Fluorspar*). Calculated from electrical conductivity of  $CaF_2 + Aq$ , 11  $H_2O$  dissolves 14 mg  $CaF_2$  at  $18^\circ$ . (Kohl- tausch and Rose, Z. phys. Ch. 12. 241)

Calcium hydrogen fluoride,  $CaH_2F_4 + 6H_2O$

Decomp. by boiling  $H_2O$ . Sol. in  $HF + Aq$ . (Fremy, A. ch. (3) 47. 35)

Calcium tantalum fluoride.

See Fluotantalate, calcium.

Calcium stannic fluoride.

See Fluostannate, calcium.

Calcium titanium fluoride.

See Fluotitanate, calcium.

Calcium fluoiodide,  $CaF_2 \cdot CaI_2$ .

Very deliquescent. Decomp. by cold  $H_2O$ , more rapidly by hot  $H_2O$ , by dil.  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$ , conc.  $H_2SO_4$ , and by alcohol and by ether if these reagents are not absolute. (De- faeqz, A. ch. 1904, (8) 1. 358)

Calcium hydride,  $CaH_2$ .

Decomp. by  $HCl + Aq$  (Winkler, B. 24. 1975. (Moldenhauer, Z. anorg. 1913, 82. 136)

$CaH_2$ . Readily decomp. by  $H_2O$  and dil. acids, almost insol. in conc. acids. Insol. in benzene, turpentine and alkyl haloids. (Mois- san, C. R. 1898, 127. 30-31.)

Decomp.  $H_2O$  and ether, sol. in dil.  $H_2SO_4$  and  $HNO_3$ ; almost insol. in conc.  $H_2SO_4$  and  $HNO_3$ . (von Lengyl, C. C. 1898, II. 262.)

Insol. in  $CCl_4$ ,  $CS_2$ , alcohols and ethers. No known solvent. (Moissan, C. C. 1903, I. 563.)

Calcium hydrosulphide,  $CaS_2H_2$

Cryst. with  $6H_2O$ . Extremely sol. in  $H_2O$  and alcohol.  $\frac{1}{4}$  of its weight of  $H_2O$  at or-

dinary temp. more than suffices to hold it in solution (Divers and Shmidzu, Chem. Soc. 45. 271.)

Sp. gr. of aqueous solution containing 32% anhydrous  $CaS_2H_2$  (64%  $CaS_2H_2 + 6H_2O$ ) = 1.255; 37.5%  $CaS_2H_2$  (75.5%  $CaS_2H_2 + 6H_2O$ ) = 1.310. (Divers and Shmidzu.)

Calcium hydroxide,  $CaO \cdot H_2O$ .

See also Calcium oxide.

Sl. sol. in cold, and less in hot  $H_2O$ .

1 pt.  $CaO$  dissolves at  $t^\circ$  in pts.  $H_2O$

$t^\circ$	Pts. $H_2O$	Authority
20	450	Davy
0	656	Philips (A. Phil. 17. 107)
	700	Bergmann (Essays, etc.)
18	785	Paves and Rotondi (B. 7. 817)
18	780	Bineau (A. ch. (3) 51. 290)
19.5	806	P. and R. (l. c.)
22	814	P. and R. (l. c.)
18.75	960	Abl.
54.4	972	Dalton (Syst. 2. 231)
15.6	778	Dalton (l. c.)
15.8	732	Philips (l. c.)
15.6	731	Wittstein (Repert. Pharm. 1. 182)
15.6	741	Tiechborne (Bull. Soc. (2) 17. 24.)
100	1270	Dalton (l. c.)
100	1280	Philips (l. c.)
100	1330	Wittstein (l. c.)
100	1340	Tiechborne (l. c.)
100	1500	Bineau (l. c.)
100	1758	Tiechborne (l. c.)

Solubility in  $H_2O$  1000 pts.  $CaO \cdot H_2O + Aq$  sat. at  $t^\circ$  contain pts.  $CaO$ .

$t^\circ$	Pts. $CaO$		
	From Nitrate	Marble	$H_2O$ dist.
0	1 362	1 381	1 430
10	1 311	1 342	1 384
15	1 277	1 299	1 344
30	1 142	1 162	1 195
45	0 996	1 005	1 033
60	0 884	0 868	0 885
100	0 562	0 576	0 584

(Lamy, C. R. 86. 333.)

Solubility of  $CaO \cdot H_2O$  in  $H_2O$  at  $t^\circ$

$t^\circ$	Pts. $H_2O$ to 1 pt. $CaO$	Pts. $CaO$ in 100 pts. $H_2O$	$t^\circ$	Pts. $H_2O$ to 1 pt. $CaO$	Pts. $CaO$ in 100 pts. $H_2O$
0	759	0 131	60	1136	0 088
10	770	0 129	70	1235	0 080
20	791	0 126	80	1362	0 073
30	862	0 116	90	1579	0 063
40	932	0 107	100	1650	0 060
50	1019	0 098	..	..	..

(Maben, Pharm. J. Trans. (3) 14. 505.)

1 pt.  $CaO \cdot H_2O$  is sol. in 640 pts.  $H_2O$  at  $19^\circ$ , and 3081 pts. at  $150^\circ$  (Shenstone and Cundall, Chem. Soc. 53. 550)

1000 g.  $H_2O$  dissolve 1.251 g.  $CaO$  (Carles, Arch. Pharm. (3) 4. 558.)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$ . 100 pts  $\text{H}_2\text{O}$  dissolve pts.  $\text{CaO}$  at  $t^\circ$

$t^\circ$	Pts $\text{CaO}$	$t^\circ$	Pts $\text{CaO}$
20	0.1374	80	0.0845
40	0.1162	100	0.0664
60	0.1026		

(Zahorsky, Z. anorg. 3. 34)

1 pt  $\text{CaO}$  is sol. in pts  $\text{H}_2\text{O}$  at  $t^\circ$   
 $t^\circ$  15° 20° 25° 30° 35° 40° 45°  
 pts  $\text{H}_2\text{O}$  776 813 848 885 924 962 1004

$t^\circ$  50° 55° 60° 65° 70° 75° 80°  
 pts.  $\text{H}_2\text{O}$  1044 1108 1158 1244 1330 1410 1482

(Herzfeld, C. C. 1897, I, 932.)

100 g. sat.  $\text{CaO}_2\text{H}_2 + \text{Aq}$  contain g  $\text{CaO}$  at  $t^\circ$ :

$t^\circ$  5 10 15 20 25  
 g.  $\text{CaO}$  0.135 0.1342 0.132 0.1293 0.1254

$t^\circ$  30 35 40 50 60  
 g.  $\text{CaO}$  0.1219 0.1161 0.1119 0.0981 0.0879

$t^\circ$  70 80 90 100  
 g.  $\text{CaO}$  0.0781 0.074 0.0696 0.0597  
 (Guthrie, J. Soc. Chem. Ind. 1901, 20. 223.)

Solubility in  $\text{H}_2\text{O}$  at high temp  
 1 litre of the solution contains at:  
 $120^\circ$  150° 190°  
 0.305 0.169 0.084 g.  $\text{CaO}$

(Harold, Z. elektrochem. 1905, 11. 421)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	1 g $\text{CaO}$ is sol. in g $\text{H}_2\text{O}$ at $t^\circ$
2	768.5
10	786.8
15	804.3
20	826.4
25	868.7
30	908.2
40	988.1
50	1083.0
60	1179.0
70	1274.8
80	1368.1

(Moody, Chem. Soc. 1908, 93. 1772.)

Sat.  $\text{CaO}_2\text{H}_2 + \text{Aq}$  contains at:

95° 76°  
 0.0580 0.0705% by wt.  $\text{CaO}$

(Tschugaeff, Z. anorg. 1914, 86. 159.)

100 g. sat. solution of  $\text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$  at  $25^\circ$  contain 0.117 g.  $\text{CaO}_2\text{H}_2$ . (Cameron and Potter, J. phys. Ch. 1911, 15. 70.)  
 Readily sol. in most acids.

Sol. in  $\text{H}_3\text{BO}_3 + \text{Aq}$  at  $30^\circ$  (Sborgi, Real Ac. Linc. 1913, (5) 22. I, 715 and 798.)

Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  Much more sol. in  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Rose)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{NH}_4\text{Cl} + \text{Aq}$ in millimols per liter	Solubility of $\text{CaO}_2\text{H}_2$ in millimols per liter
0.00	20.22
21.76	29.08
43.52	39.23
87.03	59.68

(Noyes and Chapin, Z. phys. Ch. 1899, 28. 520)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{CaCl}_2 + \text{Aq}$  100 pts.  $\text{CaCl}_2 + \text{Aq}$  of given strength dissolve pts.  $\text{CaO}$  at  $t^\circ$

$t^\circ$	$\text{CaCl}_2 + \text{Aq}$ 3% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 10% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 15% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 20% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 25% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 30% $\text{CaCl}_2$
20	0.1370	0.1041	0.1093	0.1537*	0.1651*	0.1630*
40	0.1100	0.1119	0.1781	0.2249	0.3039*	0.3684*
60	0.1020	0.1313	0.1700	0.2204	0.2989	0.3694
80	0.0936	0.1328	0.1736	0.2295	0.3381	0.4122
100	0.0908	0.1589	0.1842	0.2325	0.3710	0.4922

\* In these cases, pts. of  $3\text{CaO}$ ,  $\text{CaCl}_2 + 15\text{H}_2\text{O}$  were formed.

(Zahorsky, Z. anorg. 3. 34.)

See also  $\text{CaCl}_2 + \text{CaO}_2\text{H}_2$  under Calcium chloride.

Solubility in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$

$\text{Sp. gr. } 25^\circ/25^\circ$	$\frac{\text{CaO}_2\text{H}_2}{\text{Ca}(\text{OH})_2}$ in 100 g $\text{H}_2\text{O}$	$\frac{\text{Ca}(\text{NO}_3)_2}{\text{CaO}_2\text{H}_2}$ in 100 g $\text{H}_2\text{O}$	Solubility phase
1.0249	0.095	3.38	Solid solution $\text{CaO}$ , $x\text{N}_2\text{O}_5$ , $y\text{H}_2\text{O}$
1.0434	0.109	8.52	
1.0640	0.125	13.42	
1.1383	0.181	20.73	
1.1840	0.187	28.98	Solid solution $\text{CaO}$ , $x\text{N}_2\text{O}_5$ , $y\text{H}_2\text{O}$
1.2101	0.193	32.84	
1.2287	0.212	36.83	
1.2290	0.213	37.55	
1.2541	0.225	40.25	
1.2581	0.230	41.98	
1.2826	0.260	47.00	
1.2905	0.263	47.16	
1.3337	0.332	58.67	
1.3735	0.429	99.40	
1.4195	0.545	83.03	Solid solution $\text{CaO}$ , $x\text{N}_2\text{O}_5$ , $y\text{H}_2\text{O}$ and $\text{Ca}(\text{NO}_3)_2$ , $3\frac{1}{2}\text{H}_2\text{O}$
1.4840	0.449	99.70	
1.5330	0.371	115.50	
1.5809	0.303	135.30	
1.5842	0.000	139.30	Solid solution $\text{Ca}(\text{NO}_3)_2$ , $4\text{H}_2\text{O}$

(Cameron and Robinson, J. phys. Chem. 1907, 11. 275.)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$   
Temp. = 25°.

G per 100 g sat solution		Solid phase
CaO	$\text{Ca}(\text{NO}_3)_2$	
0 1150	0	$\text{CaO}_2\text{H}_2$
0 0978	4.84	"
0 1074	9.36	"
0 1193	13.77	"
0 1444	22.46	"
0 1650	27.83	"
0 1931	32.94	"
0 2579	40.66	"
0 3060	44.44	"
0 2802	45.28	$\text{Ca}_2\text{N}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$
0 2314	47.79	"
0 1894	51.07	"
0 1659	53.20	"
0 1486	55.25	"
0 0836	57.72	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
0	57.98	"

Temp. = 100°.

0 0581	0	$\text{CaO}_2\text{H}_2$
0 0550	2.42	"
0 0624	4.91	"
0 1110	15.39	"
0 1200	18.10	"
0 165	21.86	"
0 269	33.03	"
0 480	42.26	"
0 973	50.94	"
1 261	53.75	"
1 477	55.40	"
1 476	55.43	"
1 491	55.65	"
1 635	56.89	$\text{CaO}_2\text{H} + \text{Ca}_2\text{N}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$
1 686	57.03	$\text{Ca}_2\text{N}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$
1 596	57.91	"
1 576	58.67	"
1 348	60.44	"
1 167	62.82	"
1 077	66.44	"
1 141	69.12	"
1 252	70.60	$\text{Ca}_2\text{N}_2\text{O}_7 \cdot 2\text{H}_2\text{O} + \text{Ca}_2\text{N}_2\text{O}_7 \cdot \frac{1}{2}\text{H}_2\text{O}$
1 203	70.40	$\text{Ca}_2\text{N}_2\text{O}_7 \cdot \frac{1}{2}\text{H}_2\text{O}$
1 103	71.44	"
0 937	73.85	"
0 849	75.74	"
0 815	76.94	"
0 804	77.62	$\text{Ca}(\text{NO}_3)_2$
0 412	77.74	"
0	78.43	"

(Bassett and Taylor, Chem. Soc. 1914, 105, 1926.)

## Solubility of CaO in KCl and NaCl + Aq.

Curves are given which show that the solubility of lime in solutions of either NaCl or

KCl is a maximum for all temps. when the solution contains about 60 g of salt per l. It is a minimum at any fixed temp when the solution is sat., the solubility then being much less than in pure  $\text{H}_2\text{O}$  of the same temp. A solution of NaCl dissolves more lime at all temps. and concentrations than a corresponding solution of KCl. In all cases the maximum solubility of lime occurs when the temp is lowest. With solutions of all concentrations the solubility decreases regularly as the temp. increases (Cabot, J Soc Chem Ind. 1897, 16, 417-419.)

Solubility in KCl + Aq increases with increased quantities of KCl and then diminishes, becoming less than the solubility in  $\text{H}_2\text{O}$  alone (Kernot, Gazz. ch. it 1908, 38, (1) 532.)

KOH or NaOH + Aq containing 1 pt. KOH or NaOH in 100 pts.  $\text{H}_2\text{O}$  do not dissolve more than  $\frac{1}{10000}$  pt  $\text{CaO}_2\text{H}_2$ , but it is sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Pelouze, A ch (3) 83. 11.)

## Solubility in NaOH + Aq at t°.

G NaOH per l	Solubility of CaO in g. per liter at			
	20°	50°	70°	100°
0	1 17	0 88	0 75	0 54
0 400	0 94	0 65	0 53	0 35
1 600	0 57	0 35	0 225	0 14
2 606	0 39	0 20	0 11	0 05
5 000	0 18	0 06	0 04	0 01
8 000	0 11	0 02	0 01	traces
20,000	0 02	traces	0	0

(d'Anselme, Bull. Soc 1903, (3) 29. 936.)

## Solubility of CaO in NaCl + NaOH + Aq.

G NaCl per l	G CaO per l of solution containing		
	No NaOH	0 50 g NaOH per l	4 09 g NaOH per l
0	1 3	0 8	0 22
5	1 4	0 9	
10	1 6	1 0	
25	1 7	1 1	
50	1 8	1 25	
75	1 9	1 4	0 55
100	1 85	1 4	
150	1 65	1 25	0 44
175	1 6	1 2	
182	1 6	1 2	
225	1 4	1 0	
250	1 3	0 9	
300	1 1	0 7	0 22

(Magret, Bull. Soc. 1905, (3) 33. 631.)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{CaSO}_4 + \text{Aq}$  at  $25^\circ$ .

G per 100 cc sat solution		Solid phase
$\text{CaSO}_4$	$\text{CaO}$	
0	0 1166	$\text{CaO}_2\text{H}_2$
0 0391	0 1141	"
0 0666	0 1150	"
0 0955	0 1215	"
0 1214	0 1242	"
0 1588	0 1222	$\text{CaO}_2\text{H}_2 + \text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
0 1634	0 0939	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
0 1722	0 0611	"
0 1853	0 0349	"
0 1918	0 0176	"
0 2030	0 0062	"
0 2126	0	"

(Cameron and Bell, J. Am. Chem. Soc 1906, 28. 1220.)

Insol in liquid  $\text{NH}_3$ . (Franklin, Am Ch J 1898, 20. 827.)

Alcohol dissolves traces

Methyl alcohol forms colloidal solution containing 1.125 g per l. (Neuberg and Rewald, Biochem. Z 1908, 9. 545)

Insol in ether.

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol in acetone and in methylal (Eidmann, C. C. 1899, II 1014)

Insol in methyl acetate (Naumann, B. 1906, 42. 3790)

Insol in ethyl acetate (Naumann, B. 1904, 37. 3601)

Much more sol. in glycerine, or sugar + Aq than in  $\text{H}_2\text{O}$

Solubility of  $\text{CaO}$  in glycerine

Wt of glycerine in 100 cc of solution	Wt $\text{CaO}$ contained in 100 cc. of liquid sat with $\text{CaO}$	Relation of $\text{CaO}$ to glycerine	
		$\text{CaO}$	Glycerine
10 00	0 370	3.6	98.4
5 00	0 240	4.6	95.4
2 86	0 196	6.4	93.6
2 50	0.192	7.1	92.9
2 00	0 186	8.5	91.5
1 00	0.165	14.2	85.8

(Berthelot, A. ch. (3) 46. 176.)

1000 g  $\text{H}_2\text{O}$  dissolve 1.251 g.  $\text{CaO}$ , 1000 g.  $\text{H}_2\text{O} + 50$  g glycerine dissolve 1.865 g.  $\text{CaO}$ ; 1000 g  $\text{H}_2\text{O} + 100$  g. glycerine dissolve 2.583 g  $\text{CaO}$ ; 1000 g.  $\text{H}_2\text{O} + 200$  g. glycerine dissolve 4.040 g.  $\text{CaO}$ , 1000 g  $\text{H}_2\text{O} + 400$  g glycerine dissolve 6.569 g.  $\text{CaO}$  (Carles, Arch Pharm (3) 4. 558.)

Insol in pure glycerine.

Solubility of  $\text{CaO}_2\text{H}_2$  in glycerine + Aq at  $25^\circ$ .  
G = g glycerine in 100 g. glycerine + Aq.  
 $\frac{1}{2}\text{Ca}(\text{OH})_2$  = millimols sol in 100 cc. glycerine + Aq.

G	$\frac{1}{2}\text{Ca}(\text{OH})_2$	Sp. gr
0	4 3	1 0003
7 15	8 13	1 0244
20 44	14 9	1.0537
31 55	22 5	1 0842
40 95	40 1	1 1137
48 7	44 0	1 1356
69 2	95 8	1 2027

(Herz and Knoch, Z. anorg. 1905, 46. 193.)

Solubility in glycerine + Aq at  $25^\circ$ 

Solution contains			Sp gr
% $\text{Ca}(\text{OH})_2$	% glycerine	% $\text{H}_2\text{O}$	
0 117	0	.	
0 178	3 50	96 32	1 008
0 413	15 59	80 28	
0 48	17 84	81 68	1 042
0 88	34 32	64 80	1 088
1 34	55 04	43 62	1 149

Solid phase in this system is  $\text{CaO}_2\text{H}_2$ .  
(Cameron and Patten, J phys. Chem. 1911, 15. 71)

100 pts sugar dissolved in  $\text{H}_2\text{O}$  dissolve 55.6 pts  $\text{CaO}$  (Osann), 50 pts  $\text{CaO}$  (Urn), 49.6 pts  $\text{CaO}$  (Daniell), 29-30 pts  $\text{CaO}$  (Huntton), 23 pts  $\text{CaO}$  (Seubert)

Sugar solution at  $100^\circ$  takes up  $\frac{1}{4}$  mol  $\text{CaO}$  for each mol sugar; at  $0^\circ$ , if it contains not less than 25% of sugar, it takes up 2 mol  $\text{CaO}$  to 1 mol sugar (Dunbrunfaut)

Amount dissolved is proportional to the density and temperature of the solutions

Solubility of  $\text{CaO}$  in sugar + Aq

Pts sugar dissolved in 100 pts $\text{H}_2\text{O}$	Relation of $\text{CaO}$ to sugar	
	$\text{CaO}$	Sugar
40	21.0	79.8
37.5	20.8	79.2
35.0	20.5	79.5
32.5	20.3	79.7
30.0	20.1	79.9
27.5	19.9	80.1
25.0	19.8	80.2
22.5	19.3	80.7
20.0	18.8	81.2
17.5	18.7	81.3
15.0	18.5	81.5
12.5	18.3	81.7
10.0	18.1	81.9
7.5	16.9	83.1
5.0	15.3	84.7
2.5	13.8	85.2

(Pelagot, C R 32. 335)

100 g solution of sugar sat. with  $\text{CaO}$  between  $10^\circ$  and  $54.4^\circ$  contain 22.5 to 23.5%  $\text{CaO}$  (Huntton, 1897.)

## Solubility of CaO in dil. sugar solutions.

Wt of sugar in 100 cem. of solution	Wt of CaO contained in 100 cem of liquid sat with CaO	Relation of CaO to sugar	
		CaO	Sugar
4 850	1 031	17 5	82 5
2 401	0 484	16 8	83 2
2 000	0 433	17 8	82 2
1 660	0 364	18 0	82 0
1 386	0 326	19 0	81 0
1 200	0 316	20 8	79 2
1 058	0 281	21 0	79 0
0 960	0 264	21 6	78 4
0 400	0 194	32 7	67 3
0 191	0 172	47 4	52 6
0 096	0 154	61 6	78 4
0 000	0 148		

(Berthelot, A. ch. (3) 46. 176.)

## Solubility in sugar+ Aq at t°.

t°	G sugar in 100 cem of solution	G CaO dissolved per 100 g. sugar
6-17°	0 7814	37 9
	0 9120	32 3
	1 4000	30 5
	1 6930	28 9
	4 754	27 7
	5 730	27 1
	10 159	27 5
	11 200	27 2
	12 500	27 3
	13 930	27 9
	14 487	27 5
	16 410	28 0
15°	0 625	71 6
	0 964	53 4
	2 084	33 0
	3 028	32 3
	3 451	31 7
	4 168	30 2
	4 880	28 7
	5 73	28 3
	6 12	27 4
	6 25	27 7
	6 51	27 5
	7 55	27 9
	8 20	27 3

(Weisberg, Bull. Soc. 1899, (3) 21. 775.)

## Solubility in sugar+ Aq at 25°

Solution contains			Sp. gr.
% Ca(OH) <sub>2</sub>	% sugar	% H <sub>2</sub> O	
0 117	0		0 983
0 188	0 62	99 19	1 000
0 730	4 82	94 50	1 021
1 355	7 50	91 12	1 037
2 31	9 87	87 85	1 051
3 21	11 90	84 89	1 067
4 57	15 10	80 33	1 092
5 38	17 42	76 93	1 109
6 07	19 86	73 07	1 123

The solid phase in this system consists of a series of solid solutions with Ca(OH)<sub>2</sub> a limiting case  
(Cameron and Patten, J. phys. Chem. 1911, 15. 70)

## Solubility of CaO in sugar+ Aq at 80°.

% sugar	% CaO	% Sugar	% CaO
4 90	0 117	19 50	0 358
9 90	0 189	24 60	0 458
14 75	0 230	29 70	1 017

Solid phase, CaO<sub>2</sub>H<sub>2</sub>  
(von Gudden, Proc. Kon. Akad. v Wetensch. Amsterdam, 1911, 14. 457)

## Solubility of CaO in mannite+ Aq

Wt of mannite in 100 cem of solution	Wt of CaO contained in 100 cem of liquid sat with CaO	Relation of CaO to mannite	
		CaO	Mannite
9 60	0 753	7 3	92 7
4 80	0 372	7 2	92 8
2 40	0 255	9 6	90 4
1 92	0 225	10 5	89 5
1 60	0 207	11 4	88 6
1 37	0 194	12 5	87 5
1 20	0 193	13 9	86 1
1 07	0 190	15 1	84 9
0 96	0 186	16 2	86 8
0 192	0 155	44 6	55 4
0 096	0 154	61 6	38 4
0 000	0 148		

(Berthelot, A. ch. (3) 46. 176.)

Solutions of CaO in sugar, mannite, or glycerine afford an abundant ppt. on being heated, but this redissolves on cooling (Berthelot)

Sol in sorbite+ Aq (Pelouze), sl sol. in quercite+ Aq. Sol in monobasic Ca saccharate+ Aq (Pelouze). Much more sol. in gelatine+ Aq than in pure H<sub>2</sub>O.

Calcium hydroxyhydrosulphide, Ca(OH)SH + 3H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O with almost immediate decomposition. Insol. in alcohol. but slowly

decomp. thereby (Divers and Shmidzu, Chem Soc 45. 270.)

Calcium subiodide,  $\text{CaI}$ .

Decomp. by moisture. (Wohler, Z anorg 1900, 61. 76.)

Calcium iodide,  $\text{CaI}_2$ .

Deliquescent 100 pts  $\text{H}_2\text{O}$  dissolve—  
at 0° 20° 40° 43° 92°  
192 204 228 286 435 pts.  $\text{CaI}_2$   
(Kremers, Pogg 103. 65.)

Sp gr. of  $\text{CaI}_2 + \text{Aq}$  at 19.5° containing.  
5 10 15 20 25 30%  $\text{CaI}_2$ ,  
1.044 1.09 1.14 1.198 1.26 1.321

35 40 45 50 55 60%  $\text{CaI}_2$ .  
1.398 1.477 1.567 1.665 1.78 1.91  
(Kremers, calculated by Gerlach, Z anal. 8. 285.)

Sol in absolute alcohol. (Gay-Lussac, A ch. 91. 57.)

Sol in acetone. (Naumann, B 1904, 37.

4328, Erdmann, C C 1899, II. 1014.)

Sol in ethyl acetate (Naumann, B. 1910, 43. 314.)

+4 $\text{H}_2\text{O}$ . (Kuznetsov, C A 1911. 842.)

+6 $\text{H}_2\text{O}$ . Sat aq. solution contains at

−23° +7° 10° 19°  
61.0 65.0 65.1 66.3% salt

51° 64° 130° 248°  
69.4 75.0 81.3 87.1% salt

(Etard, A. ch. 1894, (7) 2. 543.)

+7 $\text{H}_2\text{O}$ . (Kuznetsov.)

Calcium periodide,  $\text{CaI}_4 + 15\text{H}_2\text{O}$

(Mosner, A. ch. 1897, (7) 12. 401.)

$\text{CaI}_4$ . (Herz and Bulla, Z. anorg. 1911, 71. 255.)

Calcium mercuric iodide,  $\text{CaI}_2 \cdot \text{HgI}_2 + 8\text{H}_2\text{O}$ .

Very deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohols, allyl iodide, aldehyde, acetic acid, ethyl oxalate and aniline. Sl. sol in nitrobenzene. Completely insol. in  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethyl iodide, ethylene bromide,  $\text{C}_6\text{H}_6$ , monochlorobenzene and toluene. (Dubouin, C R. 1906, 142. 573.)

= 3 $\text{CaI}_2$ , 4 $\text{HgI}_2 + 24\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with pptn. of red  $\text{HgI}_2$ .

Very sol in alcohols, glycerine, ethyl acetate, methyl and isobutyl propionate, allyl iodide, aldehyde, acetone, aniline and ethyl oxalate. Insol or sl. sol in nitrobenzene. Insol in  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ , ethyl iodide, monochlorobenzene, etc. (Dubouin, C R. 1906, 142. 397.)

$\text{CaI}_2$ , 2 $\text{HgI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Boullay)

$\text{CaI}_2$ , 5 $\text{HgI}_2 + 8\text{H}_2\text{O}$ . Decomp by  $\text{H}_2\text{O}$ ,

alcohols, glycerine, aldehyde, and acetic acid, slowly by nitrobenzene and ethyl oxalate. Insol in monochlorobenzene, toluene,  $\text{CHCl}_3$  and ethylene bromide (Dubouin, l. c.)

Calcium silver iodide,  $\text{CdI}_2$ , 2 $\text{AgI} + 6\text{H}_2\text{O}$

Immediately decomp by  $\text{H}_2\text{O}$  (Simpson, Roy Soc Proc 27. 120.)

Calcium zinc iodide,  $\text{CaI}_2$ ,  $\text{ZnI}_2 + 8\text{H}_2\text{O}$

Very hygroscopic. (Ephraim, Z anorg. 1910, 67. 384.)

Calcium iodide ammonia,  $\text{CaI}_2 \cdot 6\text{NH}_3$

(Isambert, C. R. 66. 1259.)

Calcium nitride,  $\text{Ca}_3\text{N}_2$

Sol. in dil acids; insol in conc. (water free) acids (Moussan, C. R. 1898, 127. 499.)

Calcium oxide,  $\text{CaO}$ .

Decomp. by  $\text{H}_2\text{O}$ , with evolution of much heat, to form  $\text{CaO}_2 \cdot \text{H}_2$ , which see for solubility in  $\text{H}_2\text{C}$ , etc.

Calcium peroxide,  $\text{CaO}_2$

Very sl. sol. in  $\text{H}_2\text{O}$ , easily sol. in acids, and  $\text{NH}_4$  salts +  $\text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Conroy, Chem. Soc (2) 11, 808.)

+2 $\text{H}_2\text{O}$ . True composition is  $\text{CaO}_2 \cdot \text{H}_2 + \text{H}_2\text{O}_2$ . (de Forcrand, C. R. 1900, 130. 1390.)  
+8 $\text{H}_2\text{O}$ . Efflorescent. Difficultly sol. in  $\text{H}_2\text{O}$  with gradual decomp. Insol in alcohol or ether (Gay-Lussac and Thénard, A ch (2) 8. 313.)

Calcium oxybromide,  $3\text{CaO}$ ,  $\text{CaBr}_2 + 16\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol. Very easily sol. in hydracids and dil.  $\text{HNO}_3$ . (Tassilly, C. R. 1894, 119. 372.)

Calcium oxychloride,  $\text{Ca}_2\text{O}_2\text{Cl}_2 + 15\text{H}_2\text{O} = 3\text{CaO}$ ,  $\text{CaCl}_2 + 15\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Rose) Formula is  $\text{Ca}_2\text{HO}_2\text{Cl} + 7\text{H}_2\text{O}$ . (Grimshaw, C N. 30. 280.)

+16 $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into  $\text{CaO}_2 \cdot \text{H}_2$  and  $\text{CaCl}_2$  until a maximum of 85 g.  $\text{CaCl}_2$  are dissolved per litre. (Ditte, C. R. 91. 576.)

4 $\text{CaO}$ ,  $\text{CaCl}_2 + 14\text{H}_2\text{O}$  (Schreinemakers and Fige, Chem. Weekbl. 1911, 8. 685.)  
 $\text{CaO}$ ,  $\text{CaCl}_2$ . (Schreinemakers and Fige)

Calcium lead oxychloride,  $\text{CaCl}_2$ ,  $\text{CaO}$ , 2 $\text{PbO} + 4\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  with decomp (André, C. R. 104. 359.)

$\text{CaCl}_2$ , 3 $\text{PbO} + 3\text{H}_2\text{O}$ . (André.)

Calcium mercuric oxychloride,  $\text{CaCl}_2$ , 2 $\text{HgO} + 4\text{H}_2\text{O}$

Decomp. immediately by  $\text{H}_2\text{O}$ . (Klinger, B 16. 997.)

Calcium oxydide,  $3\text{CaO}$ ,  $\text{CaI}_2 + 16\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ , alcohol, and acids. Sol. in hydrochloric acid and in very dil.  $\text{HNO}_3$ . (Tassily, C. R. 1894, 119. 372.)

Calcium oxysulphide,  $\text{Ca}_4\text{O}_2\text{S}_4 + 12\text{H}_2\text{O} = 3\text{CaO}$ ,  $\text{CaS}_4 + 12\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Not acted on by absolute alcohol. (Schone, Pogg. 117. 77.)

According to Geuther (A. 224. 178) =  $\text{CaS}_8$ ,  $2\text{CaO} + 10$ , or  $11\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{Aq}$  with separation of S.

$\text{Ca}_4\text{O}_2\text{S}_4 + 18\text{H}_2\text{O} = 4\text{CaO}$ ,  $\text{CaS}_4 + 18\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ , but not acted on by absolute alcohol. (Schone, Pogg. 117. 82.)

According to Geuther (A. 224. 178) =  $\text{CaS}_8$ ,  $3\text{CaO} + 14$ , or  $15\text{H}_2\text{O}$ .

$\text{Ca}_4\text{O}_2\text{S}_8 + 20\text{H}_2\text{O} = 5\text{CaO}$ ,  $\text{CaS}_8 + 20\text{H}_2\text{O}$  (Rose, Pogg. 55. 433.)

Sol. in 400 pts. cold, decomp. by boiling  $\text{H}_2\text{O}$  (Buchner), sl. sol. in cold, much more in hot  $\text{H}_2\text{O}$ , but it is not deposited on cooling. Aqueous solution sat. at  $6^\circ\text{--}7^\circ 2'$  has sp. gr. = 1.0105 (Herschel); sol. in alcohol (Gay-Lussac); insol. in alcohol (Gmelin).

Calcium phosphide,  $\text{CaP}$ .

Deliquescent. Decomp. in moist air or with  $\text{H}_2\text{O}$ . Not attacked by conc.  $\text{HNO}_3$ , but decomp. by dil.  $\text{HNO}_3 + \text{Aq}$  (Thénard, A. ch. (3) 14. 14.)

$\text{Ca}_2\text{P}_2$ . Crystallized.

Decomp. by  $\text{H}_2\text{O}$ .

Not attacked by conc.  $\text{H}_2\text{SO}_4$ . Violently attacked by dil.  $\text{H}_2\text{SO}_4$ .

Not attacked by abs. alcohol, ether, benzene or oil of turpentine (Moissan, C. R. 1899, 128. 792.)

$\text{Ca}_2\text{P}_2$ . Insol. in liquid  $\text{CO}_2$ . (Buchner, Z. phys. Ch. 1906, 54. 674.)

Calcium selenide,  $\text{CaSe}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Very easily decomp. (Fabre, C. R. 102. 1469.)

Calcium silicide,  $\text{CaSi}_2$ .

Slowly decomp. by  $\text{H}_2\text{O}$ , sol. in conc.  $\text{H}_2\text{SO}_4$  and dil.  $\text{HNO}_3$  with evolution of  $\text{H}_2$ . With conc.  $\text{HCl}$  it gives  $\text{H}_2$ , Si and silicon hydride; with dil.  $\text{HCl}$ ,  $\text{H}_2$  and a yellow substance. Sol. in alkali +  $\text{Aq}$  or  $\text{NH}_3 + \text{Aq}$  with evolution of  $\text{H}_2$  (Moissan, C. R. 1902, 134. 505.)

Two modifications:

(a) Only sl. sol. in  $\text{HNO}_3$ ; decomp.  $\text{H}_2\text{O}$  to give an insol. ppt. on addition of  $\text{HCl}$ .

(b) Easily sol. in  $\text{HNO}_3$  and acetic acid; decomp.  $\text{HCl}$  to give a ppt. which is sol. in  $\text{KOH} + \text{Aq}$ . (de Chalmot, Am. Ch. J. 1896, 18. 320.)

$\text{Ca}_2\text{Si}_2$ . Slowly decomp. by  $\text{H}_2\text{O}$ , rapidly by dil. acetic acid or by  $\text{H}_2\text{SO}_4 + \text{Aq}$  without evolution of spontaneously inflammable gas. (Hönigschmid, M. 1909, 30. 497.)

Decomp. by dil. min. acids, with evolution

of spontaneously inflammable gas. (Hackspill, Bull. Soc. 1908, (4) 3. 619.)

$\text{Ca}_2\text{Si}_2$ . Insol. in all solvents. Decomp. by boiling  $\text{H}_2\text{O}$ , by conc.  $\text{HCl}$  and by acetic acid. Sol. in dil. alkali and alkali carbonates +  $\text{Aq}$ . Hardly attacked by conc.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ . (Kolb, Z. anorg. 1909, 64. 349.)

$\text{Ca}_{11}\text{Si}_{10}$ . Easily decomp. by boiling with  $\text{H}_2\text{O}$ . Decomp. by dil. acetic acid, dil. or conc.  $\text{HCl}$ . (Kolb, Z. anorg. 1909, 64. 349 and 356.)

Calcium silicotrinitride,  $\text{CaSi}_2\text{N}_3$ .

(Kolb, Z. anorg. 1909, 64. 363.)

$\text{Ca}_2\text{Si}_2\text{N}_4$ . Slowly decomp. by boiling with  $\text{H}_2\text{O}$ , somewhat more rapidly with dil.  $\text{NaOH} + \text{Aq}$ . Slowly decomp. by conc.  $\text{HCl}$  (Kolb, l. c.)

$\text{Ca}_{11}\text{Si}_{10}\text{N}_{14}$ . Completely decomp. by  $\text{HCl}$ . (Kolb, l. c.)

Calcium sulphide,  $\text{CaS}$ .

500 pts.  $\text{H}_2\text{O}$  dissolve 1 pt.  $\text{CaS}$  completely, less  $\text{H}_2\text{O}$  dissolves out  $\text{CaS}_2\text{H}_2$  and leaves  $\text{CaO}_2\text{H}_2$ . Very much  $\text{H}_2\text{O}$  decomposes completely into  $\text{CaO}_2\text{H}_2$  and  $\text{H}_2\text{S}$ . (Béchamp, A. ch. (4) 16. 222.)

Not decomp. by  $\text{H}_2\text{O}$ , and only sl. sol. therein at ordinary temp. (Pelouze.)

After 48 hours contact with  $\text{CaS}$ , 1 l.  $\text{H}_2\text{O}$  contains at

$10^\circ$	$18^\circ$	$40^\circ$	$60^\circ$	$90^\circ$
0.15	0.23	0.30	0.48	0.83 g. $\text{CaS}$ .

After boiling for 2 hours, 0.27 g.  $\text{CaS}$  is dissolved, addition of  $\text{NaCl}$  diminishes solubility, but  $\text{Na}_2\text{SO}_4$  increases it. Lime-water dissolves at  $14^\circ$  0.18 g.  $\text{CaS}$ , the same amount which  $\text{H}_2\text{O}$  dissolves at  $60^\circ$ . Milk of lime dissolves 0.55 g. at  $60^\circ$ .  $\text{H}_2\text{O}$  containing 3 to 79 g.  $\text{Na}_2\text{O}$  per litre dissolves only traces of  $\text{CaS}$  at  $10^\circ$ , but at  $40\text{--}60^\circ$ , or by boiling, a large amount of  $\text{Na}_2\text{S}$  is formed. (Kolb, A. ch. (4) 7. 126.)

Sol. in 12,500 pts.  $\text{H}_2\text{O}$  at  $12.6^\circ$  (Scheurer-Kestner, Répert. chim. appl. 1882. 331.)

Sat.  $\text{Na}_2\text{CO}_3 + \text{Aq}$  has scarcely any action on  $\text{CaS}$ , but a dilute solution has more action. (Kolb.)

Sol. in  $\text{H}_2\text{O}$  and sulphur, forming  $\text{CaS}_4$ .

Insol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate (Naumann, B. 1904, 37. 3601.)

Insol. in methylal. (Eidmann, C. C. 1899, II. 1014.)

Sol. in 10 pts. glycine (Cap and Garot, J. Pharm. (3) 26. 81.)

Sol. in sugar +  $\text{Aq}$  (Stolle, C. C. 1900, I. 1044.)

Calcium tetrakisulphide,  $\text{CaS}_4$ .

Known only in solution.

**Calcium pentasulphide,  $\text{CaS}_5$ .**

Sol in  $\text{H}_2\text{O}$  and alcohol. (Berzelius)  
 Exists only in aqueous solution (Schöne,  
 Pogg 117 73.)

**Calcium hydroxyl sulphide,  $\text{Ca}(\text{OH})\text{SH} + 3\text{H}_2\text{O}$ .**

Easily sol in  $\text{H}_2\text{O}$  with immediate decomp  
 and separation of  $\text{Ca}(\text{OH})_2$ . Insol in alcohol,  
 but slowly decomp thereby (Divers and  
 Shmidt, Chem. Soc 45 270)

**Calcium stannic sulphide.**

See Sulphostannate, calcium.

**Calomel.**

See Mercurous chloride.

**Carbamic acid.****Ammonium carbamate acid carbonate (commercial carbonate of ammonia)**

See Carbonate carbamate, ammonium hydro-

gen.  
 (salts of hartshorn),  $2\text{NH}_4\text{HCO}_3$ ,  
 $\text{NH}_4\text{CONH}_2$ .

See Carbonate carbamate, ammonium hydro-

**Carbazote silicon,  $\text{C}_3\text{SiN}$ .**

Insol. in acids, even HF; also in boiling  
 $\text{KOH} + \text{Aq}$  (Schutzenberger and Colson,  
 C R. 92 1508.)

**Carbon, C.**

Insol. in all solvents.

Diamond is unacted upon by  $\text{KClO}_3 + \text{fum.}$   
 $\text{HNO}_3$ , graphite forms graphitic acid by  
 $\text{KClO}_3 + \text{fum. HNO}_3$ ; amorphous carbon is  
 sol. in  $\text{KClO}_3 + \text{fum. HNO}_3$  (Berthelot, A.  
 ch. (4) 19. 399.)

Diamond is sol in molten iron at  $1160^\circ$   
 Amorphous carbon is insol. in molten iron at  
 $1160^\circ$ , but becomes sol. therein by heating to  
 $1400^\circ$  (Hempel, B. 18. 998)

Insol in liquid  $\text{CO}_2$ . (Buehner, Z. phys.  
 Ch. 1906, 54. 674.)

Charcoal is insol in liquid  $\text{NH}_3$ . (Gore,  
 Am Ch J 1898, 20. 830.)

The quantity of carbon dissolved by iron  
 diminishes by increasing phosphorus, falling  
 by about 0.5% for each additional 2.0% of  
 phosphorus (Fettweis, Metallurgie, 1906,  
 3. 60.)

Solubility in iron is reduced by the presence  
 of tin and of sulphur. (Wüst, Metallurgie,  
 1906, 3. 169.)

The solubility of C in iron is increased by  
 the presence of chromium, 9.2% C dissolved  
 when 62% Cr is present in the mixture.  
 (Goerens, Metallurgie, 1907, 4. 18.)

**Carbon boride,  $\text{CB}_2$ .**

Insol. in boiling  $\text{HNO}_3 + \text{Aq}$ . (Joly, C R  
 97. 456)

**Carbon suboxide,  $\text{C}_3\text{O}_2$ .**

B.-pt  $+7^\circ$  at 761 mm  
 Sol in  $\text{H}_2\text{O}$  with formation of malonic acid.  
 Slowly decomp on standing in a sealed  
 tube (Dübs, B. 1906, 39. 606)

**Carbon monoxide, CO**

Sol in 50 vols recently boiled  $\text{H}_2\text{O}$ . (Davy)  
 Sol in 16 vols  $\text{H}_2\text{O}$  (de Saussure)  
 Sol in 27 vols  $\text{H}_2\text{O}$  (Dalton)  
 100 vols  $\text{H}_2\text{O}$  dissolve 0.2 vols CO at  $18^\circ$ . (de Saussure)

Solubility of CO in  $\text{H}_2\text{O}$ : 1 vol  $\text{H}_2\text{O}$  at  $t^\circ$  dis-  
 solves V vols. CO reduced to  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0.03287	7	0.02796	14	0.02466
1	0.03207	8	0.02739	15	0.02432
2	0.03131	9	0.02686	16	0.02402
3	0.03057	10	0.02635	17	0.02374
4	0.02987	11	0.02588	18	0.02350
5	0.02920	12	0.02544	19	0.02329
6	0.02857	13	0.02504	20	0.02312

(Bunsen's Gasometry, pp. 287, 128, 146)

Coefficient of absorption = 0.032874—  
 $0.00081632t + 0.000016421t^2$ . (Bunsen and  
 Pauli, A. 93. 16.)

**Solubility of CO in  $\text{H}_2\text{O}$ .**

$\beta$  = Vol CO absorbed by 1 vol  $\text{H}_2\text{O}$  at a  
 partial pressure of 760 mm

$\beta^1$  = Vol. CO (reduced to  $0^\circ$  and 760 mm)  
 absorbed by 1 vol. of  $\text{H}_2\text{O}$  under a total pres-  
 sure of 760 mm

$q$  = g. CO dissolved by 100 g.  $\text{H}_2\text{O}$  at a  
 total pressure of 760 mm.

$t^\circ$	$\beta$	$\beta^1$	$q$
0	0.03537	0.03516	0.0044
5	0.03149	0.03122	0.0039
10	0.02816	0.02782	0.0035
15	0.02543	0.02501	0.0031
20	0.02319	0.02266	0.0028
25	0.02142	0.02076	0.0026
30	0.01998	0.01915	0.0024
40	0.01775	0.01647	0.0021
50	0.01615	0.01420	0.0018
60	0.01488	0.01197	0.0015
70	0.01440	0.00998	0.0013
80	0.01430	0.00762	0.0010
90	0.01420	0.00438	0.0006
100	0.01410	0.00000	0.0000

(Winkler, B. 1901, 34. 1416.)

Solubility in H<sub>2</sub>O at various pressures

V = Volume of the absorbing liquid.

P = Hg pressure in metres

 $\lambda$  = Coefficient of solubility.

V	t°	P	$\lambda$
30 830 ccm.	17 7	0 9202	0.02791
		1 1438	0.02787
		1 4624	0.02786
		1 7986	0.02783
		2 3659	0.02782
		2 8390	0.02776
		3 2622	0.02771
		4 0114	0.02770
		4 6017	0.02763
		5 1953	0.02761
31 939 ccm.	19 0	5 8717	0.02756
		6 5462	0.02744
		7 0983	0.02738
		7 6470	0.02723
		8 0184	0.02715
		0 9176	0.02716
		1 1506	0.02717
		1 3897	0.02715
		1 7044	0.02712
		2 1239	0.02708
		2 7173	0.02701
		3 2576	0.02693
		3 9311	0.02689
		4 4584	0.02680
		5 2470	0.02673
		6 0346	0.02665
		6 6303	0.02654
		7 1542	0.02636
		7 9542	0.02617

(Cassuto, Phys. Zeit. 1904, 5. 236.)

Coefficient of absorption of CO in H<sub>2</sub>O at 25° equals 0.0154. (Findlay and Creighton, Biochem. J. 1911, 5. 294.)

Cuprous chloride in an hydrochloric acid or ammoniacal solution, and ammoniacal solutions of cuprous salts absorb large amounts of CO. (Leblanc, C. R. 30. 488.)

Cuprous chloride dissolved in HCl + Aq absorbs 15-20 vols CO. (Berthelot, A. ch. (3) 51. 66.)

Absorbed by KOH, NaOH, Ba(OH)<sub>2</sub>, and Ca(OH)<sub>2</sub> + Aq, more readily by ether, alcohol, and wood spirit, with formation of formic acid (Berthelot, A. ch. (3) 61. 463.)

Sol. in HCN. (Böttger, B. 10. 1122.)  
1 vol alcohol absorbs 0.20443 vols CO gas at all temperatures between 0° and 25° (Carius, A. 94. 135.)

100 vols. alcohol (0.84 sp. gr.) dissolve 14.5 vols. CO at 18°, 100 vols rectified naphtha (0.784 sp. gr.), 20.0 vols CO at 18°, 100 vols oil of lavender (0.88 sp. gr.), 15.6 vols CO at 18°, 100 vols olive oil (0.915 sp. gr.), 14.2 vols CO at 18°, 100 vols sat KCl + Aq (1.168 sp. gr.), 5.2 vols CO at 18° (de Saussure, 1814.)

1 vol. oil of turpentine absorbs 0.16-0.20 vol. CO (de Saussure.)

Sol in ether. (Regnault.)

Insol. in caoutchouc

## Solubility in alcohol + Aq

% alcohol  
by weight 0 00 9.09 16 67 23 08  
Solubility 2 41 1.87 1.75 1 68

% alcohol  
by weight 28 57 33 33 50.00  
Solubility 1.50 1.94 3.20

(Lubarsch, W. Ann. 1889, 37. 524.)

## Solubility of CO in organic solvents.

Solvent	Solubility at 20° C	Solubility at 25° C.
Glycerine	Not measurable	
Water	0 02404	0 02586
Aniline	0 05358	0 05055
Carbon bisulphide	0 08314	0 08112
Nitrobenzene	0 09366	0 09105
Benzene	0 1707	0 1645
Glacial acetic acid	0 1714	0 1689
Amyl alcohol	0 1714	0 1706
Xylene	0 1781	0 1744
Toluene	0 1808	0 1742
Ethyl alcohol (99.8%)	0 1921	0 1901
Chloroform	0 1954	0 1897
Methyl alcohol	0 1955	0 1830
Amyl acetate	0 2140	0 2108
Acetone	0 2225	0 2128
Isobutyl acetate	0 2365	0 2314
Ethyl acetate	0 2516	0 2419

(Just, Z. phys. Ch. 1901, 37. 361.)

Solubility of CO in ether at 0° = 0.3618, and at 10° = 0.3842 (Christoff, Z. phys. Ch. 1912, 79. 459.)

Solubility of CO in organic mixtures  
CO in benzene and naphthalene at 25°C.

Per cent by weight of naphthalene	Per cent by weight of benzene	* Solubility of CO
0	100	0 174
11 52	88 48	0 164
11 65	88 35	0 163
23 98	76 02	0 149
23 60	76 40	0 148
32.35	67 65	0 142
32 74	67 26	0 143
33 79	66 21	0 141

(Skirrow, Z. phys. Ch. 1902, 41. 144.)

\* See under Oxygen.

## CO in benzene and phenanthrene at 25° C

Per cent by weight of phenanthrene	Per cent by weight of benzene	Solubility of CO
0	100	0 174
10 48	89 52	0 144
10 48	89 52	0 144
19 22	80 78	0 132
18.99	81 01	0 133
27 04	72 96	0 128
27 39	72 61	0 127

(Skirrow.)

CO in benzene and  $\alpha$ -naphthol at 25° C.

Per cent by weight of $\alpha$ -naphthol	Per cent by weight of benzene	Solubility of CO
0	100	0.174
3.48	96.52	0.149
6.75	93.25	0.145
6.59	93.41	0.144
12.10	87.90	0.139
11.81	88.19	0.139

(Skirrow.)

CO in benzene and  $\beta$ -naphthol at 25° C

Per cent by weight of $\beta$ -naphthol	Per cent by weight of benzene	Solubility of CO
0	100	0.174
2.06	97.94	0.158
4.14	95.86	0.151
4.36	95.64	0.149

(Skirrow.)

## CO in benzene and nitrobenzene at 25° C

Per cent by weight of nitrobenzene	Per cent by weight of benzene	Solubility of CO
0	100	0.174
14.5	85.5	0.162
14.12	85.88	0.162
28.18	71.82	0.152
28.14	71.86	0.152
40.58	59.42	0.140
40.63	59.37	0.140
54.9	45.1	0.126
54.9	45.1	0.127
83.33	16.67	0.101
83.2	16.8	0.102
100	0	0.093

(Skirrow.)

## CO in benzene and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of benzene	Solubility of CO
0	100	0.174
12.69	87.31	0.156
12.03	87.97	0.158
19.57	80.43	0.145
19.43	80.57	0.144
28.43	71.57	0.131
28.26	71.74	0.131
37.68	62.32	0.0945
57.38	42.62	0.0953
78.90	21.10	0.0689
78.80	21.20	0.0684
100	0	0.053

(Skirrow.)

## CO in toluene and naphthalene at 25° C.

Per cent by weight of naphthalene	Per cent by weight of toluene	Solubility of CO
0	100	0.182
7.13	92.87	0.169
7.10	92.9	0.171
15.10	84.9	0.161
15.13	84.87	0.161
22.76	77.25	0.153
22.58	77.42	0.154

(Skirrow.)

## CO in toluene and phenanthrene at 25° C.

Per cent by weight of phenanthrene	Per cent by weight of toluene	Solubility of CO
0	100	0.182
5.59	94.41	0.170
5.58	94.42	0.171
11.16	88.84	0.161
11.20	88.8	0.161
21.62	78.38	0.147
21.93	78.07	0.147

(Skirrow.)

## CO in toluene and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of toluene	Solubility of CO
0	100	0.182
8.86	91.14	0.168
8.87	91.13	0.168
18.27	81.73	0.160
18.19	81.81	0.161
26.82	73.18	0.151
26.76	73.24	0.151
49.14	50.86	0.131
49.02	50.98	0.131
76.31	23.69	0.108
76.31	23.69	0.108
100	0	0.093

(Skirrow.)

## CO in toluene and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of toluene	Solubility of CO
0	100	0.182
6.61	93.39	0.169
6.61	93.39	0.168
13.56	86.44	0.157
13.55	86.45	0.156
19.91	80.09	0.148
19.96	80.04	0.148
44.64	55.36	0.115
44.31	55.69	0.116
74.63	25.37	0.0768
75.03	24.97	0.0753
100	0	0.053

(Skirrow.)

CO in toluene and  $\alpha$ -naphthol at 25° C.

Per cent by weight of $\alpha$ -naphthol	Per cent by weight of toluene	Solubility of CO
0	100	0.182
4.46	95.54	0.171
4.44	95.56	0.171
8.75	91.25	0.162
8.89	91.11	0.163

(Skirrow.)

## CO in acetone and naphthalene at 25° C.

Per cent by weight of naphthalene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
13.31	86.69	212.4	0.199
27.40	72.60	196.6	0.187

(Skirrow.)

## CO in acetone and phenanthrene at 25° C.

Per cent by weight of phenanthrene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
12.77	87.23	218	0.205
25.04	74.96	207.5	0.183

(Skirrow.)

CO in acetone and  $\beta$ -naphthol at 25° C.

Per cent by weight of $\beta$ -naphthol	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
13.95	86.05	213	0.190
26.88	73.12	195	0.169

(Skirrow.)

## CO in acetone and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
21.59	78.4	201	0.207
53.20	46.8	152	0.157
100	0	..	0.093

(Skirrow.)

## CO in acetone and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
20.83	79.17	192	0.179
55.10	44.9	120	0.110
100	0	..	0.053

(Skirrow.)

## CO in acetic acid and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of acetic acid	Solubility of CO
0	100	0.173
21.65	78.35	0.156
51.03	48.97	0.130
100	0	0.093

(Skirrow.)

## CO in acetic acid and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of acetic acid	Solubility of CO
0	100	0.173
13.5	86.5	0.110
41.64	58.36	0.0699
60.77	39.23	0.0618
82.21	17.79	0.0580
100	0	0.053

(Skirrow.)

## CO in methyl alcohol and glycerine at 25° C.

Per cent by weight of glycerine	Per cent by weight of methyl alcohol	Measured vapor pressure	Solubility of CO
0	100	122	0.196
39.6	60.4	106	0.0964
60.5	39.5	91	0.0515
77.1	22.9	63	0.0246
100	0	..	very small

(Skirrow.)

## CO in acetone and chloroform at 25° C.

Per cent by weight of chloroform	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
33.38	66.62	202	0.226
53.2	46.8	179	0.219
65.03	34.97	167	0.220
73.46	26.54	162	0.212
79.83	20.17	163	0.204
87.3	12.7	168	0.207
94.4	5.6	178	0.205
100	0	188	0.207

(Skirrow.)

## CO in acetone and carbon disulphide at 25° C.

Per cent by weight of carbon disulphide	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
8.18	91.82	306	0.236
18.02	81.98	367	0.236
49.46	50.54	443	0.227
62.6	37.4	457	0.210
74.05	25.95	457	0.187
85.51	14.49	433	0.144
96.42	3.58	382	0.114
100	0	356	0.0959

(Skirrow.)

## CO in benzene and ethyl alcohol at 25° C.

Per cent by weight of acetic acid	Per cent by weight of chloroform	Measured vapor pressure	Solubility of CO
0	100	95.9	0.174
15.43	84.56	125	0.179
52.34	47.66	119	0.181
100	0	59	0.192

(Skirrow.)

## CO in chloroform and methyl alcohol at 25° C.

Per cent by weight of alcohol	Per cent by weight of chloroform	Measured vapor pressure	Solubility of CO
0	100	188	0.207
13	87	233	0.202
100	0	122	0.196

(Skirrow.)

## CO in acetic acid and benzene at 25° C.

Percent by weight of acetic acid	Percent by weight of benzene	Measured vapor pressure	Solubility of CO
0	100	95.9	0.174
19.17	80.83	87.5	0.190
33.54	66.46	82	0.198
67.51	32.49	64.5	0.199
100	0	14	0.172

(Skirrow.)

## CO in acetic acid and toluene at 25° C.

Per cent by weight of acetic acid	Per cent by weight of toluene	Measured vapor pressure	Solubility of CO
0	100	9	0.182
20.48	79.52	31.6	0.190
56.89	43.11	28	0.195
74.71	25.29	25.6	0.191
100	0	14	0.172

(Skirrow.)

## CO in acetic acid and chloroform at 25° C.

Per cent by weight of acetic acid	Per cent by weight of chloroform	Measured vapor pressure	Solubility of CO
0	100	188	0.206
26.67	73.33	144.5	0.207
56.46	43.54	88.5	0.196
100	0	14	0.172

(Skirrow.)

## CO in carbon bisulphide and ethylene dichloride at 25° C

Per cent by volume of carbon bisulphide	Per cent by volume of ethylene dichloride	Measured vapor pressure	Solubility of CO
0	100	77	0.147
25	75	231	0.159
49	51	294	0.160
81.6	18.4	338	0.140
100	0	356.5	0.083

(Skirrow.)

Coefficient of absorption for petroleum = 0.123 at 20°, and 0.134 at 10°. (Gniwiasz and Walisz, Zeit. phys. Ch. 1. 70.)

Carbon dioxide, CO<sub>2</sub>.

## Gas.—

H<sub>2</sub>O dissolves about its own vol. CO<sub>2</sub> at the ordinary temperature (the solution obtained being of 1.0018 sp. gr.) and pressure, and an additional vol. for the pressure of each additional atmosphere to which it is subjected.

The power of H<sub>2</sub>O to absorb CO<sub>2</sub> does not increase in precisely the same ratio as the pressure. (Soubeiran.) 5 vols. CO<sub>2</sub> dissolve in 1 vol. H<sub>2</sub>O at 7 atmos. pressure, and much greater pressure is necessary in order to increase the amount of gas dissolved, but up to 4 or 5 atmospheres the amount of gas dissolved is very nearly proportional to the pressure. (Courbe, J. Pharm. 26. 121.)

100 vols. H<sub>2</sub>O at 12.75° absorb 118 vols. CO<sub>2</sub> (Cavendish), at 29.44°, 84 vols. CO<sub>2</sub> (Henry); at 15.66°, 106 vols. CO<sub>2</sub> (Saunders), at 15.66°, 108 vols. CO<sub>2</sub> (Henry); at 15.66°, 100 vols. CO<sub>2</sub> (Dalton).

100 vols. H<sub>2</sub>O at t° C. absorb V vols. of CO<sub>2</sub> gas reduced to 0° F. and 30 in. pressure

t°	V	t°	V
0	175.72	26.7	68.90
4.4	147.94	32.2	57.50
10	122.27	37.8	50.39
15.6	100.50	65.0	11.10
21.1	83.86	100	trace

(Rogers, Am. J. Sci. (2) 6. 107.)

1 vol. H<sub>2</sub>O at 5° abs. ; 1 vol. CO<sub>2</sub> at 10° scarcely 1 temp. CO<sub>2</sub> + Aq sat. at 2° has 16 CO<sub>2</sub> escapes upon exposing the solution to the air, the more quickly the higher the temperature. But as CO<sub>2</sub> diminishes, the remainder is more obstinately held, so that boiling for ½ hour is necessary to expel it completely. (Borgman.)

Solubility of CO<sub>2</sub> in H<sub>2</sub>O. 1 vol. H<sub>2</sub>O at t° and 760 mm. dissolves V vols. CO<sub>2</sub> gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	1.7967	7	1.3339	14	1.0321
1	1.7207	8	1.2809	15	1.0020
2	1.6481	9	1.2311	16	0.9753
3	1.5787	10	1.1847	17	0.9519
4	1.5128	11	1.1416	18	0.9318
5	1.4497	12	1.1018	19	0.9150
6	1.3901	13	1.0653	20	0.9014

(Bunsen's Gasometry, pp. 287, 128, 152.)

Coefficient of absorption = 1.7967—0.07761t + 0.001642t<sup>2</sup>. (Bunsen.)

Solubility in  $H_2O$  at various pressures: P = pressure in atmospheres

P	Vol. gas in 1 ccm. $H_2O$		P	Vol. gas in 1 ccm. $H_2O$	
	at 0°	at 12.43°		at 0°	at 12.43°
1	1.797	1.086	20	26.65	17.11
5	8.65	5.15	25	30.55	20.31
10	16.03	9.65	30	33.74	23.35
15	21.95	13.63		—	—

(Wroblewski, C. R. 94. 1355.)

Absorption of  $CO_2$  in  $H_2O$  at various pressures: P = pressure in mm.; V = vols.  $CO_2$  reduced to 0° and 760 mm, absorbed by 1 vol.  $H_2O$ .

P	V	P	V
697.71	0.9441	2188.65	3.1764
809.03	1.1619	2369.02	3.4857
1289.41	1.8647	2554.00	3.7152
1469.95	2.1623	2738.33	4.0031
2002.06	2.9067	3109.51	4.5006

(Khanikoff and Longunne, A. ch. (4) 11. 412.)

C = coefficient of absorption in  $H_2O$  at t° and 760 mm

t°	C	t°	C	t°	C
15.2	1.009	18.38	0.896	21	0.838
17.6	0.930	18.3	0.885	23	0.798

(Setschenow, Mém. Acad. St. Petersb. 22. Nos. 6, 7.)

Absorption coefficient of  $CO_2$  in  $H_2O$  at 0° = 1.7308. (Prytz and Holst, W. Ann. 1895, 54. 136.)

Absorption of  $CO_2$  by  $H_2O$  at t°.

a = coefficient of absorption.

t°	a	t°	a
0	1.713	19	0.902
1	1.646	20	0.878
2	1.584	21	0.854
3	1.527	22	0.829
4	1.473	23	0.804
5	1.424	24	0.781
6	1.377	25	0.759
7	1.331	26	0.738
8	1.282	27	0.718
9	1.237	28	0.699
10	1.194	29	0.682
11	1.154	30	0.665
12	1.117	35	0.592
13	1.083	40	0.530
14	1.050	45	0.479
15	1.019	50	0.436
16	0.985	55	0.394
17	0.956	60	0.359
18	0.928		..

(Bohr, W. Ann. 1899, 68. 504.)

Solubility in  $H_2O$  at 25° = 0.8255, at 15° = 1.070 (Geffcken, Z. phys. Ch. 1904, 49. 273.)  
75 cc.  $H_2O$  absorb 0.1381 g.  $CO_2$  at 15.5° and 720 mm. (Christoff, Z. phys. Ch. 1905, 53. 329.)

Absorption-coefficient of  $CO_2$  in  $H_2O$  at 20° = 0.877, or 1000 g.  $H_2O$  dissolve 878 cc.  $CO_2$ . (Usher, Chem. Soc. 1910, 97. 72.)

Solubility of  $CO_2$  in  $H_2O$  = 1.158 at 12° and 0.825 at 25°. (Findlay and Shenn, Chem. Soc. 1911, 99. 1315.)

Absorption of  $CO_2$  by  $H_2O$  at high pressure

Amount of  $H_2O$  used { a = 0.210 ccm  
b = 0.102 ccm  
V = ccm of  $CO_2$  absorbed by  $H_2O$  at t°, reduced to a pressure of 1 kg per sq. cm.  
V<sub>1</sub> = ccm. of  $CO_2$  absorbed by 1 ccm. of  $H_2O$ .

Pressure kg/sq. cm.	t°	V <sub>1</sub>	
		a	b
25	20°		17.77
30			19.77
40			21.52
50			28.09
55			29.75
30	35°	11.77	13.57
40		14.82	20.00
50		18.96	24.64
60		22.90	22.50
70		27.18	27.62
80			32.85
40	60°	10.88	9.798
50		12.24	13.72
60		14.46	15.28
70		16.80	17.46
80		19.74	22.67
90		23.74	21.16
100		26.21	27.85
110		28.92	28.79
120		30.20	33.90
60	100°	8.965	
70		10.11	6.395
80		11.05	9.591
90		12.63	10.85
100		13.63	12.40
110		14.88	16.31
120		16.40	15.78
130		17.93	16.89
140		19.56	17.71
150		20.58	17.49
160		22.07	
170		22.78	

(Sander, Z. phys. Ch. 1912, 78. 537.)

Solubility of carbon dioxide in water at 25°.

P. = Pressure in mm. Hg

S. = Solubility calculated according to formula for which see the original article (Findlay, Chem. Soc. 1910, 97, 538.)

P	S	P	S
743	0 816	1059	0 817
752	0 817	1064	0 819
800	0 815	1153	0 818
841	0 817	1243	0 819
955	0 816	1351	0 820
955	0 817	1351	0 820

(Findlay and Creighton, Chem. Soc. 1910, 97, 538)

Solubility of carbon dioxide in water at 25°.

P = Pressure in mm. Hg.

S. = Solubility See above.

P	S	P	S
755	0 826	1060	0 823
759	0 825	1084	0 825
836	0 825	1210	0 825
841	0 826	1211	0 825
927	0 826	1350	0 824
934	0 824	1350	0 826

(Findlay and Creighton, Chem. Soc. 1912, 101, 1460.)

Solubility of carbon dioxide in water at 25°.

P = Pressure in mm. Hg

S = Solubility. See above.

P	S	P	S
263	0 817	495	0 816
271	0 816	651	0 816
382	0 814	667	0 817
392	0 811	752	0 818
479	0 816	768	0 817

(Findlay and Creighton, Chem. Soc. 1913, 103, 638.)

Sl. sol. in HCl + Aq.

100 vols H<sub>2</sub>SO<sub>4</sub> of 1.840 sp. gr. absorb 45 vols CO<sub>2</sub> (de Saussure)

H<sub>2</sub>SO<sub>4</sub> of ordinary density at 15.50° and common pressure absorbs 94% of its vol. of CO<sub>2</sub>, fuming H<sub>2</sub>SO<sub>4</sub>, 125%; the absorption for pure H<sub>2</sub>O under the same conditions being 68% (Rogers, Am. J. Sci. (2) 6, 115)

H<sub>2</sub>SO<sub>4</sub> absorbs 7-10% CO<sub>2</sub>. (Hasiwetz, W. A. B. 20, 193.)

Coefficient of absorption by conc. H<sub>2</sub>SO<sub>4</sub> = 0.932, which is the same as that by H<sub>2</sub>O; but this diminishes on diluting, and is at its lowest limit 0.666, when the composition of the solution is H<sub>2</sub>SO<sub>4</sub>, H<sub>2</sub>O; upon further dilution the coefficient of solubility gradually increases, and when 58 H<sub>2</sub>O are present to 1 H<sub>2</sub>SO<sub>4</sub>, the

coefficient of absorption is 0.857 (Set-schenow, J. B. 1876, 46.)

Absorption of CO<sub>2</sub> by H<sub>2</sub>SO<sub>4</sub> + Aq.

Solution	Grams CO <sub>2</sub> absorbed by 75 cc at 15.5° and 720 mm
1/2-N H <sub>2</sub> SO <sub>4</sub>	0 1273
1-N H <sub>2</sub> SO <sub>4</sub>	0 1179
2-N H <sub>2</sub> SO <sub>4</sub>	0 1092
4-N H <sub>2</sub> SO <sub>4</sub>	0 1003

(Christoff, Z. phys. Ch. 1905, 53, 329)

Solution	Grams CO <sub>2</sub> absorbed by 75 cc at 15.5° and 720 mm
2 5% H <sub>2</sub> SO <sub>4</sub>	0 1282
3 0% "	0 1179
10 0% "	0 0833
20 0% "	0 0755
30 0% "	0 0751
40 0% "	0 0713
45 0% "	0 0725
70 0% "	0 0918
90 0% "	0 1433

(Christoff, l. c)

Coefficient of absorption for 96% H<sub>2</sub>SO<sub>4</sub> = 0.926 at 20°. (Bohr, Z. phys. Ch. 1910, 71, 48.)

Absorption of CO<sub>2</sub> by acids

M = Content in gram-equivalents per liter.

S = Solubility (see under oxygen).

Absorption of CO<sub>2</sub> by HNO<sub>3</sub> + Aq.

M	S <sub>25°</sub>	S <sub>15°</sub>
0.472	0 8382	1.073
0.475	0 8366	1.075
0 557	0 8387	1 069
0 704	0.8447	1 080
1 382	0 8620	1 093
1 387	0.8622	1 093
1 860	0.8752	1.105
2.519	0.8839	1 109
2.539	0.8865	1.111

(Geffeken, Z. phys. Ch. 1904, 49, 273.)

Absorption of CO<sub>2</sub> by HCl + Aq.

M	S <sub>25°</sub>	S <sub>15°</sub>
0 499	0 8047	1 041
0 511	0 8074	1 042
1 212	0 7973	1 020
1 249	0.7984	1 023
2 080	0 7951	0.9864
2 180	0 7951	1 009

(Geffeken.)

Absorption of CO<sub>2</sub> by  $\frac{\text{H}_2\text{SO}_4}{2} + \text{Aq}$ 

M	S <sub>15°</sub>	S <sub>15°</sub>
0 512	0 7923	1 016
0 517	0 7936	1 016
0 995	0 7693	0.9772
1 039	0 7685	0 9775
1 067	0 7672	0 9756
1 966	0 7302	0 9175
2 088	0 7273	0 9143
3 790	0 6736	0 8354
3 800	0 6747	0 8385

(Geffeken.)

In collecting CO<sub>2</sub> gas in pneumatic operations, a saturated solution of common salt is better than H<sub>2</sub>O for filling the trough. This solution will only absorb about 1/2 of the amount of CO<sub>2</sub> absorbed by pure H<sub>2</sub>O (de Saussure, l. c.)

100 vols of the following solutions at 15° and ordinary pressure absorb vols CO<sub>2</sub>—

Sat	Sp. gr.	CO <sub>2</sub>
Sat. NaCl + Aq (containing 20% of NaCl)	1.212	32.9
Sat. NH <sub>4</sub> Cl + Aq (containing 27.53% of NH <sub>4</sub> Cl)	1.078	75
Sat. KCl + Aq (containing 26% of KCl)	1.108	61
Sat. CaCl <sub>2</sub> + Aq (containing 40.2% of CaCl <sub>2</sub> )	1.402	26.1
Sat. K <sub>2</sub> SO <sub>4</sub> + Aq (containing 9.42% of K <sub>2</sub> SO <sub>4</sub> )	1.077	62
Sat. Na <sub>2</sub> SO <sub>4</sub> + Aq (containing 11.14% of Na <sub>2</sub> SO <sub>4</sub> )	1.105	58
Sat. K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> + Aq (containing 9.14% of K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> + 24H <sub>2</sub> O)	1.047	70
Sat. KNO <sub>3</sub> + Aq (containing 20.6% of KNO <sub>3</sub> )	1.139	57
Sat. NaNO <sub>3</sub> + Aq (containing 20.4% of NaNO <sub>3</sub> )	1.206	45
Sat. H <sub>2</sub> C <sub>2</sub> H <sub>3</sub> O <sub>6</sub> + Aq (containing 53.37% of H <sub>2</sub> C <sub>2</sub> H <sub>3</sub> O <sub>6</sub> )	1.288	41

About half as sol. in NaCl + Aq (15% NaCl) as in H<sub>2</sub>O

Much more sol. in Na<sub>2</sub>HPO<sub>4</sub> + Aq or Na<sub>2</sub>CO<sub>3</sub> + Aq than in H<sub>2</sub>O, the quantity dissolved increasing with the amount of salt in the solution. The solubility in these solutions depends on the coefficient of solubility in H<sub>2</sub>O plus the product of a constant coefficient multiplied by the amount of salt in the solution; this constant equals 0.069 for Na<sub>2</sub>HPO<sub>4</sub> and 0.088 for Na<sub>2</sub>CO<sub>3</sub>. (Fernet, A. ch. (3) 47. 307.)

Fernet's determinations are not accurate. (L. Meyer, A. Suppl. 2. 157.)

1 mol Na<sub>2</sub>HPO<sub>4</sub> in dil Na<sub>2</sub>HPO<sub>4</sub> + Aq absorbs 2 mols CO<sub>2</sub> (Setchenow.)

Solutions of salts of similar constitution are equivalent in regard to their power of absorption of CO<sub>2</sub>, when they contain the same percentage of crystal water. Experiments were made with solutions of alum, MgSO<sub>4</sub>·7H<sub>2</sub>O, and ZnSO<sub>4</sub>·7H<sub>2</sub>O, containing 10% of the salts. The MgSO<sub>4</sub> solution absorbed the greatest proportional amount of CO<sub>2</sub>, and the alum the least. The further rule was deduced that with salts of similar constitution

absorptometric equivalents are identical with the chemical equivalents. (Setchenow, B. 6. 1461.)

Salts can be divided into two classes, according as CO<sub>2</sub> has chemical action on the salt or not. In the first case, i. e., when there is chemical combination or action of CO<sub>2</sub> on the salt in solution, the amount of CO<sub>2</sub> absorbed increases with increasing concentration of the solution; in the second case, however, the amount of CO<sub>2</sub> decreases with the strength of the solution. Several salts can be arranged in a series as regards their power of absorption, beginning with that which has the greatest, as follows: Na<sub>2</sub>CO<sub>3</sub>, Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub>, Na<sub>2</sub>HPO<sub>4</sub>, Na<sub>2</sub>C<sub>2</sub>H<sub>3</sub>O<sub>6</sub>, Na<sub>2</sub>C<sub>2</sub>H<sub>3</sub>O<sub>7</sub>, Na<sub>2</sub>C<sub>2</sub>O<sub>4</sub>, Na<sub>2</sub>C<sub>2</sub>H<sub>3</sub>O<sub>5</sub>, MnO<sub>2</sub>, MCl, M<sub>2</sub>SO<sub>4</sub>. The division between the two classes occurs in this series at Na<sub>2</sub>C<sub>2</sub>O<sub>4</sub>.

The matter is discussed at length in the original papers. (Setchenow, Mémoires Acad. St. Petersb. 22. No. 3. Also further, Setchenow, *ib.* 34. No. 3, and 35. No. 7. See also Ostwald, *Allgemeine Chemie*, 2te Aufl. vol. I, p. 629.)

Solubility of CO<sub>2</sub> in salts + Aq at 15.2°.

CO<sub>2</sub> = cc. CO<sub>2</sub> (at 0° and 760 mm.) dissolved per cc. of salt solution.

Salt	g. salt per l.	CO <sub>2</sub>
NH <sub>4</sub> Cl	1	1.005
"	10	0.985
"	51.6	0.941
"	172	0.819
"	258	0.770
NH <sub>4</sub> NO <sub>3</sub>	2.8	1.013
"	11.2	1.002
"	55	0.989
"	101	0.962
"	202.1	0.911
"	404.3	0.807
"	810.4	0.612
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	73.2	0.712
"	144.4	0.575
Ba(NO <sub>3</sub> ) <sub>2</sub>	62.7	0.922
Ca(NO <sub>3</sub> ) <sub>2</sub>	41	0.923
LiCl	16.72	1.035
"	50.15	0.808
"	125.4	0.596
"	250.8	0.497
"	501.5	0.120
MgSO <sub>4</sub>	26.5	0.901
"	79.5	0.669
"	159	0.441
"	318	0.188
KBr	83.9	0.908
"	167.7	0.819
"	251.5	0.748
"	503.1	0.579
KI	319.1	0.777
"	478.6	0.688
"	957.3	0.506
KSCN	326	0.691
"	489	0.590

Solubility of CO<sub>2</sub> in salts + Aq at 15.2°—Cont

Salt	g salt per l	CO <sub>2</sub>
KSCN	978	0.387
KNO <sub>3</sub>	58.8	0.959
"	117.5	0.890
"	235.1	0.781
NaCl	12.9	0.978
"	64	0.760
"	128	0.580
"	192	0.466
NaBr	115.1	0.775
"	460.3	0.364
"	690.4	0.221
NaNO <sub>2</sub>	89.3	0.835
"	125	0.762
"	208.4	0.621
"	416.8	0.385
"	625.2	0.244
NaClO <sub>3</sub>	233.3	0.625
"	340.9	0.506
"	699.8	0.257
Na <sub>2</sub> SO <sub>4</sub>	14.2	0.950
"	94.8	0.620
"	284.4	0.234
ZnSO <sub>4</sub>	38.3	0.903
"	76.7	0.783
"	230	0.474
"	460	0.209

(Sethenow, A. ch. 1892, (6) 25. 226.)

CO<sub>2</sub> is not disengaged at ordinary temp. from H<sub>2</sub>O, in which  $\frac{1}{1000}$  pt of CaCO<sub>3</sub> or MgCO<sub>3</sub> is held in solution thereby. These solutions have a great power of retaining CO<sub>2</sub>, even at a boiling temp. or with diminished pressure, and they also absorb CO<sub>2</sub> from the air in much larger quantity than pure H<sub>2</sub>O. (Bureau.)

BaCO<sub>3</sub> in H<sub>2</sub>O also retains CO<sub>2</sub>, even after long boiling. (Storer)

CO<sub>2</sub> is also absorbed from the air by Na<sub>2</sub>CO<sub>3</sub>, or K<sub>2</sub>CO<sub>3</sub> + Aq, especially if dilute

Absorption of CO<sub>2</sub> by NaCl + Aq at t°  
 $\alpha$  = Coefficient of absorption for a 6.52% NaCl solution.

$\alpha_1$  = Coefficient of absorption for a 17.62% NaCl solution.

t°	$\alpha$	$\alpha_1$
0	1.234	0.678
5	1.024	0.577
10	0.875	0.503
15	0.755	0.442
20	0.664	0.393
25	0.583	0.352
30	0.517	0.319
35	0.460	0.288
40	0.414	0.263
45	0.370	0.235
50	0.335	0.215
55	0.305	0.198
60	..	0.183

(Bohr, W. Ann. 1899, 68. 504.)

Absorption of CO<sub>2</sub> by CsCl + Aq

M = Content in g equiv per l.  
 S = Solubility. (See under Oxygen.)

M	S <sub>25°</sub>	S <sub>15°</sub>
0.552	0.7771	1.001
0.554	0.7769	0.9995

(Geffcken, Z. phys. Ch. 1904, 49. 273.)

Absorption of CO<sub>2</sub> by KNO<sub>3</sub> + Aq.

M	S <sub>25°</sub>	S <sub>15°</sub>
0.536	0.7832	1.002
0.537	0.7818	0.9997
1.022	0.7452	0.9439
1.033	0.7447	0.9421

(Geffcken.)

Absorption of CO<sub>2</sub> by KI + Aq.

M	S <sub>25°</sub>	S <sub>15°</sub>
0.559	0.7678	0.9809
0.573	0.7676	0.9835
1.043	0.7236	0.9144
1.119	0.7166	0.9090

(Geffcken.)

Absorption of CO<sub>2</sub> by RbCl + Aq.

M	S <sub>25°</sub>	S <sub>15°</sub>
0.479	0.7705	0.9908
0.481	0.7698	0.9910
1.007	0.7190	0.9210
1.012	0.7157	0.9200

(Geffcken.)

Absorption of CO<sub>2</sub> by KBr + Aq.

M	S <sub>25°</sub>	S <sub>15°</sub>
0.550	0.7621	0.9783
0.565	0.7619	0.9766
1.066	0.7030	0.9100
1.064	0.7068	0.9065

(Geffcken.)

Absorption of CO<sub>2</sub> by KCl + Aq.

M	S <sub>25°</sub>	S <sub>15°</sub>
0.423	0.7695	0.9892
0.432	0.7667	0.9865
1.045	0.6920	0.8875
1.058	0.6961	0.8910

(Geffcken.)

Absorption of CO<sub>2</sub> by salts + Aq

Salt	Grams CO <sub>2</sub> absorbed by 75 cc. of salt solution at 15° and 720 mm
1-N KBr	0 1280
1-N KNO <sub>3</sub>	0 1231
1-N KCl	0 1213
1-N KI	0 1204
1-N LiCl	0 1087
1-N NaCl	0 1050
1-N (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	0 1093
1-N (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> · Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> + 24H <sub>2</sub> O	0 0991
1-N K <sub>2</sub> SO <sub>4</sub>	0 1002
1-N K <sub>2</sub> SO <sub>4</sub> · Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> + 24H <sub>2</sub> O	0 1054
<sup>1</sup> / <sub>2</sub> -N K <sub>2</sub> SO <sub>4</sub>	0 1140
<sup>1</sup> / <sub>2</sub> -N MgSO <sub>4</sub>	0 1209
1-N MgSO <sub>4</sub>	0 1047
2-N MgSO <sub>4</sub>	0 0656
4-N MgSO <sub>4</sub>	0 0527
2-N CuSO <sub>4</sub>	0 0751
2-N ZnSO <sub>4</sub>	0 0720
<sup>1</sup> / <sub>2</sub> -N KHSO <sub>3</sub>	0 1017
2-N KHSO <sub>3</sub>	0 0999
1-N KH <sub>2</sub> AsO <sub>4</sub>	0 0808
1-N KH <sub>2</sub> PO <sub>4</sub>	0 0852
<sup>1</sup> / <sub>2</sub> -N K <sub>2</sub> HAsO <sub>4</sub>	0 1111
<sup>1</sup> / <sub>2</sub> -N K <sub>2</sub> HPO <sub>4</sub>	0 0989
<sup>1</sup> / <sub>2</sub> -N Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0 2205
<sup>1</sup> / <sub>2</sub> -N Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0 5317
<sup>1</sup> / <sub>2</sub> -N Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0 8511
<sup>1</sup> / <sub>2</sub> -N NaBO <sub>3</sub>	0 8124
<sup>1</sup> / <sub>2</sub> -N NH <sub>4</sub> HB <sub>2</sub> O <sub>4</sub>	0 7672
N-Na <sub>2</sub> PO <sub>4</sub> + 12H <sub>2</sub> O	0 5828
N-Na <sub>2</sub> P <sub>2</sub> O <sub>7</sub> + 10H <sub>2</sub> O	0 8457
N-NaPO <sub>3</sub>	0 2081
N-KPO <sub>3</sub>	0 2618

(Christoff, Z. phys. Ch. 1905, 53, 338-340.)

Solubility of CO<sub>2</sub> in KCl + Aq at 25°.

Concentration, 7.45 g. in 100 cc of solution, sp. gr. = 1.043.

Pressure 756 850 953 1116 1249 1362  
Solubility 0.694 0.693 0.688 0.700 0.709 0.710Concentration, 5 g. in 100 cc. of solution,  
sp. gr. = 1.031Pressure 756 832 901 1050 1150 1223  
Solubility 0.731 0.727 0.724 0.726 0.735 0.736Concentration, 2.56 g. in 100 cc. of solution,  
Sp. gr. = 1.016.Pressure 756 852 981 1079 1190 1362  
Solubility 0.767 0.761 0.761 0.762 0.768 0.766  
(Findlay and Creighton, Chem. Soc. 1910,  
97, 557.)Solubility of CO<sub>2</sub> in NH<sub>4</sub>Cl + Aq at 25°

Concentration (C) denotes number of grams of solute in 100 cc of solution.

Density (D) equals the specific gravity of the solution.

Solubility (S) calculated by formula given in the original article.

C	D	S
2 35	1 005	0 791
5 05	1 013	0 754
8 24	1 022	0 732
10 02	1 027	0 712
17 09	1 045	0 665

(Findlay and Shenn, Chem.

Soc. 1912, 101, 1461.)

Solubility of CO<sub>2</sub> in KCl + Aq at 25°.

C	D	S
1 84	1 008	0 792
3 05	1 017	0 764
4 58	1 026	0 740
7.46	1 044	0 701

(Findlay and Shenn.)

Solubility of CO<sub>2</sub> in BaCl<sub>2</sub> + Aq at 25°

°C	D	S
2 80	1 018	0 789
5 81	1 040	0 741
8 15	1 054	0 710
9 97	1 070	0 676

(Findlay and Shenn.)

Solubility of CO<sub>2</sub> in (NH<sub>4</sub>)<sub>2</sub>Fe(SO<sub>4</sub>)<sub>2</sub> + Aq at 25°

C	D	S
9 51	1 052	0 641
10 26	1 057	0 629
22 47	1 124	0 460

(Findlay and Shenn.)

Solubility of CO<sub>2</sub> in solutions of sucrose at 25°.

C	D	S
2 63	1 009	0 813
5 16	1 018	0 798
9 68	1 038	0 767
12 33	1 051	0 744

(Findlay and Shenn.)

Solubility of CO<sub>2</sub> in solutions of chloral hydrate at 25°.

C	D	S
5.08	1 019	0 815
10 12	1 041	0 795

(Findlay and Shenn.)

100 vols. alcohol (0.803 sp gr) at 18° absorb 260 vols. CO<sub>2</sub>.  
100 vols. alcohol (0.840 sp gr) at 18° absorb 186 vols. CO<sub>2</sub>. (de Saussure, l. c.)

Solubility of CO<sub>2</sub> in alcohol 1 vol. alcohol at t° and 760 mm. dissolves V vols CO<sub>2</sub> gas reduced to 0° and 760 mm

t°	V	t°	V	t°	V
0	4 3295	9	3 5844	18	3 0402
1	4 2368	10	3 5140	19	2 9921
2	4 1466	11	3 4461	20	2 9465
3	4 0589	12	3 3807	21	2 9034
4	3 9736	13	3 3178	22	2 8628
5	3 8908	14	3 2573	23	2 8247
6	3 8105	15	3 1993	24	2 7890
7	3 7327	16	3 1438		
8	3 6573	17	3 0908		

(Bunsen's Gasometry, pp. 287, 128, 153)

Coefficient of absorption = 4.32955—  
0.09395t + 0.00124t<sup>2</sup> (Bunsen)

Much less sol. in 30% alcohol than in pure alcohol or pure H<sub>2</sub>O. (Muller, W. Ann 37. 24.)

Solubility of CO<sub>2</sub> in 99% alcohol at t°.

a = Coefficient of absorption, i. e., the no. of cem. of CO<sub>2</sub> measured at 0° and 760 mm. which are absorbed at the given temp. and at an absorption pressure of 760 mm by 1 cem. alcohol.

a<sub>1</sub> = Coefficient of absorption corrected for increase in the volume of the alcohol used due to absorption of CO<sub>2</sub>.

t°	a	a <sub>1</sub>
-65	38.41	35.93
-25	8.75	8.61
-20	7.51	7.41
-15	6.59	6.51
-10	5.75	5.69
-5	5.01	4.96
0	4.44	4.40
+5	3.96	3.93
10	3.57	3.55
15	3.25	3.23
20	2.98	2.96
25	2.76	2.74
30	2.57	2.56
35	2.41	2.39
40	2.20	2.19
45	2.01	2.00

(Bohr, W. Ann. 1900, (4) 1. 249.)

Solubility in 98.7% alcohol at t°.

a = Coefficient of absorption

a<sub>1</sub> = Coefficient of absorption corrected for increase in volume of the alcohol used due to absorption of CO<sub>2</sub>.

t°	a	a <sub>1</sub>
0	4.35	4.31
-10	5.43	5.38
-20	7.25	7.16
-30	9.97	9.79
-40	14.25	13.89
-50	21.28	20.49
-60	31.25	29.59
-65	39.89	37.22
-67	44.07	40.83

(Bohr, W. Ann. 1900, (4) 1. 253.)

Solubility in alcohol + Aq at t°

t°	% by wt of alcohol in the solvent	Solubility of CO <sub>2</sub> in alcohol + Aq	Solubility of CO <sub>2</sub> in H <sub>2</sub> O
14	6.325	1.5884	1.6916
32	4.464	1.4878	1.5652
92	7.276	1.1829	1.2216
138	2.870	1.0268	1.0385

(Langer, C. C. 1904, I, 1583.)

Solubility of CO<sub>2</sub> in ethyl alcohol at 25°.

Concentration. 2.95 g. alcohol in 100 cc. of solution. Sp. gr. 25°/15° = 0.99308.  
Pressure 737 836 929 1073 1213 1338  
Solubility 0.812 0.813 0.812 0.811 0.813 0.811

Concentration. 3.01 g. alcohol in 100 cc. of solution. Sp. gr. 25°/15° = 0.99295.  
Pressure 745 823 937 1083 1226 1357  
Solubility 0.814 0.812 0.815 0.813 0.812 0.812

Concentration. 3.83 g. alcohol in 100 cc. of solution. Sp. gr. 25°/15° = 0.98342.  
Pressure 747 846 942 1090 1231 1360  
Solubility 0.786 0.786 0.784 0.785 0.786 0.788  
(Findlay and Shenn, Chem Soc 1911, 99. 1315.)

Solubility of CO<sub>2</sub> in organic solvents at low temperatures.

Solvent Ethyl alcohol.

t = -78°; sp. gr. = 0.872

Pressure	Coefficient of absorption	Solubility
100	111.8	68.4
200	115.7	69.5
400	123.8	71.4
700	138.6	74.7

Solubility of CO<sub>2</sub> in organic solvents at low temperatures.—*Continued*

t = -59°, sp gr = 0.856

Pressure	Coefficient of absorption	Solubility
100	40.85	27.27
200	41.00	27.16
400	42.35	27.65
700	44.15	28.10

## Solvent. Methyl alcohol.

t = -78°, sp gr = 0.884

Pressure	Coefficient of absorption	Solubility
50	194.0	120.5
100	195.0	119.6
200	202.9	120.1
400	221.5	122.2
500	226.4	
740	260.0	126.8

t = -59°, sp gr = 0.866

Pressure	Coefficient of absorption	Solubility
100	63.0	42.5
200	64.2	42.7
400	66.3	43.1
700	69.0	43.3

## Solvent. Acetone.

t = -78°, sp gr = 0.900

Pressure	Coefficient of absorption	Solubility
50	311	196.6
100	322	198.1
200	344.5	201.5
400	400	208.8
640	487	215.7
700	545.5	...

t = -59°, sp gr = 0.879

Pressure	Coefficient of absorption	Solubility
100	97.8	67.2
200	101.2	68.0
460	106.6	72.8
700	118.8	72.8

## Solvent—Ethyl acetate.

t = -78°, sp gr = 1.017

Pressure	Coefficient of absorption	Solubility
50	250.2	177.5
100	255.6	177.1
200	271.8	179.2
400	310.9	183.2
650	386.9	191.2

Solubility of CO<sub>2</sub> in organic solvents at low temperatures.—*Continued*

t = -59°, sp gr = 0.904

Pressure	Coefficient of absorption	Solubility
100	85.3	65.6
200	86.3	65.3
400	91.6	66.7
700	101.5	69.7

## Solvent. Methyl acetate

t = -78°, sp gr = 1.036

Pressure	Coefficient of absorption	Solubility
50	304.9	224.1
100	315.0	224.3
200	337.4	223.1
400	389.3	225.6
650	498.1	231.2

t = -59°, sp gr = 1.032

Pressure	Coefficient of absorption	Solubility
100	94.3	75.8
200	98.45	77.1
400	103.6	77.6
700	112.9	79.0

(Stern, Z. phys. Ch 1912, 81. 468.)

Solubility of CO<sub>2</sub> in ether at 0° = 7.33, at 10° = 6.044; at 15° = 5.46. (Christoff, Z. phys. Ch. 1912, 79. 459.)

Coefficient of absorption in chloroform is 0.20376 at 36.57 mm., and 4.43757 at 762 mm. pressure. (Woukoloff, C. R. 109. 62.)

100 vols of following liquids absorb vols. CO <sub>2</sub> at 18°—		
	Sp gr	Vols CO <sub>2</sub>
Ether	0.727	217
Rectified naphtha	0.784	169
Oil of turpentine	0.860	163
Oil of lavender (freshly distilled)	0.850	191
Oil of thyme	0.860	188
Lancet oil	0.940	163
Ohve oil	0.915	151
Gum-arabic + Aq (containing 25% of the gum)	1.082	75
Cane-sugar + Aq (containing 25% of sugar)	1.104	72

(de Saussure, l. c.)

1 vol oil of turpentine absorbs 17-19 vols CO<sub>2</sub> (Saussure.)

1 vol spirit at 10° absorbs 2 vols. CO<sub>2</sub> (de Saussure.)

1 vol. ohve oil at 10° absorbs 1 + vol CO<sub>2</sub> (de Saussure.)

1 vol oil of turpentine at 10° absorbs 2 vols CO<sub>2</sub> (Bergman.)

1 vol. caoutchouc absorbs 11 vols CO<sub>2</sub> (Bergman.)

Coefficient of absorption for petroleum is 1.17 at 20° and 1.31 at 10°. (Gniwiasz and Walfisz, Zeit. phys. Ch. 1. 70.)

100 vols. petroleum absorb 70 vols CO<sub>2</sub> at 10°. (Robinet, C. R. 58. 608.)

Solubility of  $\text{CO}_2$  in  $\frac{N}{2}$  solutions of various organic substances at  $20^\circ$ .

Substances	Sp gr of $\frac{N}{2}$ solution	Coeff of absorption	cc $\text{CO}_2$ dissolved in 1000 g $\text{H}_2\text{O}$
Dextrose	1.0328	0.792	841
Mannite	1.03031	0.782	833
Glycerine	1.01413	0.843	864
Pyrogallol	1.01718	0.853	894
Hydroquinon	1.00946	0.887	928
Resorcin	1.00958	0.901	945
Pyrocatechin	1.0107	0.868	908
Urethane	1.0037	0.869	907
Carbamide	1.00715	0.864	884
Thiocarbamide	1.00917	0.859	885
Antipyrine	1.01339	0.859	935
Acetamide	1.005	0.879	906
Acetic acid	1.0026	0.868	893
N Propylic acid	0.9939	0.869	902

(Usher, Chem. Soc 1910, 97 73.)

Absorption of  $\text{CO}_2$  by ethyl alcohol

Amount of alcohol used = 0.093 ccm.

$V$  = ccm of  $\text{CO}_2$  absorbed by the solvent at  $t^\circ$ , reduced to a pressure of 1 kg. per sq. cm.

$V_1$  = ccm. of  $\text{CO}_2$  absorbed by 1 ccm. of the solvent.

Pressure kg./sq. cm.	$t^\circ$	Gas volume ccm	$V$	$V_1$
30	$20^\circ$	57.31	9.462	104.8
40			15.15	149.7
50			23.04	188.8
30	$35^\circ$	60.05	7.114	77.87
40			10.52	113.1
50			14.73	144.5
60			19.63	173.0
70			27.39	210.8
40	$60^\circ$	64.44	6.429	72.82
50			9.023	97.09
60			12.27	122.5
70			15.64	145.2
80			19.11	167.9
90			20.64	180.7
100			23.88	195.7
50	$100^\circ$	72.19	3.809	42.49
60			6.034	66.05
70			8.374	88.67
80			10.76	111.2
90			13.06	129.0
100			14.90	145.7
110			16.22	155.0
120			18.93	174.6
130			20.48	182.6
140			20.61	186.0

(Sander, Z. phys. Ch 1912, 78. 524)

Absorption of  $\text{CO}_2$  by propyl alcohol  
Amount of alcohol used = 0.103 ccm.  
 $V$  and  $V_1$ . See under absorption of  $\text{CO}_2$  by ethyl alcohol.

Pressure kg./sq. cm.	$t^\circ$	Gas volume ccm	$V$	$V_1$
20	$20^\circ$	60.59	4.867	56.16
30			8.472	86.62
40			13.46	122.1
50			21.62	174.6
20	$35^\circ$	62.96	3.493	40.00
30			6.307	64.08
40			9.296	98.16
50			13.99	122.8
60			18.90	159.9
70			35.03	228.2
80			49.23	269.6
20	$60^\circ$	68.08	2.602	24.73
30			4.722	47.68
40			6.723	64.65
50			9.810	88.54
60			13.06	111.5
70			17.15	144.4
80			19.61	159.2
90			24.75	184.3
100			30.19	213.9
40	$100^\circ$	76.27	2.592	26.50
50			5.669	54.19
60			8.025	74.51
70			10.44	92.17
80			13.13	107.7
90			15.72	132.3
100			17.10	144.7
110			20.95	183.5
120			23.55	175.4

(Sander)

Absorption of  $\text{CO}_2$  by ether  
Amount of ether used = 0.131 ccm  
 $V$  and  $V_1$ . See under absorption of  $\text{CO}_2$  by alcohol.

Pressure kg./sq. cm.	$t^\circ$	Gas volume ccm	$V$	$V_1$
45	$35^\circ$	62.06	42.62	205.6
50			46.81	217.3
60			57.83	241.6
50	$60^\circ$	67.11	28.49	171.6
60			35.24	195.4
70			42.01	210.0
80			46.64	221.4
90			50.72	235.0
100			56.63	248.7
60	$100^\circ$	71.03	12.57	101.0
70			20.00	134.6
80			26.34	142.8
90			32.16	166.4
100			35.70	175.4

(Sander)

Absorption of CO<sub>2</sub> by benzene

Amount of benzene used = 0.080 ccm.

V and V<sub>1</sub>. See under absorption of CO<sub>2</sub> by ethyl alcohol

Pressure kg/sq. cm.	t°	Gas volume ccm.	V	V <sub>1</sub>
15	20°	55.14	2.728	46.89
20			4.845	71.16
30			9.618	125.3
40			18.70	192.4
50			30.10	304.3
15	35°	58.17	2.225	39.94
20			3.373	48.65
30			6.879	94.39
40			11.56	138.3
50			17.09	186.6
60	60°	61.86	25.73	243.1
70			35.80	289.0
20			2.140	34.57
30			3.880	55.97
40			6.699	88.71
50	100°	73.75	10.28	128.5
60			13.57	156.6
70			17.71	184.6
80			22.50	215.0
90			28.09	246.6
100			33.76	284.4

(Sander.)

Absorption of CO<sub>2</sub> by chlorbenzene.

Amount of chlorbenzene used = 0.106 ccm.

V and V<sub>1</sub>. See under absorption of CO<sub>2</sub> by ethyl alcohol

Pressure kg/sq. cm.	t°	Gas volume ccm.	V	V <sub>1</sub>
20	20°	61.03	5.813	62.61
30			10.25	95.22
40			17.17	137.3
50			26.59	187.5
20	35°	64.16	4.650	46.66
30			7.705	72.73
40			11.81	101.5
50			16.83	137.3
60			22.82	168.3
70	60°	69.38	32.83	205.5
20			3.685	35.86
30			5.510	53.04
40			7.982	73.69

Absorption of CO<sub>2</sub> by chlorbenzene.—Cont

Pressure kg/sq. cm.	t°	Gas volume ccm.	V	V <sub>1</sub>
50	100°	77.73	11.16	99.06
60			13.74	118.1
70			16.65	134.5
80			19.50	149.3
90			22.23	165.5
110	100°	77.73	31.64	204.4
30			3.562	33.65
40			5.008	48.16
50			7.106	63.78
60			8.701	77.24
70	100°	77.73	10.37	91.02
80			12.05	103.00
90			13.88	121.2
100			14.89	121.5
110			16.35	130.7
120	100°	77.73	17.77	140.7
130			18.54	146.8

(Sander.)

Absorption of CO<sub>2</sub> by brombenzene.

Amount of brombenzene used = 0.113 ccm.

V and V<sub>1</sub>. See under absorption of CO<sub>2</sub> by ethyl alcohol.

Pressure kg/sq. cm.	t°	Gas volume ccm.	V	V <sub>1</sub>
20	20°	60.84	4.531	50.83
30			7.793	82.29
40			12.22	121.1
50			17.37	160.0
20	35°	63.96	3.947	43.38
30			5.782	62.69
40			8.508	90.43
50			11.96	116.4
60			16.00	146.0
70	60°	69.16	22.56	184.1
80			41.26	233.9
20			2.650	30.58
30			3.714	46.15
40			5.971	62.64
50	100°	77.48	7.406	77.19
60			9.718	98.73
70			10.27	108.4
80			13.99	131.4
90			16.70	144.3
100	100°	77.48	20.06	169.7
110			23.13	190.6
30			2.970	30.56
40			4.032	41.49
50			5.833	59.61
60	100°	77.48	7.239	72.61
70			8.330	82.56
80			9.714	92.86
90			11.14	107.1
100			12.79	118.0
110	100°	77.48	13.80	125.3
120			15.50	140.7

(Sander.)

Absorption of CO<sub>2</sub> by nitrobenzene  
Amount of nitrobenzene used = 0.164 cem.  
V and V<sub>1</sub>. See under absorption of CO<sub>2</sub>  
by ethyl alcohol.

Pressure kg./sq. cm.	t°	Gas volume cem.	V	V <sub>1</sub>
15	20°	57.65	5.459	41.60
20			7.354	57.12
30			12.14	92.50
40			15.93	115.9
50			21.71	155.9
20	35°	59.86	5.644	44.48
30			8.658	68.23
40			11.98	94.39
50			15.59	113.4
60			19.94	145.1
70	80		25.57	179.6
80			34.95	227.0
20	60°	64.73	3.787	31.38
30			4.519	38.23
40			6.308	52.26
50			7.750	64.21
60			8.887	72.15
70	80		10.15	82.40
80			10.80	85.03
20	100°	75.52	2.749	24.67
30			4.162	41.00
40			5.393	50.36
50			6.832	63.80
60			7.763	70.85
70	80		9.048	75.75
80			10.65	86.86

(Sander.)

Absorption of CO<sub>2</sub> by toluene.  
Amount of toluene used = 0.114 cem.  
V and V<sub>1</sub>. See under absorption of CO<sub>2</sub>  
by ethyl alcohol.

Pressure kg./sq. cm.	t°	Gas volume cem.	V	V <sub>1</sub>
20	20°	59.97	7.420	57.91
30			13.31	103.3
40			23.25	155.9
50			45.10	235.8
20	35°	63.05	6.018	49.60
30			10.13	82.63
40			16.03	118.8
50			23.34	155.8
60			31.30	192.1
70	80		44.17	225.8
30	60°	68.17	6.735	54.67
40			9.885	78.67
50			13.98	104.6
60			18.00	128.1
70			22.66	150.1
80	90		26.60	171.9
90			31.66	191.5
100			38.86	210.0

Absorption of CO<sub>2</sub> by toluene.—Continued

Pressure kg./sq. cm.	t°	Gas volume cem.	V	V <sub>1</sub>
30	100°	76.37	3.356	28.68
40			5.045	49.25
50			8.703	67.93
60			11.18	85.98
70			13.72	101.7
80			16.30	117.6
90			18.88	132.6
100			21.85	149.0
110			24.86	161.9
120			26.80	171.8
130			28.21	178.7

(Sander.)

Absorption of CO<sub>2</sub> by ethyl acetate.  
Amount of ethyl acetate used = 0.155 cem.  
V and V<sub>1</sub>. See under absorption of CO<sub>2</sub>  
by ethyl alcohol.

Pressure kg./sq. cm.	t°	Gas volume cem.	V	V <sub>1</sub>
25	20°	60.30	29.43	158.6
30			37.91	188.2
40			51.26	227.9
30	35°	63.40	26.54	145.2
40			38.69	188.4
50			48.35	213.9
60			51.88	219.8
30	60°	68.55	18.12	108.0
40			25.67	140.5
50			33.21	165.2
60			40.12	186.7
70			45.47	201.1
80	100°	76.80	49.16	223.4
40°			12.76	80.70
50	100°	76.80	18.80	110.1
60			24.12	132.0
70			28.99	152.0
80			32.96	162.3
90			36.92	172.1
100			42.75	191.5

(Sander.)

Absorption of CO<sub>2</sub> by CH<sub>3</sub>COOH + CCl<sub>4</sub>.

Solvent		cc. CO <sub>2</sub> absorbed
1 mol.	CH <sub>3</sub> COOH	58.8
0.8	" CH <sub>3</sub> COOH +	
0.2	" CCl <sub>4</sub>	61.0
0.5	" CH <sub>3</sub> COOH +	
0.5	" CCl <sub>4</sub>	62.4
0.2	" CH <sub>3</sub> COOH +	
0.8	" CCl <sub>4</sub>	60.2
1	" CCl <sub>4</sub>	57.6

(Christoff, J. phys. Ch. 1905, 53, 382.)

Absorption of CO<sub>2</sub> by C<sub>2</sub>H<sub>4</sub>Cl<sub>2</sub> + CS<sub>2</sub>.

Solvent	or CO <sub>2</sub> absorbed
1 mol C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub>	209.7
0.8 " C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> +	
0.2 " CS <sub>2</sub>	173.4
0.5 " C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> +	
0.5 " CS <sub>2</sub>	140.0
0.2 " C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> +	
0.8 " CS <sub>2</sub>	71.9
1 " CS <sub>2</sub>	19.9

(Christoff.)

Solubility of CO<sub>2</sub> in organic solvents.

$\frac{ds}{dt}$  = change of solubility for 1° increase in temp

Solvent	Sol- ubility at 25° C	Sol- ubility at 20° C	Sol- ubility at 15° C	ds dt
Glycerine	0.0802			
Water	0.8256			
Carbon bisulphide	0.8890	0.8888	0.9448	-0.00747
Iodobenzene	1.301	1.371	1.440	-0.0139
Aniline	1.324	1.434	1.531	-0.0207
o-Toluidine	1.381	1.473	1.539	-0.0158
m-Toluidine	1.430	1.531	1.730	-0.0244
Eugenol	1.539	1.553	1.703	-0.0223
Benzotrifluoride	1.843			
Cumene	1.782	1.879	1.978	-0.0190
Carvone	1.802	1.921	2.034	-0.0232
Dichlorobenzene	1.810	1.917	2.020	-0.0210
Amyl alcohol	1.831	1.941	2.058	-0.0227
Bromobenzene	1.842	1.964	2.082	-0.0250
Isobutyl alcohol	1.849	1.964	2.088	-0.0239
Benzyl chloride	1.038	2.072	2.180	-0.0242
m-Xylene	2.090	2.215	2.340	-0.0250
Ethylene bromide	2.157	2.264	2.424	-0.0207
Chlorobenzene	2.285	2.420	2.581	-0.0810
Carbon tetrachloride	2.284	2.502	2.603	-0.0309
Propylene bromide	2.301	2.453	2.586	-0.0281
Toluene	2.305	2.420	2.557	-0.0250
Benzene	2.425	2.540	2.710	-0.0285
Amyl bromide	2.455	2.638	2.803	-0.0348
Nitrobenzene	2.455	2.555	2.845	-0.0389
Propyl alcohol	2.498			
Carvol	2.498	2.690	2.914	-0.0410
Ethyl alcohol (97%)	2.708	2.823	3.130	-0.0424
Benzaldehyde	2.841	3.057	3.304	-0.0463
Amyl chloride	2.910	3.127	3.363	-0.0453
Isobutyl chloride	3.105	3.388	3.689	-0.0554
Chloroform	3.430	3.681	3.956	-0.0320
Butyric acid	3.478	3.767	4.084	-0.0606
Ethylene chloride	3.525	3.795	4.001	-0.0536
Pyridine	3.656	3.862	4.291	-0.0635
Methyl alcohol	3.837	4.205	4.006	-0.0709
Amyl formate	4.026	4.320	4.640	-0.0620
Propionic acid	4.078	4.417	4.787	-0.0709
Amyl acetate	4.110	4.411	4.850	-0.0731
Glacial acetic acid	4.079	5.129	5.014	-0.0935
Isobutyl acetate	4.691	4.968		-0.0554
Acetic anhydride	5.206	5.720	6.218	-0.1012
Acetone	6.296	6.921		-0.1252
Methyl acetate	6.494			

(Just, Z. phys. Ch. 1901. 37. 354)

Absorption of CO<sub>2</sub> by organic substances +  
Aq at 15°

P = % of the organic substance in the solvent.

 $\beta_{15}^{\circ}$  = Coefficient of absorption at 15°. $S_{15}^{\circ}$  = Solubility at 15°.

Organic substance used	P	$\beta_{15}^{\circ}$	$S_{15}^{\circ}$
Chloral hydrate	0	0.996	
	0	0.992	1.056
	0	1.012	
	17.7	0.885	0.935
	21.8	0.860	0.908
	31.6	0.803	0.848
	37.0	0.790	0.834
	38.3	0.781	0.825
	49.8	0.760	0.802
	51.1	0.769	0.812
	52.6	0.764	0.807
	57.1	0.765	0.808
	61.1	0.780	0.824
	68.8	0.797	0.842
	71.0	0.812	0.857
	74.6	0.848	0.895
	79.4	0.903	0.953
Glycerine	0	1.003	1.064
	0	1.013	
	26.11	0.785	0.829
	27.69	0.800	0.845
	43.72	0.639	0.675
	46.59	0.620	0.655
	62.14	0.511	0.540
	73.36	0.449	0.474
	77.75	0.430	0.454
	87.74	0.422	0.446
	90.75	0.404	0.427
	96.64	0.415	0.433
	99.26	0.410	0.438

(Hammel, Z. phys. Ch. 1915. 90. 123.)

Solubility of carbon dioxide in solutions of  
aniline at 25°.

I. Concentration, 0.206 g. aniline in 100 c. c. of solution.

P = Pressure.

S = Solubility calc. according to formula given in original article

P	S	P	S
748	0.865	1053	0.855
808	0.855	1159	0.862
920	0.857	1243	0.860

II. Concentration, 0.425 g. aniline in 100 c. c. of solution.

P	S	P	S
760	0.909	1150	0.897
816	0.897	1236	0.902
921	0.897	1380	0.908

Solubility of carbon dioxide in solutions of aniline at 25°.—*Continued*

III. Concentration, 0.566 g aniline in 100 c. c. of solution.

P	S	P	S
760	0.935	1082	0.923
823	0.929	1223	0.924
941	0.925	1341	0.930

IV Concentration, 0.743 g aniline in 100 c. c. of solution

P	S	P	S
760	0.953	1063	0.940
895	0.941	1223	0.940
983	0.940	1302	0.942

(Findlay and Craghton, Chem Soc. 1910. 97. 555.)

Solubility of CO<sub>2</sub> in CS<sub>2</sub> increases approx. proportionally with the pressure. The absorption is greater at lower temp. and less at higher temp. than is required by Dalton's law. (Woukoloff, C. R. 1889, 108. 674.)

Absorption of CO<sub>2</sub> by sugar + Aq.

Sugar + Aq	Grams CO <sub>2</sub> absorbed by 75 cc of solution at 15° and 720 mm
1/10-N sugar solution	0.1225
1/2-N " "	0.1089
1-N " "	0.0931

(Christoff, Z. phys. Ch 1905, 53. 829.)

Absorption of CO<sub>2</sub> in sugar + Aq at 20°.

Conc. of solution	Sp. gr	Coefficient of absorption
1/8 mol. per l.	1.01513	0.846
1/4 " " "	1.03125	0.815
1/2 " " "	1.06372	0.758
1 " " "	1.12809	0.649

(Usher, Chem. Soc. 1910, 97. 72.)

*Liquid*.—Not miscible with H<sub>2</sub>O, though slightly sol therein, or with fatty oils; miscible with alcohol, ether, CS<sub>2</sub>, and the essential oils. (Thilorier, Mitchell.)

Unacted upon by H<sub>2</sub>O; sol. in alcohol, ethers, petroleum, oil of turpentine, and CS<sub>2</sub>. (Mareska and Donny.)

Petroleum dissolves 5 to 6 vols. liquid CO<sub>2</sub>. (Caillietet, C. R. 75. 1271.)

Sl. sol. in CS<sub>2</sub>. (Caillietet.)

*Solid*.—When immersed in H<sub>2</sub>O, rapidly volatilizes and dissolves. With alcohol or ether it forms a semi-fluid mixture (Channing, Am. J. Sci. (2) 5. 186.)

Only slightly sol. in anhydrous ether, but may be mixed therewith to a paste. (Thilorier.)

Sol in methyl chloride below -65° to the point of sat. without decomp. (Villard, C. R. 1895, 120. 1413.)

+6H<sub>2</sub>O. (Villard, C. R. 1894, 119. 369.)

Carbon selenide, C<sub>2</sub>Se

Sol only in hot conc. H<sub>2</sub>SO<sub>4</sub>. (v. Bartsch, Ch Z 1906, 30. 810.)

C<sub>2</sub>Se Insol. in H<sub>2</sub>O, CS<sub>2</sub>, and ether. Easily sol. in hot conc. H<sub>2</sub>SO<sub>4</sub>; sol in conc. NaOH + Aq from which it is pptd by HCl. (v. Bartsch)

Carbon silicide CSi.

(*Carborundum*). Not attacked by any acids, even HF; sl. attacked by caustic alkalis or carbonates (Acheson, C. N. 68. 179.)

Not attacked by KOH + Aq. (Schutzenberger, C. R. 114. 1089.)

Carbon monosulphide, CS

Insol in H<sub>2</sub>O, alcohol, oil of turpentine, or benzene, somewhat sol. in CS<sub>2</sub> or ether; sol in warm HNO<sub>3</sub>; sol in conc. KOH + Aq. (Siddot, C. R. 81. 32.)

Readily absorbed by alcohol and aniline. (Dewinger, J. pr. 1895, (2) 51. 349.)

Carbon disulphide, CS<sub>2</sub>.

Very sl. sol. in H<sub>2</sub>O.

11. H<sub>2</sub>O dissolves 2-3 g. CS<sub>2</sub> (Ckianidi, Bull. Soc. 43. 562); 3.5-4.5 g. (Peligot, ib 43. 563).

30 cc. CS<sub>2</sub> shaken with 8000 cc. H<sub>2</sub>O at 20-23° for 18 days decreased 11 cc. in 9 days and 1.4 cc. in the next 3 days by diffused light, and 0.8 cc. in the last 5 days (no light). Part of the CS<sub>2</sub> was decomp. and 7.85 cc. were dissolved, therefore H<sub>2</sub>O dissolves 1/1000 of its weight CS<sub>2</sub>. (Sestini, Gazz. ch. it. 1. 473.)

Solubility of CS<sub>2</sub> in H<sub>2</sub>O

100 pts. H<sub>2</sub>O dissolve 0.203 pts CS<sub>2</sub> at 12-13°

" " 0.191 " " 15-16°

" " 0.168 " " 25-27°

" " 0.145 " " 30-33°

(Page, C. N. 41. 195.)

Solubility of CS<sub>2</sub> in H<sub>2</sub>O. a = g. CS<sub>2</sub> in 1000 cc. solution at t°.

a	t°	a	t°	a	t°
2.04	0	1.79	20	1.11	40
1.99	5	1.69	25	0.70	45
1.94	10	1.55	30	0.14	49
1.87	15	1.37	35		

(Chancel and Parmentier, C. R. 100. 773.)

100 g. H<sub>2</sub>O dissolve at t°:

t° 0 - 10 20 30

0.258 0.239 0.201 0.195 g. CS<sub>2</sub>.

(Rex, Z. phys. Ch. 1906, 55. 365.)

Absorption of CS<sub>2</sub> vapor by H<sub>2</sub>O at t°

t°	Coefficient of absorption
0	3 573
10	2 189
20	1 346
30	0 799

Calc. from data of Chancel and Parmentier, C. R. 100. 733.)

(Winkler, Z. phys. Ch. 1906, 55. 352)

Vapors of CS<sub>2</sub> are most easily absorbed by alcoholic solution of KOH. Sl. absorbed by KOH+Aq. and very slowly by CuSO<sub>4</sub>, Pb(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+Aq. conc. H<sub>2</sub>SO<sub>4</sub>, or CaCl<sub>2</sub> in HCl+Aq. (Berthelot, A. ch. (3) 61. 74)

Solubility in alcohol S=strength of alcohol in per cent by weight; P=pts. CS<sub>2</sub> which dissolve in 10 ccm. alcohol at 17°.

S	P	S	P
100	∞	91 37	5 00
98 5	18 20	84 12	3 00
98 15	13 20	76 02	2 00
96 95	10 00	48 40	0 20
93 54	7 00	47 90	0 00

(Tuchschmidt and Follenius, B. 4. 583.)

Miscible with absolute alcohol, ether, ethereal and fatty oils, and liquid CO<sub>2</sub>

Tricarbon disulphide, C<sub>3</sub>S<sub>2</sub>.

Insol. in H<sub>2</sub>O; easily sol. in alcohol, ether, chloroform, benzene, and CS<sub>2</sub>. The alcoholic and ethereal solutions decomp. on standing. (Lengyel, B. 28. 2960.)

Sol. in alcohol with decomp. Sol. in CS<sub>2</sub> and in benzene. (Stock, B. 1912, 45. 3575.)

Solid modification. Insol. in H<sub>2</sub>O and ordinary solvents. Sol. in KOH+Aq. (Lengyel.)

## Carbon sulphoselenide, CSSe

Mpt. -85°, bpt +84°

Decomp. by light. Not attacked by H<sub>2</sub>O. Sol. in hot conc. HNO<sub>3</sub>. Decomp. by Br<sub>2</sub> to an oil. Sol. in alcohol with decomp. Miscible with CS<sub>2</sub>. (Stock, B. 1914, 47. 150.)

## Carbon sulphotelluride, CSTe.

Mpt -54°. Very unstable.

Miscible with CS<sub>2</sub> and benzene without decomp. (Stock, B. 1914, 47. 142.)

## Carbonatochloroplatin diamine carbonate chloroplatin diamine nitrate.

CO<sub>2</sub> [Pt N<sub>2</sub>H<sub>4</sub>] (CO<sub>2</sub>)<sub>2</sub>, Cl<sub>2</sub>Pt(N<sub>2</sub>H<sub>4</sub>NO<sub>2</sub>)<sub>2</sub>.  
Cl<sub>2</sub> [Pt N<sub>2</sub>H<sub>4</sub>] (CO<sub>2</sub>)<sub>2</sub>, Cl<sub>2</sub>Pt(N<sub>2</sub>H<sub>4</sub>NO<sub>2</sub>)<sub>2</sub>.  
Precipitate. (Cleve, J. B. 1867. 321)

## Carbonatonitratoplatin diamine carbon-

ate, CO<sub>2</sub> (NO<sub>2</sub>)<sub>2</sub> [Pt(N<sub>2</sub>H<sub>4</sub>)<sub>2</sub>](CO<sub>2</sub>)<sub>2</sub>

Sol. in boiling H<sub>2</sub>O (Cleve.)

Carbonatotetramine cobaltic bromide, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>Br.

Much less sol. than chloride. (Jorgensen, Z. anorg. 2. 279)

— carbonate, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>CO<sub>2</sub>+3H<sub>2</sub>O

Very sol. in H<sub>2</sub>O. (Jorgensen.)

— chloraurate, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>AuCl<sub>4</sub>+  
½H<sub>2</sub>O.

Somewhat sol. in H<sub>2</sub>O; nearly absolutely insol. in alcohol. (Jorgensen)

— chloride, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>Cl.

Easily sol. in H<sub>2</sub>O; insol. in alcohol. (Jorgensen.)

— chloroplatinate, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>PtCl<sub>6</sub>+  
2H<sub>2</sub>O.

Nearly insol. in H<sub>2</sub>O and alcohol. (Jorgensen)

— chloroplatinite, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>PtCl<sub>4</sub>

Nearly insol. in H<sub>2</sub>O; wholly in alcohol. (Jorgensen)

— dithionate, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>S<sub>2</sub>O<sub>6</sub>.

Ppt. (Jorgensen.)

— iodide, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>I.

Much less sol. than bromide or chloride (Jorgensen.)

— nitrate, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>NO<sub>2</sub>+½H<sub>2</sub>O.

Sol. in about 15 pts. cold H<sub>2</sub>O, insol. in alcohol. (Jorgensen.)

— sulphate, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>SO<sub>4</sub>+3H<sub>2</sub>O.

Considerably less sol. in H<sub>2</sub>O than the nitrate. (Jorgensen.)

Carbonic acid, H<sub>2</sub>CO<sub>3</sub>

See Carbon dioxide.

## Carbonates.

Carbonates of Na, K, Rb, and Cs are easily sol. in H<sub>2</sub>O; carbonates of Li and Tl are much less sol.; other carbonates are nearly or quite insol. All carbonates are sol. to some extent in H<sub>2</sub>O containing CO<sub>2</sub>. All carbonates, except those of NH<sub>4</sub>, Rb, and Cs, are insol. in alcohol.

Sol. in those acids which are themselves sol. in H<sub>2</sub>O, except HCN and H<sub>2</sub>BO<sub>3</sub>.

Insol. in liquid NH<sub>3</sub> (Franklin, Am. Ch. J. 1896, 20. 824)

**Aluminum carbonate, basic.**

$5\text{Al}_2\text{O}_3, 6\text{CO}_2 + 37\text{H}_2\text{O} = 3\text{Al}(\text{OH})_3, \text{Al}_2(\text{CO}_3)_3 + 14\text{H}_2\text{O}$ . (Seubert, Z. anorg. 1893, 4. 67)

$\text{Al}_2\text{O}_3, \text{CO}_2$ . (Paikmann, Sil. Am. J. (2) 34. 324)

$3\text{Al}_2\text{O}_3, 2\text{CO}_2 + 16\text{H}_2\text{O}$ . (Muspratt and Danson, A. 72. 120)

$3\text{Al}_2\text{O}_3, 2\text{CO}_2 + 9\text{H}_2\text{O}$ . (Wallace, Chem. Gaz. 1858, 410)

$5\text{Al}_2\text{O}_3, 3\text{CO}_2 + 18\text{H}_2\text{O}$ . (Bley, J. pr. 39. 11.)

$2\text{Al}_2\text{O}_3, \text{CO}_2 + 6\text{H}_2\text{O} = 10\text{Al}(\text{OH})_3, \text{Al}_2(\text{CO}_3)_3 + 3\text{H}_2\text{O}$ . Sol. in cold dil. acids. (Schlumberger, Bull. Soc. 1895, (3) 13. 46)

+  $8\text{H}_2\text{O}$ . (Urban and Renoul, J. Pharm. (4) 30. 340.) =  $10\text{Al}(\text{OH})_3, \text{Al}_2(\text{CO}_3)_3 + 9\text{H}_2\text{O}$  (Seubert, Z. anorg. 1893, 4. 67.)

$3\text{Al}_2\text{O}_3, 3\text{CO}_2 + 40\text{H}_2\text{O}$ . (Langlois, A. ch. (3) 48. 505)

All are precipitates, insol. in  $\text{H}_2\text{O}$ , sol in acids, and give off  $\text{CO}_2$  at slight heat.

There are no definite carbonates of aluminum. (Cameron, J. phys. Chem. 1908, 12. 572.)

**Aluminum ammonium carbonate,  $\text{Al}_2\text{O}_3, \text{CO}_2, (\text{NH}_4)_2\text{CO}_3 + 4\text{H}_2\text{O}$ .**

Precipitate. (Rose, Pogg. 91. 460.)

**Aluminum sodium carbonate,  $\text{Al}_2\text{O}_3, \text{CO}_2, 2\text{Na}_2\text{CO}_3 + 24\text{H}_2\text{O}$ .**

Precipitate. Sol. in cold dil. acids. (Bley, J. pr. 39. 22.)

**Ammonium carbonate,  $(\text{NH}_4)_2\text{CO}_3 + \text{H}_2\text{O}$ .**

Sol. at  $15^\circ$  in its own weight  $\text{H}_2\text{O}$ . Solution in  $\text{H}_2\text{O}$  gives off gas at  $70-75^\circ$ , and boils at  $75-80^\circ$ . Sl. sol. in cold dil.  $\text{NH}_4\text{OH} + \text{Aq}$ , more sol. at ordinary temp. Insol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Divers, Chem. Soc. (2) 8. 171, 259, and 364.)

Insol. in liq.  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826)

Insol. in alcohol.

Insol. in  $\text{CS}_2$ . (Aicetowski, Z. anorg. 1894, 6. 257.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

100 g. pure glycerine dissolve 20 g  $(\text{NH}_4)_2\text{CO}_3$  at  $15^\circ$  (Ossendowski, Pharm. J. 1907, 79. 575)

**Ammonium hydrogen carbonate,  $\text{NH}_4\text{HCO}_3$ .**

Sol. at  $15^\circ$  in about 8 pts.  $\text{H}_2\text{O}$ . (Berthollet, J. Phys. 66. 168.)

Sol. at  $12.8^\circ$  in about 6 pts.  $\text{H}_2\text{O}$ . (J. Davy, N. Edinb. J. 16. 245.)

Solution decomp. on air or by gentle heat or by addition of the solid salt. (Berthollet)

100 pts.  $\text{H}_2\text{O}$  dissolve at  $0^\circ$ , 11.9 pts; at  $10^\circ$ , 15.85 pts; at  $20^\circ$ , 21 pts; at  $30^\circ$ , 27 pts.  $\text{NH}_4\text{HCO}_3$ . (Dibbitts, J. pr. (2) 10. 417.)

**Solubility of  $\text{NH}_4\text{HCO}_3$  in  $\text{NH}_4\text{Cl} + \text{Aq}$ , sat. with  $\text{CO}_2$ , at  $t^\circ$ .**

$t^\circ$	g. per 100 g. $\text{H}_2\text{O}$		Sp. gr. of sat. solution
	$\text{NH}_4\text{Cl}$	$\text{NH}_4\text{HCO}_3$	
$0^\circ$	0 29.08	11.9 3.6	1.077
$15^\circ$	0 2.99 6.06 8.51 11.68 18.30 26.93 33.25 34.35	18.64 16.29 14.22 12.69 11.68 9.33 7.73 6.64 6.42	1.064 1.063 1.062 1.062 1.065 1.069 1.076 1.085 1.085
$30^\circ$	0 39.7	27.0 9.1	

(Fedotieff, Z. phys. Ch. 1904, 49. 168)

**Solubility of  $\text{NH}_4\text{HCO}_3$  in  $\text{NaHCO}_3 + \text{Aq}$ , sat. with  $\text{CO}_2$  at  $t^\circ$ .**

$t^\circ$	g. per 100 g. $\text{H}_2\text{O}$		Sp. gr. of sat. solution
	$\text{NaHCO}_3$	$\text{NH}_4\text{HCO}_3$	
$0^\circ$	0 4.82	11.90 10.94	1.072
$15^\circ$	0 5.92	18.64 17.06	1.064 1.090
$30^\circ$	0 7.0	27.0 23.0	

(Fedotieff, Z. phys. Ch. 1904, 49. 168.)

**Solubility of  $\text{NH}_4\text{HCO}_3$  in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $t^\circ$ .**

$t^\circ$	g. per 100 g. $\text{H}_2\text{O}$		Sp. gr. of sat. solution
	$\text{NH}_4\text{NO}_3$	$\text{NH}_4\text{HCO}_3$	
$0^\circ$	0 118	11.90 4.52	1.2625
$15^\circ$	0 23.26 49.82 103.4 128.9 166.9	18.64 12.91 10.33 8.25 7.79 7.49	1.064 1.113 1.164 1.242 1.269 1.302
$30^\circ$	0 231.9	26.96 12.57	

(Fedotieff and Koltunoff, Z. anorg. 1914, 85. 251.)

Insol. in alcohol. (J. Davy.)

Insol. in acetone. (Eidmann, C. C. 1899, II 1014; Naumann, B. 1904, 37. 4329.)

Ammonium dihydrogen carbonate,  
( $\text{NH}_4$ ) $\text{H}_2(\text{CO}_3)_3 + \text{H}_2\text{O}$ .

Sol. in 5 pts  $\text{H}_2\text{O}$  at  $15^\circ$ ; decomp by more  $\text{H}_2\text{O}$  or by heat. (Divers, Chem. Soc. (2) 8, 171, 359, and 364.)

\* Sl. sol. in alcohol.

Ammonium hydrogen carbonate carbamate,  
 $2\text{NH}_4\text{HCO}_3, \text{NH}_4\text{CONH}_2$ . (*Salts of harts-horn.*)

1 pt. salt dissolves at:

$13^\circ$  in 4 pts.  $\text{H}_2\text{O}$ .

$16.7^\circ$  " 3.3 "

$32.2^\circ$  " 2.7 "

$40.6^\circ$  " 2.4 "

$49^\circ$  " 2 "

(J. Davy, N. Edinb J 18. 245.)

Strong alcohol dissolves out carbamate, and the carbonate remains undissolved.

$\text{NH}_4\text{HCO}_3, \text{NH}_4\text{CO}_2\text{NH}_3$ . (*Commercial carbonate of ammonia.*)

Sol. at  $15^\circ$  in 4 pts.  $\text{H}_2\text{O}$ , at  $65^\circ$  in  $1\frac{1}{2}$  pts.  $\text{H}_2\text{O}$ . (Divers.)

30 pts. salt + 100 pts  $\text{H}_2\text{O}$  lower temp. from  $15.3^\circ$  to  $3.2^\circ$ . (Rtdorff, B. 2. 68.)

Sol in 1 667 pts cold, and 0 833 pt. hot  $\text{H}_2\text{O}$  (Fourcroy.)

100 pts  $\text{H}_2\text{O}$  at  $13^\circ$  dissolve 25 pts.

" "  $17^\circ$  " 30 "

" "  $37^\circ$  " 37 "

" "  $41^\circ$  " 40 "

" "  $49^\circ$  " 50 "

(Berzelius)

100 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 38 pts.; at  $100^\circ$ , 100 pts (Tre's Dict.)

Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$ , and in less than 1 pt. boiling  $\text{H}_2\text{O}$ ; sat. solution at  $15.5^\circ$  contains 33.3%, and sat. boiling solution 50%. (Abt.)

Sat. aqueous solution at  $10^\circ$  contains 15.7%. (Eller.)

Sat. aqueous solution at (?) contains 6.1%. (Mussembroek.)

Sat. solution in the cold contains 37.5%. (Fourcroy.)

Does not dissolve as such in  $\text{H}_2\text{O}$ , ( $\text{NH}_4$ ) $\text{CO}_3$  dissolves out first, and  $\text{NH}_4\text{HCO}_3$  later. (Scanlon)

Sp gr of carbonate of ammonia + Aq at  $12^\circ$ .

Deg. Tw.	Sp gr at $12^\circ$	% Carb ammon.	Change of sp gr for $1^\circ \text{C}$
1	1.005	1.66	0 0002
2	1 010	3.18	0 0002
3	1 015	4.66	0.0003
4	1.020	6 04	0 0003
5	1 025	7 49	0 0003
6	1 030	8 93	0.0004
7	1.035	10 35	0.0004
8	1 040	11 88	0.0004
9	1 045	13 36	0 0005
10	1.050	14.83	0.0005
11	1 055	16 16	0.0005
12	1 060	17.70	0.0005
13	1.065	19 18	0 0005
14	1.070	20 70	0 0005
15	1.075	22.25	0 0006
16	1.080	23.78	0.0006
17	1.085	25.31	0 0006

Sp. gr. of carbonate of ammonia + Aq at  $12^\circ$ .—Continued

Deg Tw.	Sp. gr. at $12^\circ$	% Carb. ammon.	Change of sp gr for $1^\circ \text{C}$ .
18	1 090	26 82	0.0007
19	1 095	28 33	0 0007
20	1.100	29 93	0.0007
21	1 105	31 77	0.0007
22	1.110	33 45	0 0007
23	1 115	35.08	0.0007
24	1 120	36 88	0 0007
25	1 125	38 71	0 0007
26	1 130	40 34	0 0007
27	1.135	42 20	0 0007
28	1.140	44 29	0 0007
29	1.144	44 90	0 0007

(Lunge, Chem. Ind. 1883. 2)

Sp. gr. of aqueous solution of salt with composition 31.3%  $\text{NH}_3$ , 56.6%  $\text{CO}_2$ , 12.1%  $\text{H}_2\text{O}$ . 100 pts. of solution contain—

6.58 9.96 14.75 19.83 25.71 pts. salt  
1.0219 1.0337 1.0497 1.0672 1.0863 sp. gr.

29.74 35.85 40.23 44.90 pts. salt.

1.0995 1.1174 1.1297 1.1414 sp. gr.

(J. H. Smith, Chem. Ind. 1883. 3.)

Conc. alcohol dissolves out carbamate and leaves carbonate (Hunefeld, J. pr. 7. 25.)

Insol. in acetone. (Naumann, B. 1904, 37, 4328.)

Ammonium cerous carbonate, ( $\text{NH}_4$ ) $\text{CO}_3$ ,  
 $\text{Ce}_2(\text{CO}_3)_3 + 6\text{H}_2\text{O}$ .

Ppt. Very sl. sol. in conc. ( $\text{NH}_4$ ) $\text{CO}_3$  + Aq. (Meyer, Z. anorg. 1904, 41. 104.)

Ammonium chromous carbonate, ( $\text{NH}_4$ ) $\text{CO}_3$ ,  
 $\text{CrCO}_3 + \text{H}_2\text{O}$ .

Decomp. by moist air; sol. in dil  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ . (Baugé, C. R. 1896, 122. 476.)

Ammonium cobaltous carbonate, ( $\text{NH}_4$ ) $\text{CO}_3$ ,  
 $\text{CoCO}_3 + 4\text{H}_2\text{O}$ .

Permanent. Sol. in  $\text{H}_2\text{O}$ . (Dewille, A. ch. (3) 35. 460.)

( $\text{NH}_4$ ) $\text{Co}_2\text{O}_7$ ,  $2\text{CoO}$ ,  $4\text{CO}_2$  +  $9\text{H}_2\text{O}$ . Quickly decomp. on air; sol. in  $\text{H}_2\text{O}$  (Dewille.)  
+  $12\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

Ammonium didymium carbonate, ( $\text{NH}_4$ ) $\text{CO}_3$ ,  
 $\text{Dy}_2(\text{CO}_3)_3 + 3\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ . (Cleve.)

Ammonium dysprosium carbonate,  
 $\text{NH}_4\text{Dy}(\text{CO}_3)_3 + \text{H}_2\text{O}$ .

Only sl. sol. in  $\text{H}_2\text{O}$ . (Jantsch, B. 1911, 44. 1277.)

**Ammonium glucinum carbonate**,  $2(\text{NH}_4)_2\text{CO}_3 \cdot 3\text{GhCO}_3(?)$ .

Very sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Nearly insol in alcohol (Debray).

Composition is  $(\text{NH}_4)_2\text{CO}_3 \cdot 2\text{GhCO}_3 \cdot \text{Gl}(\text{OH})_2 + 2\text{H}_2\text{O}$ . (Humpidge, Royal Soc. Proc. 39. 1.)

**Ammonium lanthanum carbonate**,  $\text{La}_2(\text{CO}_3)_3 \cdot (\text{NH}_4)_2\text{CO}_3 + 4\text{H}_2\text{O}$ .

Ppt. (Meyer, Z. anorg. 1904, 41. 102.)

**Ammonium magnesium carbonate**,  $(\text{NH}_4)_2\text{Mg}(\text{CO}_3)_2 + 4\text{H}_2\text{O}$ .

Sol. in 71 pts.  $\text{H}_2\text{O}$  with decomp.; more sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Divers, Chem. Soc. 51. 196.)

$\text{H}_2\text{O}$  containing  $(\text{NH}_4)_2\text{CO}_3$  dissolves very slightly; more sol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$ . (Favre, A. ch. (3) 10. 473.)

**Ammonium magnesium hydrogen carbonate**,  $(\text{NH}_4)_2\text{Mg}_2\text{H}_2(\text{CO}_3)_4 + 8\text{H}_2\text{O}$ , or  $12\text{H}_2\text{O}$ .

Decomp. on air. (Deville, A. ch. (3) 35. 454.)

**Ammonium neodymium carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot \text{Nd}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Ppt. Sl. sol. in conc.  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Meyer, Z. anorg. 1904, 41. 106.)

**Ammonium nickel carbonate**,  $\text{NH}_4\text{HCO}_3 \cdot \text{NiCO}_3 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 35. 452.)

**Ammonium praseodymium carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot \text{Pr}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Ppt. Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Meyer, Z. anorg. 1904, 41. 105.)

**Ammonium samarium carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot \text{Sm}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Ppt

**Ammonium scandium carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot 2\text{Sc}_2(\text{CO}_3)_3 + 6\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . Sol. in cold alkali-carbonate + Aq, less sol. in hot. (R. Meyer, Z. anorg. 1910, 67. 410.)

**Ammonium tin (stannous) carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot 2\text{SnCO}_3 + 3\text{H}_2\text{O}$ .

Decomp. by cold  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 35. 456.)

**Ammonium uranyl carbonate**,  $2(\text{NH}_4)_2\text{CO}_3 \cdot \text{UO}_2\text{CO}_3$ .

Sol. at  $15^\circ$  in 20 pts.  $\text{H}_2\text{O}$ , more abundantly in  $\text{H}_2\text{O}$  containing  $(\text{NH}_4)_2\text{CO}_3$ . (Ebelmen.)

Insol. in pure  $\text{H}_2\text{O}$ , sol. in  $\text{H}_2\text{O}$  containing  $(\text{NH}_4)_2\text{CO}_3$ . Solution is decomp. by boiling. (Berzelius.)

Sol. in  $\text{SO}_2 + \text{Aq}$  (Berthier, A. ch. (3) 7. 76.)

$3(\text{NH}_4)_2\text{CO}_3 \cdot 2(\text{UO}_2)_2\text{CO}_3 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Giolitta C. C. 1905, II. 227.)

**Ammonium vanadyl carbonate**,  $3(\text{NH}_4)_2\text{O} \cdot 7\text{VO}_2 \cdot 5\text{CO}_2 + 16\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ .

Sol. in acids and alkalis. (Koppel, Z. anorg. 1905, 45. 350.)

**Ammonium yttrium carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot \text{Y}_2(\text{CO}_3)_3 + 2\text{H}_2\text{O}$ .

Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Mosander.)

**Ammonium zinc carbonate, basic**,  $3\text{ZnO} \cdot \text{NH}_4\text{OH} \cdot 2\text{CO}_2 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Kassner, Arch. Pharm. (3) 27. 673.)

**Ammonium zinc carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot \text{ZnCO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Deville.)

Quite sol. in  $\text{H}_2\text{O}$ ; more sol. than  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{MgCO}_3$ . Tolerably permanent in the air. Slowly decomp. by cold, rapidly by hot  $\text{H}_2\text{O}$ .

Very sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Not attacked by alcohol (Favre, A. ch. (3) 10. 481.)

**Barium carbonate**,  $\text{BaCO}_3$ .

Sol. in 4304 pts. cold, and 2304 pts. boiling  $\text{H}_2\text{O}$ . (Fourcroy.)

Sol. in 47,320 pts.  $\text{H}_2\text{O}$  (Bineau, A. ch. (3) 51. 290.)

Sol. in 14,137 pts.  $\text{H}_2\text{O}$  at  $16-20^\circ$ , and 15,421 pts. at  $100^\circ$  (Fresenius.)

Sol. in 12,027 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Kiemers, Pogg. 85. 247.)

Calculated from electrical conductivity of solution, 1 pt.  $\text{BaCO}_3$  is sol. in 64,070 pts.  $\text{H}_2\text{O}$  at  $8.8^\circ$  and 45,566 pts. at  $24.2^\circ$  (Holleman, Z. phys. Ch. 12. 125.)

#### Solubility in $\text{H}_2\text{O}$ at $t^\circ$

$t^\circ$	g. sol. in 100 g. $\text{H}_2\text{O}$
14	$4.32 \times 10^{-4}$
18	$4.57 \times 10^{-4}$
23	$4.89 \times 10^{-4}$
27	$5.22 \times 10^{-4}$
32	$5.69 \times 10^{-4}$
38	$6.27 \times 10^{-4}$

(Weissenberger, Z. phys. Ch. 1914, 88. 266.)

"Solubility product" =  $8.1 \times 10^{-8}$  mol. l. (McCoy and Smith, J. Am. Chem. Soc. 1911, 33. 473.)

Sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ . (See *barium hydrogen carbonate*.)

Easily sol. in dil. acids. Not acted upon by conc.  $\text{HNO}_3 + \text{Aq}$ .

Not decomp. by 1 pt.  $\text{H}_2\text{SO}_4 + 6$  pts. absolute alcohol. Slowly decomp. by 1 pt.

$\text{HNO}_3$  + 6 pts. absolute alcohol Slowly decomp by 1 pt.  $\text{H}_2\text{C}_2\text{O}_4$  + 6 pts absolute alcohol.

Not decomp by absolute alcoholic solutions of racemic, tartaric, citric, or glacial acetic acids (Babington and Phillips, 1816.)

Almost completely insol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3$ , when digested in such a solution and allowed to stand. 1 pt.  $\text{BaCO}_3$  dissolves in 141,000 pts of such a solution (Fresenius)

Not more sol. in  $\text{NaCl}$  + Aq than in  $\text{H}_2\text{O}$ . (Karsten)

Sol in cold  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4$  succinate + Aq. (Vogel, J. pr 7. 453.)

2 mols.  $\text{NH}_4\text{Cl}$  dissolved in  $\text{H}_2\text{O}$  dissolve 1 mol.  $\text{BaCO}_3$  by continued boiling (Smith, Phil. Mag. J. 9. 540)

Solubility in  $\text{H}_2\text{O}$  increases by addition of  $\text{NH}_4\text{Cl}$ , at first strongly, then less strongly and finally strongly again. (D'Augustino and Pellegrino, Gazz. ch. it. 1908, 38 (1) 532)

Somewhat sol. in  $\text{K}_2\text{CO}_3$  + Aq. (Waackroder, A. 24. 30.)

Solubility of  $\text{BaCO}_3$  in  $\text{KCl}$  + Aq at bpt. of solution

g KCl per 100 g solution	g. $\text{BaCO}_3$ per 1000 cc sat. solution
0 15	0 0847
1	0 1781
3	0 2667
10	0 4274
30	0 3550

(Cantoni and Goguelia, Bull. Soc. 1905, (3) 33. 13.)

Solubility of  $\text{BaCO}_3$  in  $\text{NaCl}$  + Aq at bpt of solution

g NaCl per 100 g solution	g. $\text{BaCO}_3$ per 1000 cc sat. solution
0 15	0.0587
1	0 0787
3	0 1056
10	0.1575
30	0.2784

(Cantoni and Goguelia, l c)

Solubility of  $\text{BaCO}_3$  in 10%  $\text{KCl}$  + Aq at  $t^\circ$ .

$t^\circ$	g $\text{BaCO}_3$ per 1000 cc sat solution
10	0.2175
20	0.2408
40	0 2972
60	0 3491
80	0.4049

(Cantoni and Goguelia, l c.)

Solubility of  $\text{BaCO}_3$  in 10%  $\text{NaCl}$  + Aq at  $t^\circ$

$t^\circ$	g $\text{BaCO}_3$ per 1000 cc sat solution
10	0 1085
20	0 1126
40	0 1231
60	0 1303
80	0 1418

(Cantoni and Goguelia, l c.)

Slowly sol in conc  $\text{Na}_2\text{SO}_4$ ,  $\text{MgSO}_4$ ,  $\text{ZnSO}_4$ ,  $\text{Ca(NO}_3)_2$ , or  $\text{CaCl}_2$  + Aq, but insol in  $\text{ZnCl}_2$  + Aq. (Karsten.)

Sl decomp by boiling  $\text{K}_2\text{SO}_4$  + Aq.

Sl decomp in the cold by 1 pt.  $\text{K}_2\text{SO}_4$  + 2 pts  $\text{Na}_2\text{SO}_4$  + Aq.

Decomp by salts of Al, Mn, Cr, Fe, U, Bi, Cd, Cu, Hg, Pb, Sn<sup>II</sup>, Sn<sup>IV</sup>, Hg<sub>2</sub>, Rh, Ir, Au, with pptn. of oxide of metal. (Rose, Tr.)

Pptn. of  $\text{BaCO}_3$  is hindered by presence of alkali citrates or metaphosphates.

Sol in solutions of various salts, as in the case of calcium carbonate (see Calcium carbonate). The solvent power of these solutions for barium carbonate is somewhat less than for calcium carbonate.

Insol in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3602)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II 1014.)

Min. *Witherite*

Barium hydrogen carbonate,  $\text{BaH}_2(\text{CO}_3)_2$  (?)

100 pts  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  dissolve 0.079 pt  $\text{BaCO}_3$ . (Bineau)

100 pts  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  dissolve 0.17 pt  $\text{BaCO}_3$ . (Lassaigne)

100 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  under a pressure of 4-6 atmospheres dissolve 0.725 pt.  $\text{BaCO}_3$ . Upon evaporating,  $\text{BaCO}_3$  is deposited. (Wagner, Z anal. 6. 167.)

$\text{BaCO}_3$  is sol. in 833 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  at  $10^\circ$ . (Lassaigne.)

$\text{BaCO}_3$  is sol. in 830 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  at  $10^\circ$ . (Fourerroy.)

$\text{BaCO}_3$  is sol in 1550 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  at  $10^\circ$ . (Bergman)

100 cc  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  dissolve 0.73 g.

$\text{BaH}_2(\text{CO}_3)_2$  (McCoy and Smith, J. Am. Chem. Soc. 1911, 33. 473.)

Barium calcium carbonate,  $\text{BaCO}_3$ ,  $\text{CaCO}_3$ .

Min. *Barytocalcite*, *Bronzite*. Sol. in dil. acids

Barium uranyl carbonate,  $\text{BaO}$ ,  $2\text{UO}_3$ ,  $2\text{CO}_2$  +  $5\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ . (Blinkoff Dissert 1900)

+  $8\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Blinkoff.)

**Bismuth carbonate, basic,  $(\text{BiO})_2\text{CO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ , sol. in acids. Insol. in  $\text{CO}_2 + \text{Aq.}$  (Bergman.)

Completely sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$ ; sl. sol. in  $\text{K}_2\text{CO}_3 + \text{Aq.}$ ; insol. in  $\text{Na}_2\text{CO}_3 + \text{Aq.}$  (Lau-gier)

Absolutely insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  unless  $\text{H}_3\text{PO}_4$  or  $\text{H}_2\text{AsO}_4$  are present. (Berzelius.)

Insol. in  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$ , or  $\text{Na}_2\text{CO}_3 + \text{Aq.}$  (Rose.)

Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Wackenroder) Insol. in  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Brett)

Sol. in  $\text{CaCl}_2 + \text{Aq.}$  (Pearson)

Min. *Bismuthosphacrite*.

$3\text{Bi}_2\text{O}_3$ ,  $\text{CO}_2$ . Min. *Bismuthite*. Easily sol. in acids

$4\text{Bi}_2\text{O}_3$ ,  $3\text{CO}_2 + 4\frac{1}{2}\text{H}_2\text{O}$ . Min *Bismuth spa*. Easily sol. in acids

**Bismuth potassium carbonate,  $\text{Bi}_3\text{OK}_4(\text{CO}_3)_4 + \text{H}_2\text{O}$ .**

Decomp. by large quantities of  $\text{H}_2\text{O}$ . (Reynolds, Chem. Soc. 1898, 73. 266.)

**Cadmium carbonate,  $\text{CdCO}_3$**

Insol. in  $\text{H}_2\text{O}$ , easily sol. in acids; insol. in  $\text{K}_2\text{CO}_3$ , and  $\text{Na}_2\text{CO}_3 + \text{Aq.}$ ; very sl. sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Fresenius)

Easily sol. in  $\text{NH}_4$  sulphate, nitrate, and succinate + Aq (Wittstein.)

Sol. in  $\text{KCN} + \text{Aq.}$ ; sol. in cold  $\text{NH}_4\text{Cl} + \text{Aq.}$ , less sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett, 1837.)

Not prevented from pptn by non-volatile organic substances. (Rose)

Not pptd. from solutions containing sodium citrate. (Spiller.)

Insol. in liquid  $\text{NH}_3$  (Gore, Am. Ch. J. 1898, 20. 827.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 814)

Insol. in acetone. (Naumann, B. 1904, 37. 4320.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . (Lefort, J. B. 1847. 346.)

(Kraut, Z. anorg. 1897, 13. 14.)

**Cadmium carbonate hydrazine,  $\text{CdCO}_3 \cdot 2\text{N}_2\text{H}_4$ .**

Easily sol. in cold  $\text{NH}_4\text{OH} + \text{Aq.}$  (Franzen, Z. anorg. 1908, 60. 281.)

**Cesium carbonate,  $\text{Cs}_2\text{CO}_3$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

100 pts. absolute alcohol dissolve 11.1 pts.  $\text{Cs}_2\text{CO}_3$  at  $19^\circ$ ; 20.1 pts.  $\text{Cs}_2\text{CO}_3$  at boiling temp. (Bunsen.)

**Cesium hydrogen carbonate,  $\text{CsHCO}_3$ .**

Not deliquescent. Sol. in  $\text{H}_2\text{O}$ .

**Calcium carbonate basic,  $\text{CaO} \cdot \text{CaCO}_3 + \text{H}_2\text{O}$ .**

Hardened by  $\text{H}_2\text{O}$ , but not dissolved. (Raoult, C. R. 92. 189.)

**Calcium carbonate,  $\text{CaCO}_3$**

More sol. in cold than in hot  $\text{H}_2\text{O}$  (Gmelin)  
When recently pptd., sol. in 8334 pts. boiling, and 10,501 pts. cold  $\text{H}_2\text{O}$ , much less sol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3$ , 85,246 pts. of which dissolve 1 pt.  $\text{CaCO}_3$ . (Fresenius (1846), A. 59. 122)

Sol. in 16,000 pts. pure  $\text{H}_2\text{O}$  (Brandes, 1825)

Sol. in 12,838 pts. pure  $\text{H}_2\text{O}$  at  $15^\circ$ . (Kremers, Pogg. 86. 247)

Sol. in 16,000–24,000 pts. pure  $\text{H}_2\text{O}$  (Bucholz)

1 l.  $\text{H}_2\text{O}$  dissolves 34 mg.  $\text{CaCO}_3$  (Chevalier, Z. anal. 8. 91; Hoffmann, Z. anal. 4. 414.)

1 l.  $\text{H}_2\text{O}$  may contain 0.016 g.  $\text{CaCO}_3$ . t. e., 1 pt. is sol. in 62,500 pts.  $\text{H}_2\text{O}$ . (Bureau, A. ch. (3) 51. 290)

1 l.  $\text{H}_2\text{O}$  dissolves 0.02 g.  $\text{CaCO}_3$ , t. e., 1 pt.  $\text{CaCO}_3$  is sol. in 50,000 pts.  $\text{H}_2\text{O}$ . (Peligot.) Solubility is much affected by  $\text{CO}_2$  of the air.

1 l.  $\text{H}_2\text{O}$  at  $16^\circ$  dissolves 13.1 mg.  $\text{CaCO}_3$ . (Sohlberg, C. R. 74. 1552.)

Calculated from electrical conductivity of  $\text{CaCO}_3 + \text{Aq.}$  1 pt.  $\text{CaCO}_3$  is sol. in 99,500 pts.  $\text{H}_2\text{O}$  at  $8.7^\circ$ , and 80,040 pts. at  $23.8^\circ$ . (Holle-mann, Z. phys. Ch. 12. 125)

By continued boiling  $\text{CaH}_2(\text{CO}_3)_2$ , 38 mg.  $\text{CaCO}_3$  remain in solution. (Weltzien, A. 136. 165)

**Solubility in  $\text{H}_2\text{O}$  at different pressures.**

Pressure in atmós.	Solubility
1	1079
2	1403
4	1820
6	2109

(Fingel, C. R. 101. 949.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.0005 pt. (calculated as  $\text{CaO}$ ) from pptd.  $\text{CaCO}_3$ , and 0.0027 pt. from calcspar. (Lubavim, J. russ. Soc. 24. 389)

1 l.  $\text{H}_2\text{O}$  dissolves 13 mg.  $\text{CaCO}_3$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1893, 12. 241)

1 l.  $\text{CO}_2$  free water dissolves 17.4 mg.  $\text{CaO}$  or 31.0 mg.  $\text{CaCO}_3$  (Gothe, Ch. Z. 1915, 39. 305.)

$\text{CaCO}_3$  dissolves in 9662 pts.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Pollacci, C. C. 1896, II. 946)

1 l.  $\text{H}_2\text{O}$  free from  $\text{CO}_2$  dissolves 9.6 mg.  $\text{CaCO}_3$  (McCoy and Smith, J. Am. Chem. Soc. 1911, 33. 473)

Found dissolved in 10,000 pts. sea water. (Davy)

Pptd. amorphous  $\text{CaCO}_3$  dissolves in 1600 pts. sea water Pptd. crystalline  $\text{CaCO}_3$  dissolves in 8000 pts. sea water. (Irvine and Young, Chem. Soc. 66. 344.)

Artificial sea water sat. with  $\text{CO}_2$  dissolves  $\text{CaCO}_3$  corresponding to 57.27 mg. of combined  $\text{CO}_2$  per litre at  $15^\circ$ .

Sea water which contains 52–55 mg. neutral combined  $\text{CO}_2$  per litre must be sat. with  $\text{CaCO}_3$ . (Cohen, Chem. Soc. 1900, 78 (2) 725)

For action of  $\text{H}_2\text{CO}_3 + \text{Aq.}$  see *Calcium hydrogen carbonate*

Sol. in  $\text{H}_2\text{SO}_4$ , even when native Sol in acids generally. When treated with acids in closed vessels effervescence ceases on increase of pressure, but is renewed at once on removing it. (Lank, 1814.)

Unacted upon by conc.  $\text{HNO}_3$ , even when boiling, as  $\text{Ca}(\text{NC}_2)_2$ ; is insol in conc.  $\text{HNO}_3$ .

Not decomp. by mixture of 1 pt.  $\text{H}_2\text{SO}_4$  and 6 pts. absolute alcohol, but immediately by  $\text{HNO}_3$ +absolute alcohol.

Not decomp. by absolute alcoholic solutions of oxalic, racemic, tartaric, citric, or glacial acetic acids (Babington and Phillips, 1816.)

Unacted upon by glacial  $\text{HC}_2\text{H}_3\text{O}_2$ , even when boiling.

Freshly pptd.  $\text{CaCO}_3$  is sol. in cold  $\text{NH}_4\text{Cl}$ +Aq; but the solution becomes cloudy on exposure to air, a portion, however, of  $\text{CaCO}_3$  remains dissolved, which cannot be pptd. even by boiling. If ppt. is washed and allowed to stand 24 hours, it is not as sol. in  $\text{NH}_4\text{Cl}$  as at first, but natural  $\text{CaCO}_3$  is not wholly insol in  $\text{NH}_4\text{Cl}$ +Aq; it is, however, much less sol than  $\text{MgCO}_3$  (Vogel, J. pr. 7. 453.)

Sol. in boiling  $\text{NH}_4\text{Cl}$ +Aq with evolution of  $\text{NH}_3$  (Demareay, 1834.)

When  $\text{NH}_4\text{OH}$ +Aq, incompletely sat. with  $\text{CO}_2$ , is mixed with  $\text{CaCl}_2$ +Aq, no ppt. occurs even during several days, if kept in a closed vessel, and only a slight ppt. if the mixture is exposed to the air, but  $\text{CaCO}_3$  is pptd. if the solution is boiled.

$\text{NH}_4\text{OH}$ +Aq wholly sat. with  $\text{CO}_2$  produces ppt. when mixed with  $\text{CaCl}_2$ +Aq, but pptn. is not complete until heat is applied. Also when an excess of  $\text{CaCl}_2$ +Aq is added to a solution of crystallized carbonate of ammonia, only a portion of the  $\text{CaCO}_3$  is pptd. until the solution is boiled. (Vogel, 1814.)

When  $\text{CaCl}_2$ +Aq mixed with  $\text{NH}_4\text{OH}$ +Aq is exposed to an atmos. of pure  $\text{CO}_2$ , no ppt. occurs for several hours, but  $\text{CaCO}_3$  is completely pptd. in several days. (Vogel.)

When recently pptd., readily sol. in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3$ +Aq. (Biett, 1837; Wackenroder, A. 41. 315.)

When recently pptd., readily sol. in  $(\text{NH}_4)_2\text{CO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4$  succinate+Aq. (Wittstein.)

Sol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ +Aq. (Thomson.)

More sol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3$ +Aq, or in neutral potassium, or sodium salts+Aq than in  $\text{H}_2\text{O}$ . (Fresenius.)

From solutions in  $\text{NH}_4$  salts,  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3$ +Aq precipitate  $\text{CaCO}_3$  more completely than  $\text{BaCO}_3$ . (Fresenius.)

When boiled with  $\text{NH}_4\text{Cl}$ +Aq,  $\text{CaCO}_3$  is dissolved, and  $(\text{NH}_4)_2\text{CO}_3$  given off. (D. Smith.)

$\text{CaCl}_2$ +Aq prevents pptn. of  $\text{CaCO}_3$  in the cold, as do also  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$ , or  $\text{NaCl}$ +Aq, but it is pptd. when boiled, if the latter solutions are not too conc.  $\text{K}_2\text{SO}_4$ ,  $\text{KNO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_4$ +Aq have a similar effect. A large excess of  $(\text{NH}_4)_2\text{CO}_3$ +Aq when quickly added to  $\text{CaCl}_2$ +Aq produces

no ppt. in the cold.  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3$ +Aq act likewise. (Storer, Am J Sci. (2) 25. 41.)

1 g.  $\text{CaCO}_3$  requires 13.98 g.  $\text{NH}_4\text{Cl}$ , 8.380 g.  $(\text{NH}_4)_2\text{SO}_4$ , or 14.438 g.  $\text{NH}_4\text{NO}_3$ , to effect solution. (Bertrand, Monit Sci (3) 10. 477.)

Less sol. in Na than in  $\text{NH}_4$  salts, but more than in K salts. (Berthelot.)

When  $\text{NH}_4\text{OH}$ +Aq, partially neutralized by  $\text{CO}_2$ , is mixed with  $\text{CaO}_2\text{H}_2$ +Aq, no cloudiness appears until the mixture is boiled; when more  $\text{CO}_2$  has been added to  $\text{NH}_4\text{OH}$ +Aq, a ppt. appears at first, which disappears and only reappears on addition of much  $\text{CaO}_2\text{H}_2$ +Aq; but  $\text{NH}_4\text{OH}$ +Aq does not dissolve pptd.  $\text{CaCO}_3$ . (Vogel.)

#### Solubility in $\text{NH}_4$ salts+Aq at 25°.

$\text{NH}_4$ salt	Millimols $\text{NH}_4$ salt per l	Millimols $\text{CaO}$ dissolved per l
$\text{NH}_4\text{Cl}$	1000	6.770
	500	5.008
	250	3.724
	125	2.743
$\text{NH}_4\text{NO}_3$	500	5.267
	250	3.830
	125	2.779
	62.5	2.004
Triammonium citrate	500	66.87
	250	39.80
	125	22.64
	62.5	14.92

(Rundell, Z. phys. Ch. 1909, 70. 454.)

#### Solubility of $\text{CaCO}_3$ in $\text{NH}_4\text{Cl}$ +Aq at 12-18° Time, 98 days

g per l of sat. solution	
$\text{NH}_4\text{Cl}$	$\text{CaCO}_3$
53.5	0.423
100	0.609
200	0.645

(Cantoni and Gogueha, Bull. Soc. 1905, (3) 33. 27.)

#### Solubility of $\text{CaCO}_3$ in $\text{NH}_4\text{NO}_3$ +Aq at 18°.

g per l of sat. solution	
$\text{NH}_4\text{NO}_3$	$\text{CaCO}_3$
0	0.131
5	0.211
10	0.258
20	0.340
40	0.462
80	0.584

(Berju and Kosmaniko, Landw. Vers. Sta. 1904, 60. 422.)

$\text{CaO}_2\text{H}_2 + \text{Aq}$  dissolves a little  $\text{CaCO}_3$ .  
(Welter and Berthollet, 1789)

$\text{CaO}_2\text{H}_2 + \text{Aq}$  retains a little  $\text{CaCO}_3$  in solution at ordinary temperature, which is pptd. on boiling. (Eliot and Storer, Proc. Am. Acad 1880, 5, 63.)

$\text{CaO}_2\text{H}_2 + \text{Aq}$ , mixed with dil.  $\text{NaOH}$ ,  $\text{KOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ , gives no immediate ppt. when  $\text{CO}_2$  is passed through it, unless boiled.

Sol. in boiling  $\text{MgCl}_2 + \text{Aq}$  even when dilute. (Cousté.)

Not decomp. when boiled with  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{CaSO}_4$ ,  $\text{MgSO}_4$ , and  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$ , but partially decomp. by boiling with  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{HPO}_4$ ,  $\text{K}_2\text{HPO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{HPO}_4$ ,  $\text{K}_2\text{HAsO}_4$ ,  $\text{Na}_2\text{HAsO}_4$ ,  $\text{K}_2\text{C}_2\text{O}_4$ ,  $(\text{NH}_4)_2\text{C}_2\text{O}_4$ ,  $\text{NaF}$ , and  $\text{K}_2\text{CrO}_4 + \text{Aq}$ . With the  $\text{NH}_4$  salts the decomposition is complete (Dulong, A. ch. 82, 286.)

Not decomp by alkali sulphates +  $\text{Aq}$  (Malaguti)

Precipitation of  $\text{CaCO}_3$  is much hindered by alkali citrates or metaphosphates

#### Solubility in $\text{KCl} + \text{Aq}$ at $25^\circ$

Sp gr $25^\circ/25^\circ$	% $\text{KCl}$	% $\text{CaCO}_3$
1.000	0.00	0.0013
1.024	3.90	0.0078
1.046	7.23	0.0078
1.072	11.10	0.0078
1.092	13.82	0.0072
1.101	15.49	0.0076
1.122	18.21	0.0070
1.133	19.84	0.0072
1.179	26.00	0.0060

(Cameron and Robinson, J phys Chem. 1907, 11, 578.)

Solubility in  $\text{NaCl} + \text{Aq}$  in contact with  $\text{CO}_2$  free air at  $25^\circ$ .

Sp gr $25^\circ/25^\circ$	g. per 100 g $\text{H}_2\text{O}$	
	$\text{NaCl}$	$\text{CaCO}_3$
1.0079	1.60	0.0079
1.0314	5.18	0.0086
1.0466	9.25	0.0094
1.0734	11.48	0.0104
1.0949	16.66	0.0106
1.1346	22.04	0.0115
1.1794	30.50	0.0119

(Cameron, Bell and Robinson, J phys. Ch. 1907, 11, 396.)

#### Solubility of $\text{CaCO}_3$ in $\text{NaOH} + \text{Aq}$ .

Solvent	1 litre dissolves	
	at $18^\circ$	at $95^\circ-100^\circ$
$\text{H}_2\text{O}$	12.8 mg $\text{CaCO}_3$	20.7 mg $\text{CaCO}_3$
ca. 0.0001 n. $\text{NaOH}$	8.7 " "	9.0 " "
ca. 0.001 n. $\text{NaOH}$	4.2 " "	6.0 " "
ca. 0.01 n. $\text{NaOH}$	4.3 " "	5.7 " "

(Le Blanc, Z. anorg. 1906, 51, 185.)

#### Solubility in $\text{K}_2\text{SO}_4 + \text{Aq}$ at $25^\circ$ .

Sp gr $25^\circ/25^\circ$	% $\text{K}_2\text{SO}_4$	% $\text{CaCO}_3$
1.010	1.60	0.0104
1.021	3.15	0.0116
1.033	4.73	0.0132
1.048	6.06	0.0148
1.061	7.85	0.0168
1.069	8.88	0.0192
1.083	10.18	0.0192
1.084	10.48	0.0188

(Cameron and Robinson, J phys. Chem. 1907, 11, 578.)

The solubility of  $\text{CaCO}_3$  in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  in equilibrium with air steadily increases with increasing amounts of  $\text{CaSO}_4$  in the solution up to saturation point of the  $\text{CaSO}_4$ . In the presence of solid  $\text{CaSO}_4$  the solubility of  $\text{CaCO}_3$  is much decreased (Cameron and Scudell, J phys Chem 1902, 6, 56.)

See under  $\text{CaH}_2(\text{CO}_3)$

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  in contact with  $\text{CO}_2$  free air at  $25^\circ$ .

g per 100 g $\text{H}_2\text{O}$	
$\text{Na}_2\text{SO}_4$	$\text{CaCO}_3$
0.97	0.0151
1.65	0.0180
4.90	0.0262
12.69	0.0313
14.55	0.0322
19.38	0.0346
23.90	0.0360

(Cameron, Bell and Robinson, J phys Ch. 1907, 11, 396.)

#### Solubility in salts + $\text{Aq}$ .

g salt added per litre	mg $\text{CaO}$ dissolved per litre
0.000	17.4
0.585 g. $\text{NaCl}$	20.05
1.17 g. "	24.9
2.93 g. "	31.1
0.85 g. $\text{NaNO}_3$	24.35
1.70 " "	27.7
4.25 " "	34.5
0.805 g. $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$	26.95
1.61 g. "	31.15
4.03 g. "	40.7
0.53 g. $\text{Na}_2\text{CO}_3$	8.4
1.06 g. "	7.2
2.65 g. "	4.4
0.55 g. $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$	9.0
1.10 g. "	8.4
2.75 g. "	8.4

The solubility of  $\text{CaCO}_3$  in  $\text{CO}_2$ -free water

is therefore increased by the addition of NaCl, NaNO<sub>3</sub> or Na<sub>2</sub>SO<sub>4</sub>, 10H<sub>2</sub>O, but decreased by the addition of Na<sub>2</sub>CO<sub>3</sub> or CaCl<sub>2</sub>, 6H<sub>2</sub>O.

(Gothe, Ch. Z. 1915, 39. 306.)

Sol. in ferric chloride or nitrate + Aq with evolution of CO<sub>2</sub> and pptn. of Fe<sub>2</sub>O<sub>3</sub>.H<sub>2</sub>O (Fuchs, 1831); also in chlorides or nitrates of Al, Mn, Cr, or U, but not in FeCl<sub>3</sub> + Aq.

Sol. in cold SnCl<sub>4</sub> + Aq with pptn. of SnO<sub>2</sub>. Insol. in conc. Na<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, BaCl<sub>2</sub>, MgCl<sub>2</sub>, Pb(NO<sub>3</sub>)<sub>2</sub>, or AgNO<sub>3</sub> + Aq (Karsten.)

Abundantly sol when freshly precipitated in CaCl<sub>2</sub> + Aq, and MgSO<sub>4</sub> + Aq (Hunt.)

Absolutely insol. at 15-19° in BaO.H<sub>2</sub> + Aq; also on boiling

1 l. H<sub>2</sub>O containing 3-4 g. MgSO<sub>4</sub> dissolves 1-2 g. CaCO<sub>3</sub>, and also 1 g. MgCO<sub>3</sub>. (Hunt, Am. J. Sci. (2) 26. 109.)

100 pts. NaCl + Aq (2.525% NaCl) dissolve 0.0037 pt. (calculated as CaO) pptd CaCO<sub>3</sub>, and 0.0053 pt. calc spar. (Lubavin, J. russ. Soc. 24. 389.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in liquid CO<sub>2</sub>. (Buchner, Z. phys. Ch. 1906, 54. 674.)

Alcohol dissolves traces of CaCO<sub>3</sub>. (Grischow.)

Sol. in Na citrate + Aq. (Spiller.)

Sol. in Ca succrate + Aq. (Barreswill.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Amorphous. Solubility in H<sub>2</sub>O cannot be determined because of its instability. (Kendall, Phil. Mag. 1912, (6) 23. 972.)

Min. Calcite. In contact with air free from CO<sub>2</sub>, 1 l. H<sub>2</sub>O dissolves at:

25°	50°	100°
0.01433	0.01504	0.01779 g. calcite.

(Kendall, Phil. Mag. 1912, (6) 23. 964.)

In contact with air containing 3.7 pts. CO<sub>2</sub> per 10,000, the solubility of calcite in H<sub>2</sub>O was found to be 0.04608 g. per l. at 25° and 0.02925 g. per l. at 50°. (Kendall, Phil. Mag. 1912, (6) 23. 973.)

Min. Aragonite. In contact with air free from CO<sub>2</sub>, 1 l. H<sub>2</sub>O dissolves at:

25°	50°	100°
0.01528	0.01617	0.01902 g. aragonite.

(Kendall, Phil. Mag. 1912, (6) 23. 964.)

+5H<sub>2</sub>O. Efflorescent.  
+6H<sub>2</sub>O. (Pelouze.)

Calcium hydrogen carbonate, CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>.

Known only in aqueous solution.

CaCO<sub>3</sub> dissolves in CO<sub>2</sub> + Aq

CaCO<sub>3</sub> is sol. in 1428 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> at 0°, and 1136 pts. at 10° (Lassaigne, J. ch. med. 4. 312.)

Bineau could dissolve, even in large quantities of H<sub>2</sub>O sat. with CO<sub>2</sub>, only 4% enough CaCO<sub>3</sub> to form CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>.

Chate dissolves in 994.5 pts. H<sub>2</sub>O sat. with CO<sub>2</sub>, while Iceland spar requires 3140 pts. (Bischhof.)

CaCO<sub>3</sub> is sol. in 1015 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> at 21° and 748.3 mm. (Warrington, Chem. Soc. 6. 296.)

Solubility of CaCO<sub>3</sub> in CO<sub>2</sub> + Aq at p pressure in atmospheres CaO + CO<sub>2</sub> = mg. CO<sub>2</sub> and CaO dissolved, corresponding to CaCO<sub>3</sub> = mg. CaCO<sub>3</sub>.

p	CaO + CO <sub>2</sub>	CaCO <sub>3</sub>
0.000504	60.96	74.6
0.000808	72.11	85.0
0.00333	123	137.2
0.03187	218.4	223.1
0.0282	310.4	296.5
0.05008	408.5	360
0.1422		533
0.2538	1072	663.4
0.4167	1500	787.5
0.5533	1846	885.5
0.7297	2270	972
0.9841	2884	1086

(Schlosing, C. R. 74. 1522.)

With high pressure, 1 l. H<sub>2</sub>O containing CO<sub>2</sub> dissolves at most 3 g. CaCO<sub>3</sub>. This maximum is reached at 5° under 4 atmospheres' pressure; at 10-13° under 5 atmospheres; and at 20° under 7 atmospheres. (Caro, Arch. Pharm. (3) 4. 145.)

CaCO<sub>3</sub> is sol. in about 1000 pts. H<sub>2</sub>CCl<sub>3</sub> + Aq, and solubility is considerably increased by Na<sub>2</sub>SO<sub>4</sub> or MgSO<sub>4</sub>.

1000 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> dissolve pts. Carrara marble at t°, and B = height of barometer in millimetres.

t°	B	Pts. CaCO <sub>3</sub>	t°	B	Pts. CaCO <sub>3</sub>
7.5	754	1.224	22.0	746	0.920
8.5	752	1.202	26.0	740	0.875
9.5	754	1.115	26.5	743	0.860
20.5	741	0.975	27.0	741	0.885
21.5	744	0.935	28.0	737	0.770

Or, from 7.5-9.5°, 1000 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> dissolve 1.181 pts. CaCO<sub>3</sub>; from 20.5-22° 0.9487 pt. CaCO<sub>3</sub>; from 26-28°, 0.855 pt. CaCO<sub>3</sub>.

Other varieties of  $\text{CaCO}_3$  are dissolved as follows in 1000 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$ .

Variety	t°	B	Pts $\text{CaCO}_3$
Litneburg chalk . . .	18	740	0 835
Pptd. $\text{CaCO}_3$ . . .	18	740	0 950
Iceland spar . . .	18	735	1 970
Calcite . . .	12	754	1 223
Traversella . . .	12	754	212
Dolomite, semi-transparent . . .	11 5	749	0.654
Dolomite, opaque, in small crystals . . .	11.5	755	0 725
Dolomite, opaque, in large crystals . . .	11	746	224
Dolomite, transparent, in large crystals . . .	11	749	1 073
Oolitic limestone . . .	15	747	252
Dolomitic limestone . . .	15.5	740	573

(Cossa, Z. anal. 8. 145.)

Solubility of  $\text{CaCO}_3$  in  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  at various pressures.

$\text{CO}_2$ pressure in atm.	1	2	4	6
Solubility	1079	1403	1820	2109

(Engel, C. R. 1885, 101. 951.)

1 l  $\text{H}_2\text{O}$  dissolves 0.3850 g.  $\text{CaH}_2(\text{CO}_3)_2$  at 15°. (Treadwell, Z. anorg. 1898, 17. 186.)

1 l. of sat.  $\text{CaH}_2(\text{CO}_3)_2 + \text{Ag}$ , obtained from pure or impure limestone, contains 1.13-1.17 g.  $\text{CaCO}_3$  at 15°. (Treadwell, Z. anorg. 1898, 17. 189.)

Solubility of  $\text{CaH}_2(\text{CO}_3)_2$  in  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  at 15°.

% carbonic acid gas at 0° and 760 mm	Hg. partial pressure mm.	Free carbonic acid mg	mg $\text{CaH}_2(\text{CO}_3)_2$ in 100 cc of the solution	mg. Ca
8.94	67 9	157 4	187 2	46.2
6.04	45.9	86 3	175.5	43 3
5.45	41.4	52.8	159.7	39 4
2.18	16.6	48 5	154 0	38 0
1 89	14.4	34 7	149.2	36 8
1.72	13.1	24 3	133.1	32.9
0 79	6.0	14 5	124 9	30 8
0.41	3.1	4 7	82.1	20.3
0.25	1 9	2 9	59.5	14 7
0.08	0 6	...	40.2	9 9
....	....	....	38.5	9 5
....	....	....	38.5	9 5
....	....	....	38.5	9 5

(Treadwell and Reuter, Z. anorg. 1898, 17. 185.)

1 l.  $\text{H}_2\text{O}$  sat. with carbonic acid dissolves 1.30 g.  $\text{CaCO}_3$  at 13.2°; 1.45 g. at 2.8° (Treadwell, Z. anorg. 1898, 17. 189.)

At 30° C. in equilibrium with the air, not more than 3 per cent of the calcium present is combined as  $\text{CaCO}_3$ . At lower temperatures and lesser concentrations the percentage of normal carbonate is even less, and practically all the calcium present is combined as  $\text{Ca}(\text{HCO}_3)_2$ . (Cameron and Briggs, J. phys. Chem. 1901, 5. 549.)

With pressures less than 4.5 atmospheres of  $\text{CO}_2$ , no other than normal calcium carbonate or a hydrate of the normal carbonate can exist as the solid phase at 0° (Cameron, J. phys. Chem. 1908, 12. 566.)

Solubility in  $\text{H}_2\text{O}$  in contact with air, containing  $\text{CO}_2$  with varying partial pressures at t°.

P = partial pressure of  $\text{CO}_2$ .

t = 15°		
P	g per l.	
	$\text{CaCO}_3$	$\text{CO}_2$
0 8	0 193	0 117
1 5	0 193	0 152
1 7	0 238	0 135
6.8	0 445	0.327
9 9	0 827	0.456
13 6	0 723	0 560
14 6	0 686	0.623
31 6	1 050	1 117

t = 25°		
P	g per l.	
	$\text{CaCO}_3$	$\text{CO}_2$
0.7	0 150	0 091
1 6	0 177	0 111
4.6	0 341	0 208
7 8	0 446	0.301
16 5	0 639	0.522
30.1	0 743	0 715
35 5	0.755	0 803

t = 40°		
P	g per l.	
	$\text{CaCO}_3$	$\text{CO}_2$
0 6	0 136	0 078
1 7	0 143	0.085
2 9	0 175	0 106
3 5	0.232	0 169
7	0 284	0 234
14 9	0 384	0 293
22.2	0 427	0 333
31 7	0.480	0 476

Similar results at 20°, 30°, and 35° are also given.

(Leather and Sen, Mem. Dept. Agric. (India) Chem. Ser. 1906, 1. 117; Seidell, Solubilities, 1919.)

Solubility of calcite in  $H_2O$  at  $25^\circ$ , in contact with  $CO_2$  under varying pressures.

P = approximate pressure of  $CO_2$  in atmospheres

P	g per l sat solution		Solid phase
	$H_2CO_3$	$Ca(HCO_3)_2$	
0.1	0.22	0.67	$CaCO_3$
1.1	2.3	1.58	"
9.9	20.6	3.02	"
13.2	27.5	4.04	"
16.3	34.1	4.21	$Ca(HCO_3)_2$
25.4	53.2	4.22	"

(McCoy and Smith, J. Am. Chem. Soc. 1911, 33, 468.)

1 l.  $H_2O$  dissolves 2.3374 g.  $CaCO_3$  at  $5^\circ$  under a  $CO_2$  pressure of 2 atmos. (Ehlert, Z. Elektrochem. 1912, 18, 727.)

Solubility data for calcite in  $H_2O$  containing  $CO_2$ , with and without the presence of salts are given by Seyler and Lloyd (Chem. Soc. 1909, 95, 346.)

A critical analysis and recalculation of results of Schloesing and others is given by Johnston (J. Am. Chem. Soc. 1915, 37, 2001).

$CaCO_3$  is not dissolved by  $CO_2$  and  $H_2O$  in presence of  $MgCO_3$ . (Leather and Sen, C. A. 1915, 181.)

1 l. of 1/10-normal  $NaCl+Ag$  dissolves 0.3320 g.  $CaH_2(CO_3)_2$  at  $15^\circ$ . (Treadwell and Reuter, Z. anorg 1898, 17, 193.)

Solubility of  $CaH_2(CO_3)_2$  in  $NaCl+Ag$  sat. with carbonic acid at  $15^\circ$ , containing 5 g.  $NaCl$  per l. of  $NaCl+Ag$ .

% carbonic acid in sat. at $0^\circ$ and 760 mm.	mm. Hg = partial pressure	mg. free $CO_2$	mg. $CaH_2(CO_3)_2$ in 100 cc of the solution	mg. Ca
16.95	128.8	132.5	218.4	53.9
11.47	87.2	110.1	214.3	52.9
6.07	46.1	23.5	149.2	36.8
3.16	24.0	13.5	118.3	29.2
0.50	3.8	2.7	73.9	18.2
0.41	3.4	0.3	49.0	12.1
..	..	..	34.9	8.6
..	..	..	33.7	8.3
..	..	..	32.9	8.1
..	..	..	33.2	8.2

(Treadwell and Reuter, Z. anorg 1898, 17, 193.)

Solubility in  $NaCl+Ag$  at  $25^\circ$  C. and in equilibrium with air.

$Ca(HCO_3)_2$		$NaCl$	
Grams per liter	Reacting wts per liter	Grams per liter	Reacting wts per litre
0.1046	0.00065	0.000	0.000
0.1770	0.00110	9.720	0.168
0.2051	0.00128	21.010	0.362
0.2152	0.00134	30.301	0.522
0.2252	0.00140	50.620	0.872
0.2212	0.00138	69.370	1.195
0.2172	0.00135	98.400	1.695
0.1971	0.00123	147.400	2.540
0.1569	0.00095	234.500	4.040
0.1227	0.00076	262.300	4.520

(Cameron and Seidell, J. phys. Chem. 1902, 6, 51.)

Solubility in various salts +  $Ag$  under a  $CO_2$  pressure of 2 atmos. at  $5^\circ$

Salt	g salt per 1000 g $H_2O$	g $CaCO_3$ sol in 1 l of solvent
$H_2O$		2.3374
$MgCl_2+6H_2O$	6.08	2.3518
	50.0	3.4045
	86.0	4.0826
	350.0	3.3009
	700.0	2.7357
	1150.0	2.2054
	1725.0	1.7058
	2300 (sat.)	1.4060
$NaCl$	27.96	3.2796
	50.0	3.7399
	80.0	3.7828
	106.9	3.6900
	175.6	3.3495
	263.4	2.8107
	351.2	2.1625 at $8^\circ$
$MgSO_4+7H_2O$	105.3 ( $14^\circ$ )	2.1788
	sat. at $14^\circ$	0.91356
$Na_2SO_4+10H_2O$	137.7 ( $14^\circ$ )	1.4060
	sat. at $14^\circ$	1.9199

(Ehlert and Hempel, Z. Elektrochem. 1912, 18, 727.)

Solubility of  $CaCO_3$  in  $KCl+Ag$  at  $25^\circ$  sat. with  $CO_2$  at atmospheric pressure.

% $KCl$	% $CaCO_3$
3.90	0.145
7.23	0.150
11.10	0.166
13.82	0.165
15.49	0.167
18.21	0.154
19.84	0.140
26.00	0.126

(Cameron and Robinson, J. phys. Chem. 1907, 11, 579.)

Solubility in NaCl+Aq in contact with CO<sub>2</sub> at atmospheric pressure at 25°.

g per 100 g H <sub>2</sub> O	
NaCl	CaCO <sub>3</sub>
1 45	0 150
5 60	0 160
11 08	0 174
15 83	0 172
19 62	0 159
29 89	0 123
35 85	0 103

(Cameron, Bell and Robinson, J. phys. Ch. 1907, 11. 396)

Solubility in K<sub>2</sub>SO<sub>4</sub>+Aq, sat with CO<sub>2</sub> at atmospheric pressure and 25° temp.

% SO <sub>3</sub>	% CaO
0 69	0 69
1 37	0 69
1 67	0 47 *
2 18	0 30 *
2 99	0 24 *

\* Solid phase, CaSO<sub>4</sub>.K<sub>2</sub>SO<sub>4</sub>.  
(Cameron and Robinson.)

Solubility in Na<sub>2</sub>SO<sub>4</sub>+Aq at 24° in equilibrium with air.

Total Ca calc. as Ca(HCO <sub>3</sub> ) <sub>2</sub> Grams per liter	Ca actually dissolved as Ca(HCO <sub>3</sub> ) <sub>2</sub> Grams per liter	Na <sub>2</sub> SO <sub>4</sub> Grams per liter
0.0925	0 0925	0 000
0.1488	0 1488	2 800
0.1729	0 1729 +	5 235
0.2230	0 2210	11 730
0.3240	0 3020	36 860
0.3960	0.3440	74 010
0.4580	0.3660	116 100
0.5630	0.3940	184 200
0.5910	0.4060	213.700
0.6650	0.4300	255 900

(Cameron and Seidell, J. phys. Chem. 1902, 6. 53.)

Data are also given for solubility of CaCO<sub>3</sub> in NaCl+Na<sub>2</sub>SO<sub>4</sub>+Aq, and CaCO<sub>3</sub>+CaSO<sub>4</sub> in NaCl+Na<sub>2</sub>SO<sub>4</sub>+Aq (Cameron, Bell and Robinson.)

Calcium copper uranium carbonate, CaCO<sub>3</sub>, 3CuCO<sub>3</sub>, 4U(CO<sub>3</sub>)<sub>2</sub>+24H<sub>2</sub>O.  
Sol. in acids.

Calcium lead carbonate, xCaCO<sub>3</sub>, yPbCO<sub>3</sub>.  
Min. *Plumbocalcite*.

Calcium magnesium carbonate, CaCO<sub>3</sub>, MgCO<sub>3</sub>.

Min *Dolomite* 1 l H<sub>2</sub>O sat. with CO<sub>2</sub> at 18° and 750 min. dissolves 0.31 g. dolomite. (Cossa, B 2. 697.)

Not obtained by evaporating solution, but can be crystallized from CO<sub>2</sub>+Aq between 100° and 200°. (Hoppe-Seyler.)

Dolomite is dissolved by CO<sub>2</sub> and H<sub>2</sub>O, but solution is prevented partially by CaCO<sub>3</sub>, and wholly by MgCO<sub>3</sub>. (Leather and Sen, C. A. 1915. 181.)

Insol in cold dil acids. (Dolomieu, J. Phys 39. 1)

Insol in cold acetic acid. (Forchhammer.)

Calcium potassium carbonate, CaK<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>.

Decomp. by H<sub>2</sub>O. (Reynolds, Chem Soc. 1895, 73. 265; Butschli, C. A. 1907, 2223) 2CaCO<sub>3</sub>, 3K<sub>2</sub>CO<sub>3</sub>+6H<sub>2</sub>O. (Butschli.)

Calcium sodium carbonate, CaNa<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>.

*Anhydrous*. Decomp by H<sub>2</sub>O.  
+2H<sub>2</sub>O (Butschli, C. A. 1907. 2223.)  
+5H<sub>2</sub>O Min *Gaylussite*. Sparingly sol. in H<sub>2</sub>O

Calcium uranyl carbonate, CaCO<sub>3</sub>, UO<sub>2</sub>CO<sub>3</sub>+20H<sub>2</sub>O

Min *Liebigite* Sol in HCl+Aq.  
+1H<sub>2</sub>O. Decomp. by H<sub>2</sub>O (Blinkoff, Dissert. 1900.)

2CaO, 4UO<sub>3</sub>, 3CO<sub>2</sub>+24H<sub>2</sub>O Decomp. by H<sub>2</sub>O (Blinkoff, Dissert. 1900.)

Calcium carbonate chloride, CaCO<sub>3</sub>, CaCl<sub>2</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O with immediate decomp. (Fritzsche, J. pr. 83. 213.)

Cerous carbonate, Ce<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>+5, and 9H<sub>2</sub>O.

Insol. in H<sub>2</sub>O, and solution of CO<sub>2</sub> in H<sub>2</sub>O. (Vauquehn.)

Somewhat sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq (Jolin)  
Insol. in neutral salt solutions and neutral alkali carbonates+Aq; easily sol. in SO<sub>2</sub>+Aq. (Berthier, A. ch. (3) 7. 77)

Ceric carbonate, Ce(CO<sub>3</sub>)<sub>2</sub>+½H<sub>2</sub>O.

Precipitate (Hisinger, A. ch 94. 108)  
Insol in H<sub>2</sub>O. Sol. in slight traces in Na<sub>2</sub>CO<sub>3</sub>+Aq; al. sol. in NaHCO<sub>3</sub>+Aq, and in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq (Rose)

Cerous lanthanum carbonate fluoride.

Min. *Baluerte*, *Hamartite*, *Hydrofluocerite*. Slowly decomp. by HCl+Aq, easily by H<sub>2</sub>SO<sub>4</sub>

Cerous potassium carbonate, Ce<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>, K<sub>2</sub>CO<sub>3</sub>+3H<sub>2</sub>O.

Ppt. (Jolin.)  
Ce<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>, K<sub>2</sub>CO<sub>3</sub>+12H<sub>2</sub>O. Ppt  
Sol. in 30% K<sub>2</sub>CO<sub>3</sub>+Aq. (Meyer, Z. anorg. 1904, 41. 103.)

**Potassic potassium carbonate**,  $\text{C}_2\text{O}_3(\text{CO}_3)_2$ ,  $4\text{K}_2\text{CO}_3 + 12\text{H}_2\text{O}$ .

*Crystalline*. Sl. sol in  $\text{H}_2\text{O}$  containing  $\text{K}_2\text{CO}_3$ ; sol. in dil  $\text{H}_2\text{SO}_4$  with decomp. (Job, C. R. 1899, 128. 1098.)

**Cerous sodium carbonate**,  $\text{Ce}_2(\text{CO}_3)_3$ ,  $2\text{Na}_2\text{CO}_3 + 2\text{H}_2\text{O}$ .

Ppt (John).  $2\text{Ce}_2(\text{CO}_3)_3$ ,  $3\text{Na}_2\text{CO}_3 + 24\text{H}_2\text{O}(?)$ . Ppt. Easily decomp (Meyer, Z. anorg. 1904, 41. 103)

**Chromous carbonate**,  $\text{CrCO}_3$ .

Sol in much  $\text{H}_2\text{O}$ ; sl. sol in  $\text{KHCO}_3 + \text{Aq}$ . (Moberg, J. pr. 44. 328; Moissan, A. ch. (5) 21. 199.)

**Chromic carbonate, basic**,  $\text{Cr}_2\text{O}_3$ ,  $2\text{CO}_2$

Precipitate. (Parkmann, Sil Am J (2) 34. 321.)

$\text{Cr}_2\text{O}_3$ ,  $\text{CO}_2 + 4\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ ; sol in acids, when freshly pptd. is sol in  $\text{K}_2\text{CO}_3$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , and still more sol. in  $\text{KOH} + \text{Aq}$ . (Meissner.)

Insol. in ethyl acetate (Naumann, B. 1910, 43. 314); methyl acetate. (Naumann, B. 1909, 42. 3790)

$2\text{Cr}_2\text{O}_3$ ,  $\text{CO}_2 + 6\text{H}_2\text{O}$  Precipitate (Langlois, A. ch. (3) 48. 502)

**Chromous potassium carbonate**,  $\text{CrCO}_3$ ,  $\text{K}_2\text{CO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  when freshly prepared; slowly polymerizes; stable in dry air, decomp. in moist air; sol. in acids with decomp (Baugé, C. R. 1898, 126. 1568)

**Chromous sodium carbonate**,  $\text{CrNa}_2(\text{CO}_3)_2 + \text{H}_2\text{O}$

Decomp. when heated In Aq. solution, passes into the hydrate containing 10 mols  $\text{H}_2\text{O}$ . (Baugé, C. R. 1897, 125. 1179)

+10  $\text{H}_2\text{O}$ . Very sol in cold  $\text{H}_2\text{O}$ ; Aq. solution decomp. below  $100^\circ$ ; effloresces in the air, sol in  $\text{HCl} + \text{Aq}$  and  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Baugé, C. R. 1897, 125. 1178.)

**Cobaltous carbonate, basic**,  $5\text{CoO}$ ,  $2\text{CO}_2 + 4\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ ; sol. in  $(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{NH}_4\text{NO}_3$ , and  $\text{NH}_4\text{Cl} + \text{Aq}$

Sol. in cold  $\text{NH}_4\text{NO}_3$ , and  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Brett, 1887.)

Sol. in  $\text{CO}_2 + \text{Aq}$ , and acid alkali carbonates + Aq, from which it is pptd. on boiling. Very sl. sol. in conc  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$ ; largely sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , and partly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Berzelius.)

Not pptd. from solutions containing Na citrate. (Spiller.)

$4\text{CoO}$ ,  $\text{CO}_2 + 4\text{H}_2\text{O}$ . Ppt. (Beetz.) +  $3\text{H}_2\text{O}$ . (Meigen, C. C. 1905, I. 1363.)

**Cobaltous carbonate, basic**,  $3\text{CoO}$ ,  $\text{CO}_2 + 2\text{H}_2\text{O}$ .

(Meigen, C. C. 1905, I. 1363)

$3\text{H}_2\text{O}$  (Rose, Pogg. 84. 551)

$3\text{CoO}$ ,  $2\text{CO}_2 + 4\text{H}_2\text{O}$  (Biatin, Z. anal. 6. 76)

$2\text{CoO}$ ,  $\text{CO}_2 + 3\frac{1}{2}\text{H}_2\text{O}$ . Converted into  $5\text{CoO}$ ,  $2\text{CO}_2 + 4\text{H}_2\text{O}$  by  $\text{H}_2\text{O}$  (Beetz)

**Cobaltous carbonate,  $\text{CoCO}_3$ .**

*Anhydrous* Not attacked by cold conc  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . (Senarmont, A. ch. (3) 30. 129)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827)

Min *Sphaerocobaltite*. Sl. attacked by cold  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ .

+  $\frac{1}{2}\text{H}_2\text{O}$ . Sol. in acids. (Dewille, A. ch. (3) 33. 95.)

+  $6\text{H}_2\text{O}$ . (Dewille)

Decomp. by  $\text{H}_2\text{O}$  with formation of a basic carbonate. (Berzelius)

**Cobaltous potassium carbonate**,  $\text{CoCO}_3$ ,  $\text{K}_2\text{CO}_3 + 4\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Dewille, A. ch. (3) 33. 90.)

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Reynolds, Chem. Soc. 1898, 73. 264)

$\text{CoCO}_3$ ,  $\text{KHCO}_3 + 4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Dewille.)

**Cobaltous sodium carbonate**,  $\text{CoCO}_3$ ,  $\text{Na}_2\text{CO}_3 + 4\text{H}_2\text{O}$ , and  $10\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Dewille, A. ch. (3) 33. 75.)

**Cupric carbonate, basic.**

The compounds produced by pptn. of copper solutions by carbonates are unstable and possess varying solubilities in solutions of  $\text{CO}_2$ . On treatment with solutions of  $\text{CO}_2$ , these substances pass over into an apparently stable compound possessing a definite solubility in solutions of  $\text{CO}_2$  of definite concentration, which solubility increases with the concentration of  $\text{CO}_2$ . Solubility of this compound in various salts + Aq is recorded. (Free, J. Am. Chem. Soc. 1908, 30. 1374.)

$8\text{CuO}$ ,  $\text{CO}_2 + 5\text{H}_2\text{O}$  (Dewille, A. ch. (3) 33. 75)

$6\text{CuO}$ ,  $\text{CO}_2$ . (Field, Chem. Soc. 14. 70)

$3\text{CuO}$ ,  $\text{CO}_2 + 2\text{H}_2\text{O}$ . (Favre, A. ch. (3) 10. 119)

$5\text{CuO}$ ,  $2\text{CO}_2 + 6\text{H}_2\text{O}$ . (Struve.)

$2\text{CuO}$ ,  $\text{CO}_2 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids, even  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; sl. sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ , 30,720 pts. of the solution containing 1 pt.  $\text{CuO}$ . (Jahn)

Sol. in 4690 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat. at 4-6 atmos pressure. (Wagner)

Sol. in 3833 pts. sat.  $\text{H}_2\text{CO}_3 + \text{Aq}$ . (Lassaigne, J. ch. méd. 4. 312)

Sol. in  $\text{NH}_4$  salts + Aq. Partially sol. in  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$ , and more sol. in

$\text{NaHCO}_3$ , or  $\text{KHCO}_3 + \text{Aq}$ ; sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Favre, A. ch. (3) 10. 18.)

Less sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  than  $\text{CuO}$  in  $\text{NH}_4\text{OH} + \text{Aq}$  (Thomson, 1831.) Sol. in  $\text{KCN} + \text{Aq}$ . (Berzelius.) Sol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett.)

Sol. in ferric salts with pptn. of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .  
Insol. in liq.  $\text{NH}_3$ . (Franklin and Kraus, Am. Ch. J. 1898, 20. 827.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone (Naumann, B. 1904, 37. 4329; Erdmann, C. C. 1899, II. 1014.)

Sol. in ethyl amine carbonate +  $\text{Aq}$ . (Wurtz.)

Sol. in cane sugar +  $\text{Aq}$  (Peschier, Repert. 1820, 6. 85.)

Not pptd. from solutions containing sodium citrate (Spiller.)

Insol. in pyridine. (Schroeder, Dissert. 1901.)

Min. *Malachite*. Sol. in acids, and  $\text{NH}_4\text{OH} + \text{Aq}$ .

+  $2\text{H}_2\text{O}$  (Favre.)

$8\text{CuO}$ ,  $5\text{CO}_2 + 7\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1900, 24. 137.)

$3\text{CuO}$ ,  $2\text{CO}_2 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in hot conc.  $\text{NaHCO}_3 + \text{Aq}$ .

Min. *Azurite*.

Copper potassium carbonate, basic,  $8\text{CuO}$ ,  $2\text{K}_2\text{CO}_3$ ,  $7\text{CO}_2 + 17\text{H}_2\text{O}$ .

Ppt.; decomp. by  $\text{H}_2\text{O}$ . (Groger, B. 1901, 34. 430.)

Mixture. (Wood and Jones, C. A. 1907. 2667.)

$5\text{CuO}$ ,  $4\text{CO}_2$ ,  $\text{K}_2\text{CO}_3 + 10\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Deville, A. ch. (3) 33. 102.)

Cupric potassium carbonate,  $\text{CuCO}_3$ ,  $\text{K}_2\text{CO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Wood and Jones, C. A. 1907. 2667.)

+  $\text{H}_2\text{O}$ . (Wood and Jones.)

+  $4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Reynolds, Chem. Soc. 1898, 73. 263.)

Could not be obtained. (Wood and Jones.)

$2\text{CuCO}_3$ ,  $\text{K}_2\text{CO}_3 + 4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Wood and Jones.)

Cupric sodium carbonate,  $\text{CuCO}_3$ ,  $\text{Na}_2\text{CO}_3$ .

Not decomp. by cold  $\text{H}_2\text{O}$ . (Debray, C. R. 49. 218.)

+  $3\text{H}_2\text{O}$ .

Cupric zinc carbonate,  $2\text{CuO}$ ,  $3\text{ZnO}$ ,  $2\text{CO}_2 + 3\text{H}_2\text{O}$ , or  $3\text{CuO}$ ,  $9\text{ZnO}$ ,  $4\text{CO}_2 + 8\text{H}_2\text{O}$ .

Min. *Aurichalcite*. Easily sol. in  $\text{HCl} + \text{Aq}$ .

Cupric carbonate ammonia (cuprammonium carbonate),  $\text{CuCO}_3$ ,  $2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Insol. in alcohol and ether. Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Favre, A. ch. (3) 10. 116.)

Didymium carbonate,  $\text{D}_{12}(\text{CO}_3)_3 + \text{H}_2\text{O}$ , or  $6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Only traces dissolve in  $\text{CO}_2 + \text{Aq}$ . Insol. in solutions of alkali carbonates or bicarbonates +  $\text{Aq}$ . (Marignac, A. ch. (3) 38. 166.) Very sl. sol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

+  $8\text{H}_2\text{O}$  (Cleve, Bull. Soc. (2) 43. 363.)

Didymium potassium carbonate,  $\text{D}_{12}(\text{CO}_3)_3$ ,  $\text{K}_2\text{CO}_3 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  (Cleve, Bull. Soc. (2) 43. 363.)

+  $12\text{H}_2\text{O}$ . (Cleve.)

Didymium sodium carbonate,  $2\text{D}_{12}(\text{CO}_3)_3$ ,  $3\text{Na}_2\text{CO}_3 + 9\text{H}_2\text{O}$ .

Ppt. (Cleve.)

$\text{D}_{12}(\text{CO}_3)_3$ ,  $2\text{Na}_2\text{CO}_3 + 8\text{H}_2\text{O}$ . Ppt. (Cleve.)

Dysprosium carbonate,  $\text{Dy}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Jantsch, B. 1911, 44. 1277.)

Erbium carbonate,  $\text{Er}_2\text{O}_3$ ,  $2\text{CO}_2 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Hoglund.)

Erbium sodium carbonate,  $\text{Er}_2(\text{CO}_3)_3$ ,  $5\text{Na}_2\text{CO}_3 + 36\text{H}_2\text{O}$ .

Efflorescent. Decomp. by  $\text{H}_2\text{O}$ .

Gadolinium carbonate, basic,  $\text{Gd}(\text{OH})\text{CO}_3 + \text{H}_2\text{O}$ .

Ppt. (Benedicks, Z. anorg. 1900, 22. 417.)

Glucinum carbonate, basic,  $3\text{GfO}$ ,  $\text{CO}_2$ ;  $4\text{GfO}$ ,  $\text{CO}_2$ ;  $5\text{GfO}$ ,  $\text{CO}_2 + 5\text{H}_2\text{O}$ , etc.

Not perceptibly sol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{CO}_3 + \text{Aq}$ .

Decomp. by boiling  $\text{H}_2\text{O}$ . Easily sol. in acids.

Sol. in  $\text{NH}_4$  salts, and  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ .

Sol. in alkali carbonates, especially  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Vauquelin.)

Sl. sol. in  $\text{K}_2\text{CO}_3 + \text{Aq}$ . When solution in  $(\text{NH}_4)_2\text{CO}_3$  is boiled, a more basic carbonate is pptd. (Rose.)

Glucinum carbonate,  $\text{GfCO}_3 + 4\text{H}_2\text{O}$ .

Efflorescent. Sol. in 278 pts.  $\text{H}_2\text{O}$ . (Klatzo, J. pr. 106. 242.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

No definite carbonate of glucinum exists (Cameron, J. phys. Chem. 1908, 12. 572.)

Glucinum potassium carbonate,  $3\text{HCO}_3\text{K}$ ,  $2\text{K}_2\text{CO}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. (Jebay.) Less easily sol. in alcohol.

Indium carbonate,  $\text{In}_2(\text{CO}_3)_3$ .

Ppt. Insol. in  $\text{K}_2\text{CO}_3$ , or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Winkler, J. pr. 94. 1)

Iron (ferric) carbonate, basic.

$9\text{Fe}_2\text{O}_3 \cdot \text{CO}_2 + 12\text{H}_2\text{O}$ . (Wallace, Chem. Gaz. 1868. 410)

$3\text{Fe}_2\text{O}_3 \cdot \text{CO}_2 + 4\text{H}_2\text{O}$ , and  $8\text{H}_2\text{O}$ . (Barrat, C N 1. 110.)

$+6\text{H}_2\text{O}$ . (Wallace.)  $2\text{Fe}_2\text{O}_3 \cdot \text{CO}_2 + 1\frac{1}{2}\text{H}_2\text{O}$ . (Rother, Pharm. J. Trans. (3) 4. 576.)

$\text{Fe}_2\text{O}_3 \cdot \text{CO}_2$ . (Parkmann, Sil. Am. J. (2) 34. 321.)

These and other similar basic salts are ppts., easily decomp. on standing into  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .

Iron (ferrous) carbonate,  $\text{FeCO}_3$ .

Insol. in  $\text{H}_2\text{O}$ .

Sol in acids, even in  $\text{H}_2\text{CO}_3 + \text{Aq}$ .

See Carbonate, ferrous hydrogen.

Min. *Siderite*, *Spathic ore*. Sl. attacked by chl. acids. Sol in  $\text{H}_2\text{CO}_3 + \text{Aq}$  under pressure.

Insol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Biett.)  $+ \text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ , easily sol. in acids; sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ .

Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in ferric salts  $+ \text{Aq}$  with evolution of  $\text{CO}_2$  and pptn. of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .

Soluble in an aqueous solution of cane sugar

100 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  dissolve 0.72 pt.  $\text{FeCO}_3$ . (Wagner.)

$\text{FeCO}_3$  dissolves in 1381 pts  $\text{H}_2\text{O}$  saturated with  $\text{CO}_2$ , under a pressure of 4-6 atmospheres. (Wagner, J. B. 1867. 135.)

1 l.  $\text{H}_2\text{O}$  dissolves 6.1907 g.  $\text{FeCO}_3$  (pure) under a  $\text{CO}_2$  pressure of 2 atmos (Ehlert, Z. Elektrochem 1912, 18. 728)

Solubility in various salts  $+ \text{Aq}$  in presence of  $\text{CO}_2$  under pressure of 2 atmos.

Salt	With $\text{CO}_2$ of 2 atmos pressure	
	g salt per 1000 g $\text{H}_2\text{O}$	1 l. of solvent dissolves g $\text{FeCO}_3$
$\text{H}_2\text{O}$		6.1907
$\text{NaCl}$	50	
	100 9	
	175 6	
	203 4	
	351 2	
$\text{MgCl}_2 + 6\text{H}_2\text{O}$	86 9	5.8403
	700 0	4.5553
	1150 0	4.4587
	1437.5	4.6934
	1725 0	5.3975
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	137 7	7.9428
	sat at $+14^\circ$	9.5780
$\text{MgSO}_4 + 7\text{H}_2\text{O}$	105 3	6.2423
	sat. at $+18^\circ$	7.3922

(Ehlert, Z. Elektrochem. 1912, 18. 728.)

A bicarbonate of ferrous iron is not formed under pressures of  $\text{CO}_2$  up to 5 atmospheres at  $0^\circ$ . (Cameron, J. phys. Chem. 1908, 12. 571)

Iron (ferrous) magnesium carbonate,  $\text{FeCO}_3 \cdot \text{MgCO}_3$ .

Min. *Pistomesite*.

$\text{FeCO}_3 \cdot 2\text{MgCO}_3$ . Min. *Mesitite*.

Iron (ferrous) potassium carbonate,  $\text{FeK}_2(\text{CO}_3)_2 + 4\text{H}_2\text{O}$ .

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Reynolds. Chem. Soc. 1898, 73. 205.)

Lanthanum carbonate,  $\text{La}_2(\text{CO}_3)_3 + \text{H}_2\text{O}$ ,  $3\text{H}_2\text{O}$ , and  $8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ .  $\text{CO}_2 + \text{Aq}$  dissolves traces.

Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ .

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Min. *Lanthanite*.

Solubility in salts  $+ \text{Aq}$  free from  $\text{CO}_2$ .

Salt	g. salt per 1000 g. $\text{H}_2\text{O}$	1 l. of solvent dissolves g $\text{FeCO}_3$
$\text{NaCl}$	351 2	0.35042
$\text{MgCl}_2 + 6\text{H}_2\text{O}$	2300.0	4.2049
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	137 7	0.70085
	sat. at $+14^\circ$	0.93444
$\text{MgSO}_4 + 7\text{H}_2\text{O}$	105 3	1.4667
	sat at $+18^\circ$	2.9334

(Ehlert, Z. Elektrochem. 1912, 18. 728.)

Iron (ferrous) hydrogen carbonate,  $\text{FeH}_2(\text{CO}_3)_2(?)$ .

Known only in aqueous solution.

By conducting  $\text{CO}_2$  at ordinary pressure through  $\text{H}_2\text{O}$ , in which Fe is suspended, a solution containing 9.1 pts  $\text{FeCO}_3$  to 10,000 pts.  $\text{H}_2\text{O}$  is obtained. (v. Hauer, J. pr. 81. 391.)

Lanthanum potassium carbonate,  $\text{La}_2(\text{CO}_3)_3 \cdot \text{K}_2\text{CO}_3 + 12\text{H}_2\text{O}$ .

Sol. in 30%  $\text{K}_2\text{CO}_3 + \text{Aq.}$  (Meyer, Z. anorg. 1904, 41, 101)

Lanthanum sodium carbonate,  $2\text{La}_2(\text{CO}_3)_3 \cdot 3\text{Na}_2\text{CO}_3 + 20\text{H}_2\text{O} (?)$ .

Ppt Easily decomp (Meyer, Z anorg 1901, 41, 102)

Lead carbonate, basic,  $2\text{PbCO}_3 \cdot \text{PbO} \cdot \text{H}_2\text{O}$ ,  $5\text{PbCO}_3 \cdot 3\text{PbO} \cdot \text{H}_2\text{O}$ ,  $3\text{PbCO}_3 \cdot \text{PbO} \cdot \text{H}_2\text{O}$ ,  $5\text{PbCO}_3 \cdot \text{PbO} \cdot \text{H}_2\text{O}$

*White Lead.* Insol. in  $\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{CO}_3 + \text{Aq.}$  even under pressure Sol in dil, insol in conc.  $\text{KOH} + \text{Aq}$  Insol in normal, or acid alkali carbonates +  $\text{Aq.}$  (Böttger)

Sol in cold dil.  $\text{NH}_4\text{Cl} + \text{Aq}$  (Brett.)  
 $\text{PbCO}_3 \cdot \text{PbO} \cdot \text{H}_2\text{O}$  Very sl. sol. in  $\text{H}_2\text{O}$ . (Yorke)

$2\text{PbCO}_3 \cdot \text{PbO} \cdot \text{H}_2\text{O}$   
Solubility is less than 0.0002 millimol Pb in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$  (Pleissner, C C 1907, II 1056.)

When not exposed to air, sol in 32,000 pts.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (0.2 g. per l.); 26,000 pts.  $\text{KNO}_3 + \text{Aq}$  (0.2 g. per l.), 23,000 pts.  $\text{CaCl}_2 + \text{Aq}$  (0.2 g. per l.), 4600 pts.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (0.2 g. per l.), 4300 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$

When exposed to air in beakers, sol in 43,000 pts.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (0.2 g. per l.); 43,000 pts.  $\text{KNO}_3 + \text{Aq}$  (0.2 g. per l.); 26,000 pts.  $\text{CaCl}_2 + \text{Aq}$  (0.2 g. per l.); 26,000 pts.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (0.2 g. per l.), 4300 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  (0.2 g. per l.) (Murr, Chem. Soc. 31, 664)

Insol in methyl acetate (Naumann, B. 1909, 42, 3790.)

$3\text{PbO} \cdot 4\text{PbCO}_3 + 2\text{H}_2\text{O}$ . Ppt. (Stromholm, Z. anorg. 1904, 38, 446.)

Lead carbonate,  $\text{PbCO}_3$ .

Sol in 30,551 pts.  $\text{H}_2\text{O}$  at ordinary temp.

Sol in 23,450 pts.  $\text{H}_2\text{O}$  with little ammonium acetate, carbonate, and free ammonia; and in somewhat less  $\text{H}_2\text{O}$ , containing much ammonium nitrate with carbonate and free ammonia (Freemans, A. 59, 124.)

Calculated from electrical conductivity of  $\text{PbCO}_3 + \text{Aq.}$  1 l  $\text{H}_2\text{O}$  dissolves 3 mg.  $\text{PbCO}_3$  at  $10^\circ$  (Kohlrausch and Rose, Z. phys. Ch. 12, 241)

Solubility is 0.0002 millimol. Pb in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner, C. C. 1907, II 1056.)

Sl sol. in  $\text{H}_2\text{O}$   $1.5 \times 10^{-3}$  g are contained in 1 l of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch 1903, 46, 604.)

Easily sol. in acids, even  $\text{HC}_2\text{H}_3\text{O}_2$ , but not decomp by conc.  $\text{HNO}_3 + \text{Aq}$  on account of insolubility of  $\text{Pb}(\text{NO}_3)_2$  in  $\text{HNO}_3 + \text{Aq}$ . Insol. in a mixture of 1 pt.  $\text{H}_2\text{SO}_4$  and 6 pts absolute alcohol, or in an alcoholic solution of racemic or tartaric acids

Insol in  $\text{H}_2\text{CO}_3 + \text{Aq.}$  (Jahn, A. 28, 117) Very sl. sol. in  $\text{H}_2\text{CO}_3 + \text{Aq.}$  but solution is prevented by traces of various salts (Tinnerman) Sol. in 7144 pts. sat.  $\text{H}_2\text{CO}_3 + \text{Aq.}$  (Lassaigne, J. ch. méd. 4, 312)  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  under 4-6 atmos pressure dissolves only traces of Pb; 1000 pts. of solution containing 0.5 pt.  $\text{PbCO}_3$ . (Wagner, Z anal 6, 167)

Solubility of  $\text{PbCO}_3$  in  $\text{H}_2\text{CO}_3 + \text{Aq}$  at  $18^\circ$ .

mg per l	
$\text{CO}_2$	$\text{PbCO}_3$
0	1.75
2.8	6
5.4	7
14.4	8.2
26	9.9
43.5	10.9
106	15.4

(Pleissner, C. C. 1907, II 1056.)

Sol in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq.}$  and  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Weppen, 1837.) Sol. in  $\text{KOH} + \text{Aq.}$ ; not absolutely insol at ord. temp. in an excess of  $\text{K}_2\text{CO}_3$  or  $\text{Na}_2\text{CO}_3 + \text{Aq.}$  and still more sol. at  $100^\circ$ ; but absolutely insol. in  $\text{NaHCO}_3$ ,  $\text{KHCO}_3$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Rose.) Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$ ; sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq.}$ ; decomp. by boiling  $\text{Ca}(\text{NO}_3)_2 + \text{Aq.}$  (Berzelius.)

Sl decomp (Perron), not at all decomp. (Malaguti) by alkali sulphates +  $\text{Aq.}$

Partially decomp. by boiling with  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{CaSO}_4$ ,  $\text{MgSO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $\text{NaNH}_4\text{HPO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ ,  $\text{K}_2\text{AsO}_4$ ,  $\text{Na}_2\text{AsO}_4$ ,  $\text{K}_2\text{C}_2\text{O}_4$ ,  $\text{Na}_2\text{C}_2\text{O}_4$ ,  $\text{NaF}$ , and  $\text{K}_2\text{CrO}_4 + \text{Aq.}$  With the  $\text{NH}_4$  salts, the decomp. is complete (Dulong, A. ch. 82, 290.)

Easily sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Brett, Rose.)

When 1 mol.  $\text{PbCO}_3$  is boiled with 1 mol.  $\text{K}_2\text{C}_2\text{O}_4$ , 15% of the  $\text{PbCO}_3$  is decomp.; with 1 mol.  $\text{K}_2\text{CO}_3$ , 93.28% is decomp. (Malaguti.)

Not decomp. by  $\text{K}_2\text{SO}_4 + \text{Aq}$  (Rose.)

Insol. in liquid  $\text{NH}_3$  (Franklin, Am Ch. J. 1898, 20, 823.)

Sol in an aqueous solution of acetates (Mercer, 1844.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790.)

Not pptd. in presence of Na citrate. (Spiller)

Min. *Cerussite*.

Lead sodium carbonate,  $4\text{PbCO}_3 \cdot \text{Na}_2\text{CO}_3$ .

Insol. in  $\text{H}_2\text{O}$  (Berzelius, Pogg. 47, 199.)

Lead carbonate bromide,  $\text{PbCO}_3 \cdot \text{PbBr}_2$ .

Insol. in  $\text{H}_2\text{O}$ . (Storer's Diet)

Lead carbonate chloride,  $\text{PbCO}_3, \text{PbCl}_2$   
 Insol in  $\text{H}_2\text{O}$ . (Miller, Chem Soc (2) 8, 37.)  
 Min *Phosgenite*. Easily sol. in acids.

Lead carbonate iodide,  $\text{PbCO}_3, \text{PbI}_2$   
 Insol. in  $\text{H}_2\text{O}$  (Poggiale)

Lead carbonate sulphate,  $\text{PbCO}_3, \text{PbSO}_4$ .  
 Min *Lanarkite*. Sol in  $\text{HNO}_3 + \text{Aq}$  with residue of  $\text{PbSO}_4$ .  
 $3\text{PbCO}_3, \text{PbSO}_4$  Min *Leadhillite*. As above.

Lithium carbonate,  $\text{Li}_2\text{CO}_3$ .  
 100 pts  $\text{H}_2\text{O}$  dissolve 1 pt  $\text{Li}_2\text{CO}_3$  (Vauquelin, A. ch. 7. 284.)  
 100 pts.  $\text{H}_2\text{O}$  at  $13^\circ$  dissolve 0.769 pt.  $\text{Li}_2\text{CO}_3$ ; at  $102^\circ$ , 0.778 pt.  $\text{Li}_2\text{CO}_3$  (Kremers, Pogg. 99. 48.)  
 100 pts  $\text{H}_2\text{O}$ , cold or hot, dissolve 1.2 pts.  $\text{Li}_2\text{CO}_3$ . (Troost, A. ch. (3) 51. 103.)  
 100 pts  $\text{H}_2\text{O}$  dissolve 1.4787 pts. at  $15^\circ$ . 0.7162 pt. at  $100^\circ$  (Diaper, C. N. 55. 169)

100 pts  $\text{H}_2\text{O}$  dissolve pts.  $\text{Li}_2\text{CO}_3$  at  $t^\circ$ .

$t^\circ$	Pts $\text{Li}_2\text{CO}_3$	$t^\circ$	Pts $\text{Li}_2\text{CO}_3$
0	1.539	75	0.866
10	1.406	100	0.728
20	1.329	102	0.796
50	1.181	...	.

0.796 pt is dissolved at  $102^\circ$  in less than  $\frac{1}{4}$  hour, and 0.955 in 1 hour (Beketow, J. russ Soc. 1884. 591.)

Sat. solution at  $15^\circ$  has sp. gr. 1.014, and contains 1 g.  $\text{Li}_2\text{CO}_3$  to 70 g.  $\text{H}_2\text{O}$ , while solution sat. at  $0^\circ$  has sp. gr. 1.0168 and contains 1 g.  $\text{Li}_2\text{CO}_3$  in 64.6 g.  $\text{H}_2\text{O}$ . By long spontaneous evaporation at  $15^\circ$  a solution can be obtained of 1.0278 sp. gr. containing 1 g.  $\text{Li}_2\text{CO}_3$  in 45.57 g.  $\text{H}_2\text{O}$ . (Flückiger, Arch. Pharm. (3) 25. 549.)

By boiling for an instant with  $\text{H}_2\text{O}$  a solution is obtained, which has sp. gr. 1.0074 and contains 1 g.  $\text{Li}_2\text{CO}_3$  to 139 g.  $\text{H}_2\text{O}$ . (Flückiger, Arch. Pharm. (3) 26. 543.)

0.1687 mol. is sol in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Rothmund, Z. phys. Ch. 1909, 69. 531.)

Sat.  $\text{Li}_2\text{CO}_3 + \text{Aq}$  contains at:

$95^\circ$        $75^\circ$   
 0.723      0.833% by wt  $\text{Li}_2\text{CO}_3$ .

(Tschuganoff, Z. anorg. 1914, 86. 159)

Sat solution boils at  $102^\circ$ . (Kremers.)  
 More sol in  $\text{CO}_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . 100

pts. sat.  $\text{CO}_2 + \text{Aq}$  dissolve 5.25 pts  $\text{Li}_2\text{CO}_3$ . (Troost.) See  $\text{LiHCO}_3$ .  
 Sol in  $\text{NH}_4$  salts +  $\text{Aq}$ .

Solubility in salts +  $\text{Aq}$  at  $25^\circ$

C = concentration of salt solution in g - equiv. per l.  
 S = solubility of  $\text{Li}_2\text{CO}_3$  in g - equiv. per l

Salt	C	S
$\text{KNO}_3$	0.25	0.3647
	0.50	0.3688
	0.75	0.3676
	1.00	0.3656
	1.50	0.3490
	2.00	0.3208
$\text{KCl}$	0.10	0.3553
	0.25	0.3590
	0.50	0.3782
	0.75	0.3832
	1.00	0.3835
	1.50	0.3731
	2.00	0.3558
$\text{NaCl}$	0.10	0.3569
	0.25	0.3691
	0.50	0.3867
	0.75	0.3956
	1.00	0.3946
	1.50	0.3901
	2.00	0.3776
$\text{K}_2\text{SO}_4$	0.25	0.4028
	0.50	0.4356
	1.00	0.4860
$\text{Na}_2\text{SO}_4$	0.50	0.4411
	1.00	0.4926
	2.00	0.5534
$\text{NH}_4\text{Cl}$	0.10	0.3902
	0.25	0.4677
	0.50	0.5659
	0.75	0.6270
	1.00	0.6810
	1.50	0.7463
	2.00	0.7739
	4.00	0.7851
$(\text{NH}_4)_2\text{SO}_4$	0.25	0.5059
	0.50	0.7863
	1.00	0.9804
	1.50	1.109
	2.00	1.174
$\text{KClO}_3$	0.1	0.3500
	0.2	0.3570
	0.4	0.3616

(Geffcken, Z. anorg. 1905, 43. 198.)

Insol in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 828.)

Solubility in organic compds. + Aq. at 25°.  
Solubility in H<sub>2</sub>O at 25° = 0.1687 mols. litre.

Organic compd.	Normality of the solution	Mol. Li <sub>2</sub> CO <sub>3</sub> sol. in 1 l.
Methyl alcohol	0 250 0 5 1 0	0 1604 0 1529 0 1394
Ethyl alcohol	0 125 0 250 0 5 1 0	0 1614 0 1555 0 1417 0 1203
Propyl alcohol	0 125 0 250 0 5 1 0	0 1604 0 1524 0 1380 0 1097
Tertiary amyl alcohol	0 125 0 250 0 5 1 0	0 1564 0 1442 0 1224 0 0899
Acetone	0 125 0 250 0 5 1 0	0 1600 0 1515 0 1366 0 1104
Ether	0 125 0 250 0 5	0 1580 0 1476 0 1300
Formaldehyde	0 125 0 250 0 5 1 0	0 1668 0 1653 0 1606 0 1531
Glycol	0 125 0 250 0 5 1 0	0 1660 0 1629 0 1565 0 1472
Glycerine	0 125 0 250 0 5 1 0	0 1670 0 1647 0 1613 0 1532
Mannitol	0 125 0 250 0 5	0 1705 0 1737 0 1778
Glucose	0 125 0 250 0 5 1 0	0 1702 0 1728 0 1752 0 1778
Sucrose	0 125 0 250 0 5 1 0	0 1693 0 1689 0 1661 0 1557
Urea	0 125 0 250 0 5 1 0	0 1686 0 1673 0 1643 0 1605

Solubility in organic compds. + Aq.  
at 25°—Continued.

Organic compd.	Normality of the solution	Mol. Li <sub>2</sub> CO <sub>3</sub> sol. in 1 l.
Thio-urea	0 125 0 250 0 5 1 0	0 1667 0 1643 0 1600 0 1523
Dimethyl-pyrone	0 125 0 250 0 5 1 0	0 1562 0 1460 0 1284 0 0992
Aminourea	0 125 0 250 0 5 1 0	0 1653 0 1630 0 1577 0 1466
Diethylamine	0 125 0 250 0 5 1 0	0 1589 0 1481 0 1283 0 0937
Pyridine	0 125 0 250 0 5 1 0	0 1592 0 1503 0 1347 0 1091
Piperidine	0 125 0 250 0 5 1 0	0 1584 0 1488 0 1320 0 1009
Urethane	0 125 0 250 0 5 1 0	0 1604 0 1525 0 1377 0 1113
Acetamide	0 250 0 5 1 0	0 1614 0 1520 0 1358
Acetonitrile	0 125 0 250 0 5 1 0	0 1618 0 1556 0 1429 0 1178
Mercuric cyanide	0 125 0 250	0 1697 0 1704

(Rothmund, Z. phys. Ch. 1909, 69, 531.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1904, 37, 3601.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014.)

Lithium hydrogen carbonate, LiHCO<sub>3</sub>.

100 pts. H<sub>2</sub>O dissolve 5.501 pts. at 13°. (Bewad, B. 17, 406 R.)

Magnesium carbonate, basic,  $Mg_3C_2O_7 + 3H_2O = 3MgO, 2CO_2 + 3H_2O$  or  $2MgCO_3, MgO \cdot H_2O + 2H_2O$ . (Fritzsche, Pogg. 37. 810.)

\**Magnesia alba*,  $3MgCO_3, Mg(OH)_2 + 4H_2O, 4MgCO_3, Mg(OH)_2 + 5H_2O$ , or  $5MgCO_3, 2Mg(OH)_2 + 7H_2O$ .

Very al. sol. in  $H_2O$ . Sol in 10,000 pts. hot or cold  $H_2O$  (Bineau)

Sol. in 2500 pts. cold, and 9000 pts. hot  $H_2O$ . (Fyfe.)

Sol. in  $H_2O$  containing  $CO_2$

Very easily sol. in acids

Easily sol. in dil.  $HCl + Aq$ .

Easily sol. in  $NH_4$  sulphate, nitrate, or succinate +  $Aq$ , also in  $(NH_4)_2CO_3 + Aq$ . (Wittstein.) Sol. in cold  $Na_2CO_3, K_2CO_3, K_2SO_4, KCl$ , or  $KNO_3 + Aq$  (Longchamp); also in  $NH_4Cl + Aq$ , separating out on heating.

(Vogel, J. pr. 7. 455.) Slowly sol. in conc.  $BaCl_2, CaCl_2$ , or  $ZnSO_4 + Aq$  (Karsten.) Sol. in  $MgSO_4 + Aq$  (Dulong)

Sol. in ferric salts +  $Aq$  with evolution of  $CO_2$  and pptn. of  $Fe_2O_3 \cdot H_2O$ . (Fuchs)

Sol. in boiling  $Co, Ni, Zn, Mn$ , or  $Cu$  nitrates or chlorides +  $Aq$ .

Min. *Hydromagnesite*,  $4MgO, 3CO_2 + 4H_2O$ .

+  $10H_2O$ . Sol. in considerable amount in  $H_2CO_3 + Aq$  as  $MgH_2(CO_3)_2 + Aq$ . (Engel, C. R. 100. 911)

Magnesium carbonate,  $MgCO_3$ .

*A hydrous*. Insol. in  $H_2O$ . 1 l  $H_2O$  dissolves 103 mg.  $MgCO_3$ . (Chevalot, Z. anal. 8. 91.) Sol. in 5071 pts  $H_2O$  at  $16^\circ$ . (Kremers.)

$MgCO_3$  combines with  $H_2O$  to form  $MgCO_3 \cdot 3H_2O$ , and +  $5H_2O$ , which are less sol. in  $H_2O$  than anhydrous salt. (Engel, C. R. 101. 814)

Very hygroscopic. About 20 g. are sol. in 1 l.  $H_2O$ . (Engel, C. R. 1899, 129. 598.)

0.7156 g. are sol. in 1 l.  $H_2O$  at  $15^\circ$ .

0.627 g. are sol. in 1 l.  $H_2O$  at  $15^\circ$  with vapour pressure of  $CO_2$  equal to zero.

0.977 grams are sol. in 1 l.  $H_2O$  at  $15^\circ$  with vapour pressure  $CO_2$  equal to 1 atmos. (Treadwell and Reuter, Z. anorg. 1898, 17. 202.)

94.4 mg are sol. in 1 l. of  $CO_2$ -free water. (Gothe, Ch. Z. 1915, 39. 306.)

Solubility in  $H_2O$  in equilibrium with  $Mg(HCO_3)_2$  and  $CO_2$ .

System:  $MgCO_3, Mg(HCO_3)_2$  and  $CO_2$  at  $30^\circ C$ .

Total Mg (grams per liter)	Mg as $MgCO_3$ (grams per liter)	Mg as $Mg(HCO_3)_2$ (grams per liter)
0.02410	0.01205	0.01205
0.13135	0.06820	0.06314
0.16087	0.08676	0.07411

Solubility in  $H_2O$  in equilibrium with  $Mg(HCO_3)_2$  and  $CO_2$ —Continued

System  $MgCO_3, Mg(HCO_3)_2$  and  $CO_2$  at  $30^\circ C$

Total Mg (grams atoms per liter)	Mg as $MgCO_3$ Per cent	Mg as $Mg(HCO_3)_2$ Per cent
0.00100	50.00	50.00
0.00545	51.92	48.08
0.00667	53.93	46.07

Total salts in solution Grams per liter	$MgCO_3$		$Mg(HCO_3)_2$	
	Grams per liter	Per cent	Grams per liter	Per cent
0.1144	0.0418	36.5	0.0726	63.5
0.6174	0.2368	38.2	0.3806	61.7
0.7479	0.3012	40.3	0.4467	59.7

In a solution near the saturation point and in equilibrium with atmospheric air upwards of 50 per cent of the magnesium is in the form of the normal carbonate. When the solution is brought in contact with the solid phase, the proportion of the base combined as normal carbonate falls to about 34 per cent, or lower. (Cameron and Briggs, J. phys. Chem. 1901, 5. 552-3.)

For solubility in  $H_2CO_3 + Aq$ , see *Magnesium hydrogen carbonate*.

Scarcely acted upon by  $HCl + Aq$ . (Senarmont)

The solubility of  $MgCO_3$  in  $NaCl + Aq$  when in contact with ordinary air increases with increasing concentration of  $NaCl$  up to a maximum, and then decreases. (Cameron and Seidell, J. phys. Chem. 1903, 7. 579.)

Solubility of  $MgCO_3$  in salts +  $Aq$  in equilibrium with an atmosphere free from  $CO_2$ .

$NaCl + Aq$ ;  $t = 23^\circ$

Weight of liter of solution	Grams $NaCl$ per liter	Grams $MgCO_3$ per liter	Reacting weights $NaCl$ per liter	Reacting weights $MgCO_3$ per liter
996.92	0.0	0.176	0.000	0.00210
1016.82	28.0	0.418	0.482	0.00500
1041.09	59.5	0.527	1.025	0.00630
1070.50	106.3	0.585	1.831	0.00699
1094.53	147.4	0.544	2.539	0.00650
1142.48	231.1	0.460	3.981	0.00580
1170.14	272.9	0.393	4.701	0.00470
1199.28	331.4	0.293	5.709	0.00350

(Cameron and Seidell, J. phys. Chem. 1903, 7; 585.)

Solubility of  $\text{MgCO}_3$  in salts + Aq.—Continued  
 $\text{Na}_2\text{SO}_4 + \text{Aq}; t = 24^\circ$ .

Weight of liter of solution	Grams $\text{Na}_2\text{SO}_4$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting weights $\text{Na}_2\text{SO}_4$ per liter	Reacting weights $\text{MgCO}_3$ per liter
997.52	0.00	0.216	0.000	0.00258
1021.24	25.12	0.586	0.178	0.00700
1047.60	54.76	0.828	0.388	0.00990
1060.95	95.68	1.020	0.678	0.01219
1133.85	160.80	1.230	1.140	0.01470
1157.34	191.90	1.280	1.360	0.01530
1206.03	254.60	1.338	1.804	0.01600
1223.91	278.50	1.338	1.973	0.01600
1241.99	305.10	1.388	2.162	0.01660

$t = 35.5^\circ$ .

Weight of liter of solution	Grams $\text{Na}_2\text{SO}_4$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting weights $\text{Na}_2\text{SO}_4$ per liter	Reacting weights $\text{MgCO}_3$ per liter
995.15	0.32	0.131		0.00156
1032.89	41.84	0.577	0.296	0.00689
1067.23	81.84	0.753	0.579	0.00900
1094.77	116.56	0.904	0.826	0.01080
1120.38	148.56	0.962	1.052	0.01149
1151.70	186.70	1.047	1.323	0.01251
1179.82	224.00	1.068	1.587	0.01300
1198.32	247.20	1.100	1.751	0.01314
1236.52	199.20	1.130	2.120	0.01350

(Cameron and Seidell.)

$\text{Na}_2\text{CO}_3 + \text{Aq}; t = 25^\circ$ .

Weight of liter of solution	Grams $\text{Na}_2\text{CO}_3$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting weights $\text{Na}_2\text{CO}_3$ per liter	Reacting weights $\text{MgCO}_3$ per liter
996.84	0.00	0.223	0.000	0.00266
1019.89	23.12	0.288	0.220	0.00344
1047.72	50.75	0.510	0.482	0.00620
1082.47	86.42	0.879	0.820	0.01027
1118.91	127.80	1.314	1.209	0.01570
1147.66	160.80	1.636	1.526	0.01955
1166.05	181.90	1.972	1.727	0.02357
1189.38	213.20	2.317	2.024	0.02770

(Cameron and Seidell.)

Solubility in salts + Aq.

g salt added per litre	mg $\text{MgCO}_3$ dissolved per litre
0.0	94.4
0.585 g. $\text{NaCl}$	128.3
1.17 g. "	134.4
2.93 g. "	120.95
0.85 g. $\text{NaNO}_3$	122.85
1.70 g. "	138.80
4.25 g. "	137.20

Solubility in salts + Aq.—Continued

g salt added per litre	mg $\text{MgCO}_3$ dissolved per litre
0.805 g. $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$	145.05
1.61 g. "	162.05
4.03 g. "	150.75
0.53 g. $\text{Na}_2\text{CO}_3$	98.6
1.06 g. "	53.5
2.65 g. "	15.7
0.51 g. $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$	47.0
1.02 g. "	39.5
2.55 g. "	35.3

The solubility of  $\text{MgCO}_3$  in  $\text{CO}_2$ -free water is increased by the addition of  $\text{NaCl}$ ,  $\text{NaNO}_3$ , or  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  but decreased by the addition of  $\text{Na}_2\text{CO}_3$  or  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ .

(Gothe, Ch. Z 1915, 39, 306.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

Insol. in acetone. (Naumann, B 1904, 37, 4329.)

Insol. in acetone and in methylal. (Eidmann, C O 1899, II, 1014.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790), ethyl acetate (Naumann, B. 1904, 37, 3801.)

Min. *Magnesia*. Very sl. attacked by warm conc.  $\text{HCl} + \text{Aq}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 0.0027 pt., calculated as  $\text{MgO}$ . (Lubavyn.)

Solution in  $\text{H}_2\text{O}$  contains 0.018 g.  $\text{Mg}$  and 0.065 g.  $\text{CO}_2$  per l. at  $20^\circ$ . (Wells, J. Am. Chem. Soc. 1915, 37, 1705.)

Solution in  $\text{H}_2\text{O}$  containing 27.2 g.  $\text{NaCl}$  per l. contains 0.028 g.  $\text{Mg}$  and 0.086 g.  $\text{CO}_2$  per l. at  $20^\circ$ . (Wells, J. Am. Chem. Soc. 1915, 37, 1705.)

+  $\text{H}_2\text{O}$ .  
 +  $2\text{H}_2\text{O}$ . Decomp. by suspension in  $\text{H}_2\text{O}$  into basic salt. (Engel, C. R. 100, 911.)

+  $3\text{H}_2\text{O}$ . Small quantities of this salt are wholly dissolved by much  $\text{H}_2\text{O}$ . (Bineau.)

The solution contains in 100 pts. at—

$0^\circ$  0.5° 8° 16°  
 0.15 0.153 0.155 0.179 pts.  $\text{MgCO}_3 + 3\text{H}_2\text{O}$ .  
 (Norgaard, 1850.)

Decomp. by boiling  $\text{H}_2\text{O}$  into a basic insol. salt and  $\text{CO}_2$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 0.1518 pt at  $19^\circ$ . (Fritzsche, Pogg. 37, 304.)

Sol. in 48 pts.  $\text{H}_2\text{O}$  and decomp. by large amt. (Fourcroy.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.1518 pt. at  $19^\circ$ , or sol. in 668 pts  $\text{H}_2\text{O}$  at  $19^\circ$ . (Beckurts, J. B. 1881, 212.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.0812 pt., calculated as  $\text{MgO}$  (Lubavyn, J. russ. Soc. 24, 389.)

Solution in  $\text{H}_2\text{O}$  contains 0.36 g.  $\text{Mg}$  and 1.01 g.  $\text{CO}_2$  per l. at  $20^\circ$ . (Wells, J. Am. Chem. Soc. 1915, 37, 1707.)

Solubility in  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  has been determined at  $20^\circ$ ,  $25^\circ$ ,  $30^\circ$ ,  $34^\circ$  and  $39^\circ$  and

at  $\text{CO}_2$  pressures corresponding with 0.5 to 30.8%  $\text{CO}_2$  in the gas phase. (Leather and Sen, Chem. Soc. 1915, 108 (2) 13.)

Easily sol. in acids, even when dil.

Not decomp. by 1 pt.  $\text{H}_2\text{SO}_4$  + 6 pts alcohol, or by alcoholic solutions of glacial acetic, racemic, or tartaric acids, but is slowly decomp. by alcoholic solution of citric acid, or  $\text{HNO}_3$  + abs alcohol. (Butini, 1827.)

100 pts.  $\text{NaCl}$  + Aq (2.525%) dissolve 0.1250 pt., calculated as  $\text{MgO}$ . (Lubavm.)

1%  $\text{Na}_2\text{CO}_3$  + Aq, when mixed with 1%  $\text{MgSO}_4$  + Aq, cause no ppt., but 1.5–2% solutions ppt. this salt. (Brandes, 1825.)

More sol. in  $\text{NH}_4\text{Cl}$  + Aq than  $\text{CaCO}_3$ . Sol. in  $\text{NH}_4\text{NO}_3$  + Aq, but less easily than in  $\text{NH}_4\text{Cl}$  + Aq.

### Solubility in $\text{KHCO}_3$ + Aq at $t^\circ$ .

Values are given in mol./litre.

$t^\circ$	K	Mg	Solid phase
15°	0 0	0 0095	$\text{MgCO}_3 + 3\text{H}_2\text{O}$
	0 0992	0 0131	"
	0 1943	0 0187	"
	0 3992	0 0211	" labile
	0 2681	0 0192	$\text{MgCO}_3 + 3\text{H}_2\text{O} + \text{MgCO}_3$
			$\text{KHCO}_3 + 4\text{H}_2\text{O}$
	0 5243	0 0097	$\text{MgCO}_3, \text{KHCO}_3 + 4\text{H}_2\text{O}$
	0 6792	0 0074	"
	0 9810	0 0028	"
25°	0 0	0 0087	$\text{MgCO}_3 + 3\text{H}_2\text{O}$
	0 0985	0 0115	"
	0 2210	0 0149	"
	0 3188	0 0175	"
	0 3434	0 0181	"
	0 4218	0 0205	" labile
	0 4985	0 0207	"
	0 3906	0 0196	$\text{MgCO}_3 + 3\text{H}_2\text{O} + \text{MgCO}_3$
			$\text{KHCO}_3 + 4\text{H}_2\text{O}$
	0 5893	0 0128	$\text{MgCO}_3, \text{KHCO}_3 + 4\text{H}_2\text{O}$
	0 6406	0 0117	"
	0 788	0 0089	"
	1 125	0 0061	"
35°	0 0	0 0071	$\text{MgCO}_3 + 3\text{H}_2\text{O}$
	0 1092	0 0098	"
	0 2001	0 0132(?)	"
	0 2811	0 0142	"
	0 3704	0 0163	"
	0 4847	0 0177	"
	0 5807	0 0198	"
	0 5088	0 0184	$\text{MgCO}_3 + 3\text{H}_2\text{O} + \text{MgCO}_3$
			$\text{KHCO}_3 + 4\text{H}_2\text{O}$
	0 6231	0 0153	$\text{MgCO}_3, \text{KHCO}_3 + 4\text{H}_2\text{O}$
	0 8435	0 0119	"

The experiments were performed in such a way as to prevent, as far as possible, loss of  $\text{CO}_2$  from the solutions.

(Auerbach, Z. Elektrochem. 1904, 10. 164.)

1 l.  $\text{H}_2\text{O}$ , containing 6%  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  and

a little  $\text{NaCl}$ , dissolves 5 g  $\text{MgCO}_3$ . (Hunt, Sill. Am. J. (2) 42, 49.)

More sol. in cold alkali borates + Aq than in hot. (Wittstein.)

Sol in Na citrate + Aq.

+  $4\text{H}_2\text{O}$ . Efflorescent.

+  $5\text{H}_2\text{O}$ . Two modifications.

$\alpha$ . Plates. Sol in 600 pts.  $\text{H}_2\text{O}$  at  $0-7^\circ$ ; solution gradually separates out  $\text{MgCO}_3 + 2\text{H}_2\text{O}$ .  $\text{H}_2\text{CO}_3$  + Aq sat. at 3–4 atmos. pressure dissolves 9% at  $0-4^\circ$ .  $\text{MgSO}_4$  + Aq dissolves 4% moist salt at  $3-4^\circ$ , and it is easily sol. in  $\text{Na}_2\text{CO}_3$ , or  $\text{NaHCO}_3$  + Aq. (Norgaard.)

$\beta$ . Prisms. More efflorescent than  $\alpha$ . Sol in 600 pts  $\text{H}_2\text{O}$  but not in  $\text{MgSO}_4$ , or  $\text{Na}_2\text{CO}_3$  + Aq. Both forms are decomp. by boiling  $\text{H}_2\text{O}$ . (Norgaard.)

### Magnesium hydrogen carbonate, $\text{MgH}_2(\text{CO}_3)_2(?)$ .

Known only in solution.

1 l.  $\text{H}_2\text{CO}_3$  + Aq sat. at 1 atmos. pressure dissolves 23.5 g  $\text{MgCO}_3$ . (Bureau.)

1 l. carbonic acid water dissolves 0.115 g. magnesite at  $18^\circ$  and 0.75 m. pressure (Cossa, B. 2. 807.)

1 pt  $\text{MgCO}_3$  dissolves in  $\text{H}_2\text{O}$  saturated with  $\text{CO}_2$  at  $5^\circ$  and a pressure of—

1	2	3	4	5	6 atmospheres
in 161	144	134	100	7	110
					76 pts. $\text{H}_2\text{O}$

(Merkel, Techn. J. B. 1867. 213.)

$\text{H}_2\text{CO}_3$  + Aq sat at 3–4 atmos. pressure and  $0-4^\circ$  dissolved 9%  $\text{MgCO}_3 + 5\text{H}_2\text{O}$ . (Norgaard.)

$\text{MgCO}_3 + 3\text{H}_2\text{O}$  is sol in 72.4 pts.  $\text{H}_2\text{CO}_3$  + Aq sat. at  $20^\circ$  and ord. pressure; 30.5 pts.  $\text{H}_2\text{CO}_3$  + Aq sat. at 2 atmos. pressure, 26.0 pts  $\text{H}_2\text{CO}_3$  + Aq sat at 3 atmos. pressure, 21.1 pts.  $\text{H}_2\text{CO}_3$  + Aq sat. at 4 atmos pressure; 17.09 pts.  $\text{H}_2\text{CO}_3$  + Aq sat. at 5 atmos pressure (Beckurts, J. B. 1881. 212.)

1.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  at p pressure and  $t^\circ$  dissolves g  $\text{MgCO}_3$ .

p atmos	$t^\circ$	g $\text{MgCO}_3$	p mm	$t^\circ$	g $\text{MgCO}_3$
1 0	19 5	27 79	751	13 4	28 45
2 1	19 5	33 11	760	19 5	25 79
3 2	19 7	37 3	762	29 3	21 95
4 7	19 0	43 5	764	46	15 7
5 6	19 2	46 2	764	62	10 4
6 2	19 2	48 51	765	70	8.1
7 5	19 5	51 2	765	82	4 9
9 0	18 7	56 59	765	91	2 4
..	...		765	100	0 0

(Engel and Ville, C. R. 93. 34.)

The low figures of other observers are due to their using basic carbonates. By very careful experiments it was found that 1 l.  $\text{H}_2\text{O}$

sat. with  $\text{CO}_2$  at 1 atmos. pressure and  $t^\circ$  dissolved the following amts. of  $\text{MgCO}_3$ :

$t^\circ$	$\frac{\text{g.}}{\text{cc. CO}_2}$	$t^\circ$	$\frac{\text{g.}}{\text{MgCO}_3}$	$t^\circ$	$\frac{\text{g.}}{\text{MgCO}_3}$
3 5	35.6	18	22 1	40	22 1
12	28 5	30	15 8	50	9 5

(Engel, C. R. 100. 444.)

1.9540 g. are sol. 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Treadwell and Reuter, Z. anorg. 1898, 17. 202.)

$\text{MgH}_2(\text{CO}_3)_2$  is not stable except in the presence of free  $\text{CO}_2$ .

At  $15^\circ$  and 760 mm., a solution having the partial pressure of  $\text{CO}_2=0$ , contains 1.9540 g.  $\text{MgH}_2(\text{CO}_3)_2$  and 0.7156 g.  $\text{MgCO}_3$  per liter. (Treadwell and Reuter, Z. anorg. 1898, 17. 204.)

Solubility of  $\text{MgH}_2(\text{CO}_3)_2$  in  $\text{H}_2\text{O}$  containing carbonic acid, at  $15^\circ$ .

% carbonate and in the form of $\text{CO}_2$ and $\text{H}_2\text{O}$	partial pressure mm. Hg.	mg. free $\text{CO}_2$	mg. $\text{MgH}_2(\text{CO}_3)_2$ in 100 cc. of the solution	mg. $\text{MgCO}_3$ in 100 cc. of the solution	mg. Mg
18.83	143.3	119.0	1210.5	.	201.6
5.47	41.6	85.6	1210.5	.	201.6
4.45	33.8	223.5	1210.5	.	201.6
1.54	11.7	.	1076.6	77.3	201.6
1.35	10.3	.	762.9	76.5	149.2
1.07	8.2	.	595.2	80.7	122.4
0.62	4.7	.	386.3	70.1	86.5
0.60	4.6	.	341.7	75.8	78.8
0.33	2.5	.	263.2	74.8	65.5
0.21	1.6	.	222.9	77.1	59.4
0.14	1.1	.	216.9	71.0	56.0
0.03	0.3	.	203.6	71.1	54.5
.	.	.	203.3	68.5	53.6
.	.	.	196.0	70.2	52.9
.	.	.	203.6	62.5	52.0
.	.	.	195.4	61.6	51.1
...	...	...	195.4	64.1	51.8

(Treadwell and Reuter, Z. anorg. 1898, 17. 200.)

No bicarbonate of magnesium is formed under pressures of  $\text{CO}_2$  up to five atmospheres at  $0^\circ$ . (Cameron, J. phys. Chem. 1903, 12. 570.)

A critical analysis and recalculation of results of Engel and others is given by Johnston (J. Am. Chem. Soc. 1915, 37. 2001.)

Solubility in  $\text{NaCl}+\text{Aq}$  at  $23^\circ\text{C}$ . in equilibrium with an atmosphere of  $\text{CO}_2$

g. $\text{NaCl}$ per liter	g. $\text{Mg}(\text{HCO}_3)_2$ per liter
7 0	30.64
56 5	30.18
119 7	37.88
163 9	24.96
224 8	20.78
306 6	10.75

(Cameron and Seidell, J. phys. Chem. 1903, 7. 582.)

Solubility in  $\text{Na}_2\text{SO}_4+\text{Aq}$  at  $23^\circ\text{C}$  in equilibrium with an atmosphere of  $\text{CO}_2$ .

Strength of $\text{Na}_2\text{SO}_4+\text{Aq}$	g. $\text{Mg}(\text{HCO}_3)_2$ in 100 ccm.
0 0	1.463
12%	1.616
saturated	1.612

(Cameron and Seidell.)

**Magnesium potassium carbonate,**  
 $\text{MgK}_2(\text{CO}_3)_2+4\text{H}_2\text{O}$ .

Quickly decomp. by cold  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 33. 87.)

Ppt. Decomp. by  $\text{H}_2\text{O}$  (Reynolds, Chem. Soc. 1898, 73. 204.)

$\text{MgKH}(\text{CO}_3)_2+4\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby into an insol. basic Mg carbonate, and  $\text{MgH}_2(\text{CO}_3)_2$  and  $\text{KHCO}_3$ , which dissolve (Berzelius.)

**Magnesium rubidium hydrogen carbonate,**  
 $\text{MgRbH}(\text{CO}_3)_2+4\text{H}_2\text{O}$ .

Decomp. in the air (Erdmann, A. 1897, 294. 75.)

**Magnesium sodium carbonate,  $\text{MgCO}_3$ ,**  
 $\text{Na}_2\text{CO}_3$ .

Quickly decomp. with  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 33. 89.)  
 $+15\text{H}_2\text{O}$ . (Norgaard.)

**Magnesium sodium carbonate sodium chloride,  $\text{MgCO}_3$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{NaCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (de Schulten, C. R. 1896, 122. 1427.)

**Manganous carbonate,  $\text{MnCO}_3$**

Permanent. Practically insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{CO}_3+\text{Aq}$  and in acids generally.

1 l.  $\text{H}_2\text{O}$  dissolves 0.065 g. at  $25^\circ$ . (Agono and Valla, Att. Accad. Linc. 1911, 20. II. 708.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Min. *Rhodochroite*.

$+1/2$ , or  $1\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Sol. in  $\text{H}_2\text{CO}_3+\text{Aq}$ . 1 pt.  $\text{MnCO}_3$  requires 2000 pts.  $\text{H}_2\text{CO}_3+\text{Aq}$  for solution.

(Lassaigne.) Sol. in 7680 pts  $H_2O$ , and 3840 pts.  $H_2O$  containing  $CO_2$ . (Jahn.) When freshly precipitated is sol. in  $NH_4$  salts + Aq. (Wittstein.) Not more sol. in  $H_2O$  containing  $Na_2CO_3$  or  $K_2CO_3$  than in pure  $H_2O$ . (Ebelmen.) Insol. in  $NH_4Cl$ , or  $NH_4NO_3$  + Aq. (Brett.)

Sol. in ferric salts + Aq, with evolution of  $CO_2$  and pptn. of  $Fe_2C_2H_6$ . (Fuchs.) Not pptd. in presence of Na citrate. (Spuller.)

**Manganous potassium carbonate,**  
 $MnK_2(CO_3)_2 + 4H_2O$ .

Ppt. Decomp. by  $H_2O$  alone.  
Sl sol. in  $Mn(C_2H_3O_2)_2$  + Aq or  $K_2CO_3$  + Aq. (Reynolds, Chem. Soc 1898, 73. 204.)

**Manganous carbonate hydroxylamine,**  
 $4MnCO_3, 3NH_2OH + 2H_2O$

Ppt Sol. in acids. (Goldschmidt and Syngros, Z. anorg. 5, 138.)

**Mercurous carbonate,  $Hg_2CO_3$**

Ppt. Decomp. by hot  $H_2O$ . Sol. in hot or warm  $NH_4Cl$  + Aq, but less easily than mercuric carbonate, less sol. in  $NH_4NO_3$  + Aq. (Brett, 1837.)

Sl. sol. in  $K_2CO_3$  + Aq; partially sol with decomp. in  $NH_4OH$  + Aq. (Wittstein)

**Mercuric carbonate, basic,  $4HgO, CO_2$**

Can be washed with cold  $H_2O$  without decomp. (Millon, A. ch. (3) 19. 368.)

$3HgO, CO_2$ . Insol. in cold  $H_2O$ . Sol. in  $CO_2$  + Aq; sl. sol. in  $K_2CO_3$  + Aq. Easily sol. in  $NH_4Cl$  + Aq (Berzelius.)

**Neodymium potassium carbonate,  $Nd_2(CO_3)_2, K_2CO_3 + 12H_2O$**

Ppt. Sol. in 30%  $K_2CO_3$  + Aq. (Meyer, Z. anorg. 1904, 41. 105.)

**Neodymium sodium carbonate,  $2Nd_2(CO_3)_2, 3Na_2CO_3 + 22H_2O(?)$**

Ppt. Easily decomp.  
Sl. sol. in conc.  $Na_2CO_3$  + Aq. (Meyer, Z. anorg. 1904, 41. 106.)

**Nickel carbonate, basic,  $3NiO, CO_2 + 5H_2O$**

Min. *Zaratite*. Easily sol in  $HCl$  + Aq.  
Pptd. nickel carbonate is a basic salt of varying composition Insol in  $H_2O$  or  $H_2CO_3$  + Aq Sol. in acids Sol. in  $(NH_4)_2CO_3$  + Aq;

very sl. sol. in  $Na_2CO_3$  + Aq; sol in warm  $NH_4Cl$  + Aq, and  $KCN$  + Aq (Rose)

Not pptd. in presence of Na citrate (Spuller.)

**Nickel carbonate,  $NiCO_3$**

1 l  $H_2O$  dissolves 0.0925 g at 25% (Agemo and Valla, Att. Accad. Linc. 1911, 20, II. 706.)

Not attacked by cold conc.  $HCl$ , or  $HNO_3$  + Aq. (Senarmont, A. ch. (3) 30. 138.)

+  $6H_2O$  Sol. in acids (Deville, A. ch. (3) 35. 446.)

See also Carbonate, nickel, basic.

**Nickel potassium carbonate,  $NiCO_3, K_2CO_3 + 4H_2O$**

Ppt (Deville, A. ch. (3) 33. 96)  
 $NiCO_3, KHCO_3 + 4H_2O$  Decomp. by  $H_2O$ , but may be washed by  $KHCO_3$  + Aq without decomp. (Rose, Pogg. 84. 566)

**Nickel sodium carbonate,  $NiCO_3, Na_2CO_3 + 10H_2O$**

Ppt. (Deville)

**Nickel carbonate hydroxylamine,  $2Ni(OH)_2, 4NiCO_3, 5NH_2OH + 7H_2O$**

Ppt. (Goldschmidt and Syngros, Z. anorg. 1894, 5. 143.)

$2Ni(OH)_2, 4NiCO_3, 6NH_2OH + 6H_2O$

Ppt. (Goldschmidt and Syngros.)

**Palladium carbonate,  $PdCO_3, 9PdO + 10H_2O$**

Insol in  $H_2O$ ; partly sol. in  $NH_4OH$  + Aq; sl. sol. in  $Na_2CO_3$  + Aq, sol. in acids. (Kane, 1842.)

**Potassium carbonate,  $K_2CO_3$**

Deliquescent. Very sol. in  $H_2O$  with evolution of heat

Sol in 1.05 pts.  $H_2O$  at 3°, 0.962 pt. at 6°, 0.900 pt. at 12.6°, 0.747 pt. at 20°, and 0.490 pt. at 70° (Osann)

Sol in 0.82 pt.  $H_2O$ . (M. R. and P.)

Sol in 0.922 pt.  $H_2O$  at 15° (Gränel)

Sol. in 1 pt.  $H_2O$  (Ubl)

100 pts.  $H_2O$  at 15° dissolve 100 pts.  $K_2CO_3$ . (Ure's Diet.)

Solubility in 100 pts.  $H_2O$  at t°.

t°	Pts $K_2CO_3$	t°	Pts $K_2CO_3$	t°	Pts $K_2CO_3$
0	83.12	40	106.20	80	134.25
10	88.72	50	112.90	90	143.18
20	94.06	60	119.24	100	153.66
30	100.09	70	127.10	135	205.11

(Poggiale, A. ch. (3) 8. 468.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts $K_2CO_3$	$t^\circ$	Pts $K_2CO_3$	$t^\circ$	Pts $K_2CO_3$
0	89.4	46	119	91	148
1	94	47	120	92	149
2	97	48	120	93	150
3	100	49	121	94	151
4	103	50	121	95	151
5	104	51	122	96	152
6	105	52	122	97	153
7	106	53	123	98	154
8	107	54	124	99	155
9	108	55	124	100	156
10	109	56	125	101	157
11	109	57	125	102	158
12	109	58	126	103	159
13	110	59	127	104	160
14	110	60	127	105	161
15	110	61	128	106	162
16	111	62	128	107	163
17	111	63	129	108	164
18	111	64	130	109	166
19	111	65	130	110	167
20	112	66	131	111	168
21	112	67	132	112	169
22	112	68	132	113	171
23	112	69	133	114	172
24	112	70	133	115	173
25	113	71	134	116	175
26	113	72	135	117	176
27	113	73	135	118	178
28	113	74	136	119	179
29	114	75	137	120	181
30	114	76	137	121	182
31	114	77	138	122	184
32	114	78	139	123	185
33	115	79	139	124	187
34	115	80	140	125	188
35	115	81	141	126	190
36	115	82	141	127	191
37	116	83	142	128	193
38	116	84	143	129	195
39	116	85	144	130	196
40	117	86	144	131	198
41	117	87	145	132	200
42	117	88	146	133	201
43	118	89	147	134	203
44	118	90	147	135	205
45	119	.	..	..	..

(Mulder, Scheik. Verhandel 1864. 97.)

112 g are sol. in 100 g.  $H_2O$  at  $20^\circ$ . (Frankforter, J. Am. Chem. Soc. 1914, 36, 1106)Sp. gr. of  $K_2CO_3$  + Aq at  $15^\circ$ .

% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.
0.480	1.0048	11.748	1.1282
0.979	1.0098	12.727	1.1400
1.458	1.0108	13.706	1.1520
2.034	1.0209	14.685	1.1642
3.016	1.0401	15.664	1.1760
4.095	1.0505	16.643	1.1862
5.874	1.0611	17.622	1.2020
6.853	1.0719	18.601	1.2150
7.832	1.0829	19.580	1.2282
8.811	1.0940	20.559	1.2417
9.790	1.1052	21.538	1.2554
10.760	1.1166	22.517	1.2694

Sp. gr. of  $K_2CO_3$  + Aq at  $15^\circ$ —Continued

% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.
23.496	1.2836	33.286	1.3917
24.175	1.2980	34.265	1.4030
25.451	1.3078	35.244	1.4147
26.442	1.3177	36.223	1.4265
27.412	1.3277	37.202	1.4384
28.391	1.3378	38.181	1.4504
29.360	1.3480	39.160	1.4620
30.349	1.3585	40.139	1.4750
31.328	1.3692	41.104	1.4812
32.807	1.3803		

(Tünnerman)

Sp. gr. and boiling-point of  $K_2CO_3$  + Aq

% $K_2CO_3$	Sp. gr.	B-pt.	% $K_2CO_3$	Sp. gr.	B-pt.
4.7	1.06	100.50°	43.3	1.46	100.44°
9.0	1.11	100.56	45.8	1.50	111.11
13.2	1.15	101.11	48.8	1.54	112.78
16.8	1.19	101.11	52.1	1.68	114.44
20.5	1.22	101.66	55.0	1.63	116.11
24.0	1.25	102.22	60.4	1.70	117.78
27.3	1.28	102.78	65.5	1.80	119.44
30.6	1.31	104.33	71.8	1.95	122.22
33.6	1.34	104.44	70.2	2.15	125.50
36.2	1.38	105.50	88.4	2.40	129.44
39.0	1.41	107.22	100.0	2.60	137.78
41.7	1.44	108.33			

(Dalton)

Sp. gr. of  $K_2CO_3$  + Aq at  $17.5^\circ$ .

% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.
1	1.009	19	1.182	36	1.368
2	1.018	20	1.192	37	1.380
3	1.027	21	1.203	38	1.392
4	1.036	22	1.213	39	1.404
5	1.045	23	1.224	40	1.416
6	1.054	24	1.235	41	1.429
7	1.064	25	1.245	42	1.441
8	1.073	26	1.256	43	1.453
9	1.082	27	1.267	44	1.466
10	1.092	28	1.278	45	1.478
11	1.102	29	1.289	46	1.489
12	1.112	30	1.300	47	1.503
13	1.122	31	1.312	48	1.516
14	1.132	32	1.323	49	0.529
15	1.141	33	1.334	50	1.542
16	1.151	34	1.345	51	1.555
17	1.161	35	1.357	52	1.569
18	1.172				

(Hager, Comm. 1883.)

The sp. gr. increases or diminishes between  $8^\circ$  and  $20^\circ$  by a decrease or increase of temp. of  $1^\circ$  by the following amounts:—

% $K_2CO_3$	Corr.
40-50	0.0007
30-40	0.0005
20-30	0.0003
10-20	0.0002

(Hager)

Sp. gr. of  $K_2CO_3 + Aq$  at  $15^\circ$ .

% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.
1	1.00914	28	1.27893
2	1.01829	29	1.28999
3	1.02743	30	1.30105
4	1.03658	31	1.31261
5	1.04572	32	1.32417
6	1.05513	33	1.33573
7	1.06354	34	1.34729
8	1.07396	35	1.35885
9	1.08337	36	1.37082
10	1.09278	37	1.38279
11	1.10258	38	1.39476
12	1.11238	39	1.40673
13	1.12219	40	1.41870
14	1.13199	41	1.43104
15	1.14179	42	1.44388
16	1.15200	43	1.44573
17	1.16222	44	1.46807
18	1.17243	45	1.48041
19	1.18265	46	1.49314
20	1.19286	47	1.50588
21	1.20344	48	1.51861
22	1.21402	49	1.53135
23	1.22459	50	1.54408
24	1.23517	51	1.55728
25	1.24575	52	1.57048
26	1.25681	52 024	1.57079
27	1.26787	..	...

(Gerlach, Z. anal. 8. 279)

Sp. gr. of  $K_2CO_3 + Aq$  at  $15^\circ$ .

% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.
5	1.0449	30	1.3002
10	1.0919	40	1.4170
20	1.1920	50	1.5428

(Kohlrausch, W. Ann. 1879. 1.)

 $K_2CO_3 + Aq$  containing 10%  $K_2CO_3$  boils at  $100.8^\circ$  $K_2CO_3 + Aq$  containing 20%  $K_2CO_3$  boils at  $102.2^\circ$  $K_2CO_3 + Aq$  containing 30%  $K_2CO_3$  boils at  $104.5^\circ$  $K_2CO_3 + Aq$  containing 40%  $K_2CO_3$  boils at  $108.6^\circ$  $K_2CO_3 + Aq$  containing 50%  $K_2CO_3$  boils at  $115.2^\circ$ 

(Gerlach.)

Sat.  $K_2CO_3 + Aq$  containing 158 pts.  $K_2CO_3$  to 100 pts.  $H_2O$  forms a crust at  $126^\circ$ ; highest temp. observed  $134.9^\circ$ . (Gerlach, Z. anal. 26. 427.)

B.-pt. of  $K_2CO_3 + Aq$  containing pts.  $K_2CO_3$  to 100 pts.  $H_2O$ . G=according to Gerlach (Z. anal. 26. 459); L=according to Legrand (A. ch. (2) 59. 438).

B.-pt.	G	L
101*	11.5	13
102	22.5	22.5
103	32	31
104	40	38.8
105	47.5	46.1
106	54.5	53.1
107	61	59.6
108	67	65.9
109	73	71.9
110	78.5	77.6
111	83.5	83.0
112	88.5	88.2
113	93.5	93.2
114	98.5	98.0
115	103.5	102.8
116	108.5	107.5
117	113.5	112.3
118	117.5	117.1
119	122.5	122.0
120	127.5	127.0
121	132.5	132.0
122	137.5	137.0
123	142.5	142.0
124	147.5	147.1
125	152.5	152.2
126	158	157.3
127	163.5	162.5
128	169.5	167.7
129	175.5	172.9
130	181.5	178.1
131	187.5	183.4
132	193.5	188.8
133	199.5	194.2
133 3	202.5	
134	.	190.6
135	....	205.0

When  $K_2CO_3 + Aq$  is sat. with  $NH_3$ , two layers form. When  $K_2CO_3$  is added to  $NH_4OH + Aq$ , it dissolves with formation of two layers and evolution of  $NH_3$ . The same takes place also when sat.  $K_2CO_3 + Aq$  and  $NH_4OH + Aq$  are brought together. (Girard, Bull. Soc. (2) 43. 552.)

Solubility of  $K_2CO_3 + KHCO_3$  in  $H_2O$  at  $70^\circ$ .

g per 100 cc solution		Sp. gr.
$K_2CO_3$	$KHCO_3$	
0 0	21.2	1.133
11 8	15.3	1.182
16 7	12.6	1.200
23 8	10.3	1.241
34.0	7.6	1.298
43.0	5.9	1.350
51 6	4 9	1.398
60 5	3 8	1.448
81.4	0.0	1.542

(Engel, A. ch. 1888, (6) 13. 348.)

Equilibrium between  $K_2CO_3$  and  $KHCO_3$  in  $H_2O$  and in contact with the air. System:  $K_2CO_3$ ,  $KHCO_3$ , and  $CO_2$  at  $25^\circ C$

Grams atoms K per liter	Amount of solution used for titration cc	Amount K combined as $K_2CO_3$ Per cent	Amount K combined as $KHCO_3$ Per cent
0.393	5	77.5	22.5
0.553	2	83.9	16.1
1.025	2	86.8	13.2
1.865	2	91.4	8.6
2.820	2	89.0	11.0
3.710	2	88.6	11.4
4.310	1	89.6	10.4
5.095	1	88.7	11.3

(Cameron and Briggs, J. phys. Chem. 1901, 5, 546.)

Solubility of  $K_2CO_3 + Na_2CO_3$  in  $H_2O$  at  $25^\circ$ .

g per 100 g solution		g per 100 g $H_2O$		Solid phase
$K_2CO_3$	$Na_2CO_3$	$K_2CO_3$	$Na_2CO_3$	
52.82	0	112	0	$K_2CO_3 \cdot 2H_2O$
42.0	1.0	110.7	2.2	"
50.7	2.6	108.7	5.7	"
19.0	4.0	105.5	10.0	$K_2CO_3 \cdot 2H_2O + Na_2CO_3$
				$K_2CO_3 \cdot 12H_2O$
46.5	4.3	94.0	8.8	$Na_2CO_3 \cdot K_2CO_3 \cdot 12H_2O$
46.2	5.2	94.8	10.0	"
41.0	5.3	77.0	11.8	"
37.7	7.0	68.3	12.6	"
31.0	10.5	33.0	17.0	"
29.8	11.3	50.5	19.1	"
25.2	14.1	41.4	23.2	"
22.4	16.6	36.8	27.3	"
19.8	18.7	32.1	30.3	"
10.1	19.7	31.2	32.1	"
15.1	23.2	24.5	37.0	"
14.5	22.8	23.1	36.4	$Na_2CO_3 \cdot K_2CO_3 \cdot 12H_2O + Na_2CO_3 \cdot 10H_2O$
10.8	22.7	16.2	34.0	"
10.7	22.4	16.0	33.5	"
7.7	21.9	6.4	29.8	"
0	22.71	0	20.37	"

(Osaka, J. Tok. Chem. Soc. 1911, 32, 870)

Solubility of  $K_2CO_3 + Na_2CO_3$  in  $H_2O$  at  $24^\circ$ .

In 1000 cem $H_2O$		Solid phase
$Na_2CO_3$	$K_2CO_3$	
28.35		$Na_2CO_3$
354.2	150.03	"
369.7	226.6	"
363.0	243.5	$Na_2CO_3 \cdot K_2CO_3 \cdot 6H_2O$
330.8	282.7	"
273.8	344.9	"
187.2	483.9	"
130.0	921.5	"
137.9	982.6	"
112.3	1074.0	$Na_2CO_3 \cdot K_2CO_3 \cdot 6H_2O + Na_2CO_3$
95.2	1085.1	"
25.5	1108.6	$K_2CO_3$
	1126.7	"

(Kremann and Zitec, M. 1909, 30, 317.)

Solubility of  $K_2CO_3 + Na_2CO_3$  in  $H_2O$  at  $10^\circ$ .

In 1000 cem $H_2O$		Solid phase
$Na_2CO_3$	$K_2CO_3$	
119.8		$Na_2CO_3$
176.4	354.1	"
108	500.1	"
61.19	1052.9	$Na_2CO_3 \cdot K_2CO_3$
	1084.0	$K_2CO_3$

(Kremann and Zitec, M. 1909, 30, 324.)

Solubility of  $K_2CO_3 + KNO_3$  in  $H_2O$  at  $25.2^\circ$ .

1 l of the solution contains	
Mol $K_2CO_3$	Mol $KNO_3$
0.00	3.217
0.59	2.62
1.35	1.97
2.10	1.46
2.70	1.14
3.58	0.79

(Touren, C. R. 1900, 131, 259)

Solubility of  $K_2CO_3 + KNO_3$  in  $H_2O$  at  $10^\circ$ .

In 1000 cem $H_2O$		Solid phase
$KNO_3$	$K_2CO_3$	
208.9		$KNO_3$
26.62	1076.0	$KNO_3 \cdot K_2CO_3$
...	1084.0	$K_2CO_3$

(Kremann and Zitec, M. 1909, 30, 325.)

Solubility of  $K_2CO_3 + KNO_3$  in  $H_2O$  at  $24.2^\circ$ .

In 1000 ccm $H_2O$		Solid phase
$KNO_3$	$K_2CO_3$	
376.85		$KNO_3$
285.00	130.3	"
161.67	348.4	"
141.80	371.9	"
73.04	688.1	"
38.78	878.3	"
31.11	1112.2	$KNO_3, K_2CO_3$

(Kremann and Zitek, M. 1909, 30, 316.)

Solubility of  $K_2CO_3 + KCl$  in  $H_2O$  at  $30^\circ$ .

$\frac{\%}{100}$		Solid phase
$K_2CO_3$	$KCl$	
53.27	0	$K_2CO_3, 1\frac{1}{2}H_2O$
52.22	1.03	$K_2CO_3, 1\frac{1}{2}H_2O + KCl$
51.66	1.07	$KCl$
1.64	26.22	$KCl$
0	28.01	"

\* Author gives intermediary data.  
(de Waal, Dissert. 1910.)Solubility of  $K_2CO_3 + KOH$  in  $H_2O$  at  $0^\circ$ .

$\frac{\%}{100}$		Solid phase
$KOH$	$K_2CO_3$	
55.75	0	$KOH, 2H_2O$
55.14	2.05	$KOH, 2H_2O + K_2CO_3, 1\frac{1}{2}H_2O$
53.77	2.50	$K_2CO_3, 1\frac{1}{2}H_2O$
0	53.27	$K_2CO_3, 1\frac{1}{2}H_2O$

\* Author gives intermediary data.  
(de Waal, Dissert. 1910.)Insol in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)Sol in 9 pts alcohol of  $17^\circ B$ . Insol in absolute alcohol.Not decomp by 1 pt.  $H_2SO_4 + 6$  pts. absolute alcohol. Not decomp. by 1 pt.  $HNO_3 + 6$  pts. absolute alcohol. Not decomp by an alcoholic solution of  $HCl$ , oxalic, racemic, tartaric, or glacial acetic acids, but is decomp. by alcoholic solution of citric acid.Solubility in methyl alcohol. Composition of liquids in equilibrium with solid  $K_2CO_3$  at  $t^\circ$ .

$t^\circ$	Upper layer			Lower layer		
	$\frac{\%}{100}$	$K_2CO_3$	$\frac{\%}{100}$	$\frac{\%}{100}$	$K_2CO_3$	$\frac{\%}{100}$
	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$
-30	21.7	42.2	36.1	.	.	.
-20	13.8	52.1	34.1	.	.	.
-20	12.4	.	.	44.2	8.2	47.6
0	7.6	66.3	28.1	46.3	6.7	47
0	7.4	.	.	46.6	6.6	46.8
+17	6.2	69.6	24.2	48.3	5.7	46
35	5.0	72.9	22.1	.	4.3	44.7

(de Bruyn, Z. phys. Ch. 1900, 32, 63 and ff.)

Solubility in ethyl alcohol. Composition of liquids in equilibrium with solid  $K_2CO_3$  at  $t^\circ$ .

$t^\circ$	Upper layer			Lower layer		
	$\frac{\%}{100}$	$K_2CO_3$	$\frac{\%}{100}$	$\frac{\%}{100}$	$K_2CO_3$	$\frac{\%}{100}$
	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$
-18	0.03	90.3	9.7	51.2	0.2	48.6
0	0.04	91.9	8.1	51.3	0.2	48.5
+17	0.06	91.5	8.4	52.1	0.2	47.7
35	0.07	90.9	9	53.4	0.2	46.4
50	0.09	91.8	8.1	55.3	0.2	44.5
75	0.12	91.4	8.5	57.9	2.0	40.9

(de Bruyn)

Solubility in ethyl alcohol + Aq at  $25^\circ$ .When  $K_2CO_3$  is dissolved in ethyl alcohol + Aq two layers are formed, the compositions of which are as follows:

Upper layer			Lower layer		
$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$	$\frac{\%}{100}$
alcohol	$H_2O$	$K_2CO_3$	alcohol	$H_2O$	$K_2CO_3$
81.25	18.61	0.14	0.82	55.42	43.76
71.67	27.91	0.42	1.79	61.61	36.60
56.98	41.55	1.47	4.03	66.73	30.25
53.92	44.13	2.05	4.88	66.87	28.25
50.21	47.24	2.55	5.54	67.06	27.41
43.93	52.04	3.92	7.71	67.55	24.74
37.64	56.45	5.90	10.54	67.40	22.06
28.43	61.57	10.00	15.73	66.38	17.90

(Cuno, W. Ann. 1909, (4) 28, 664)

Solubility of  $K_2CO_3$  in alcohol + Aq at  $30^\circ$ .

$K_2CO_3$	$\frac{\%}{100}$	$\frac{\%}{100}$	Solid phase	
	Alcohol	$H_2O$		
53.27	0	46.73	$K_2CO_3, 1\frac{1}{2}H_2O$	
53.09	0.1	46.81	"	
			"	
			"	
0.13	90.49	9.38	$K_2CO_3, 1\frac{1}{2}H_2O$	
			"	
			"	
0.04	99.92	0.04	$K_2CO_3 + K_2CO_3, 1\frac{1}{2}H_2O$	

\* Solution separates into two layers.  
(de Waal, Dissert. Leiden, 1910)A full discussion of the solubility of  $K_2CO_3$  in methyl, ethyl, propyl, isopropyl, and allyl alcohols is given by Frankforter and Frary (J. phys. Ch. 1913, 17, 402), and Frankforter and Temple (J. Am. Chem. Soc. 1915, 37, 2697).

$K_2CO_3$  will "salt out" acetone from aqueous solution. The table shows the composition of the solutions at the points at which inhomogeneous solutions of  $K_2CO_3$ , acetone and  $H_2O$  just become homogeneous at 20°. 100 g. of the solution contain

$K_2CO_3$	$H_2O$	acetone	$K_2CO_3$	$H_2O$	acetone
18.84	73.22	7.94	2.43	55.36	42.21
13.32	71.38	15.30	22.29	72.81	4.90
11.83	70.34	17.83	17.86	73.12	9.02
10.13	69.03	20.84	15.81	72.53	11.66
8.24	67.31	24.45	14.39	71.89	13.72
7.22	65.99	26.79	10.29	69.46	20.25
6.04	64.39	29.57	1.91	54.05	44.04
28.87	69.08	2.05	1.76	52.86	45.38
23.94	71.98	4.08	1.60	51.60	46.80
21.52	72.75	5.33	1.29	49.57	49.14
19.60	73.10	7.70	1.08	47.86	51.06
6.46	65.34	28.20	0.94	46.73	52.33
5.91	64.65	29.44	0.75	44.72	54.53
5.60	63.93	30.47	0.63	43.31	56.03
5.04	62.80	32.16	0.60	42.49	56.91
4.50	61.48	34.02	0.54	41.73	57.73
3.80	59.79	36.41	0.50	40.69	58.81
3.18	57.95	38.87	0.46	40.48	60.06
2.73	56.50	40.77	.	.	.

(Frankforter and Cohen, J. Am. Chem. Soc. 1914, 36, 1121.)

Insol in benzonitrile (Naumann, B. 1914, 47, 1370.)

Insol in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1910, 34, 314.)

Sol in phenol.

Sol. in 13.5 pts. glycerine of 1.225 sp gr. (Vogel, N. Repert. 16, 557.)

100 g. sat.  $K_2CO_3$  + sugar + Aq contains 22.44 g.  $K_2CO_3$  and 56 g. sugar at 31.25° (Köhler, Z. Ver. Zuckerind 1897, 47, 447.)

+  $H_2O$ .

+  $1\frac{1}{2}H_2O$ . Very deliquescent. (Pohl.) Deliquescent only in very moist air. (Städeler.)

Sol. in  $H_2O$  with evolution of heat. (Pohl.)

Sol. at 17.6° with absorption of heat, at 32° with evolution of heat, and at 25° with neither absorption nor evolution of heat. (Berthelot, C. R. 78, 1722.)

Sat. solution of  $K_2CO_3$  +  $1\frac{1}{2}H_2O$  in  $H_2O$  contains 53.27 g. anhydrous  $K_2CO_3$  in 100 g. solution at 80°. (de Waal, Dissert. 1910.)

+  $2H_2O$ . Salt usually given as containing  $1\frac{1}{2}H_2O$  contains  $2H_2O$ . (Gerlach, Z. anal. 26, 460.)

Sat. solution of  $K_2CO_3$  +  $2H_2O$  contains 112 g. anhydrous  $K_2CO_3$  in 100 g.  $H_2O$  at 25°. (Osaka, J. Tok. Ch. Soc. 1911, 32, 870.)

+  $4H_2O$ . Not deliquescent in closed vessels. (Gerlach, l. c.)

Potassium hydrogen carbonate,  $KHCO_3$ .

Not deliquescent.

Sol. in 3.5 pts  $H_2O$  at 15° (Redwood) Sol in 4 pts  $H_2O$  at moderate temperatures (Bergmann) Sol in 0.8334 pt. boiling  $H_2O$  (Pelletier); in 4 pts. cold, and 1.2 pts. boiling  $H_2O$  (M. R. and P.'s Pharm.) Sol in 4 pts  $H_2O$  at 18.75° (Abt.) 100 pts  $H_2O$  at 13.3° dissolve 30 pts and at 100°, 83 pts (Ure's Diet) 100 pts  $H_2O$  at 10-11° dissolve 26.1 pts  $KHCO_3$ , and the sp gr of solution is 1.1535 (Anshon, Dingl 161 216)

100 pts.  $H_2O$  dissolve at—

0°	10°	20°	30°
19.61	23.23	26.91	30.57 pts. $KHCO_3$ ,
40°	50°	60°	70°
34.15	37.92	41.35	45.24 pts. $KHCO_3$ .

(Poggiale, A. ch. (3) 8, 468.)

100 pts  $H_2O$  dissolve pts.  $KHCO_3$  at t°.

t°	Pts $KHCO_3$	t°	Pts $KHCO_3$
0	22.4	40	45.2
20	33.2	60	46.4

(Dibbitts, J. pr. (2) 10, 417.)

Sp gr. of  $KHCO_3$  + Aq at 15° containing 5%  $KHCO_3$  = 1.0823; containing 10%  $KHCO_3$  = 1.0674. (Kohlrausch, Z. anal. 28, 472.)

Sol. in 1200 pts. boiling alcohol. (Berthelot.) Insol. in alcohol. (Dumas.)

100 pts.  $H_2O$  dissolve 19.3 pts.  $KHCO_3$  and 8.3 pts.  $NaHCO_3$ , if the sat. solution of latter is sat. with former; and 26.1 pts  $KHCO_3$  and 6.0 pts  $NaHCO_3$ , if the sat. solution of the former is sat with the latter, all at 10° (Mulder, J. B. 1866, 67.)

Insol. in sat.  $K_2CO_3$  + Aq. (Engel, C. R. 102, 365.)

Solubility of  $KHCO_3$  +  $KNO_3$  in  $H_2O$  in an atmosphere of  $CO_2$ .

1 litre of the solution contains			
at 14.5°		at 25.2°	
Mol $KHCO_3$	Mol $KNO_3$	Mol $KHCO_3$	Mol $KNO_3$
0.00	2.33	0.00	3.28
0.39	2.17	0.89	2.84
0.76	2.03	1.33	2.65
1.16	1.92	1.91	2.45
1.55	1.81	.	.

This case is complicated by the fact that  $KNO_3$  is more sol. in  $H_2O$  sat with  $CO_2$  than in pure  $H_2O$ .

(Touren, C. R. 1900, 131, 261.)

Insol. in benzonitrile (Naumann, B. 1914, 47, 1370.)

Insol in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate (Naumann, B. 1910, 43, 314.)

Potassium praseodymium carbonate,  $K_2CO_3$ ,  $Pr_2(CO_3)_3$  +  $12H_2O$ .

Ppt. Sol. in 20%  $K_2CO_3$  + Aq (Meyer, Z. anorg. 1904, 41, 104.)

Potassium samarium carbonate,  $K_2CO_3 \cdot Sm_2(CO_3)_3 + 12H_2O$ .  
(Cleve.)

Potassium silver carbonate,  $KAgCO_3$ .  
Decomp. by  $H_2O$ . (de Schulten, C. R. 105. 811.)

Ppt. Decomp. by  $H_2O$ . (Reynolds, Chem. Soc 1898, 73 265.)

Potassium sodium carbonate,  $KNaCO_3 + 6H_2O$

Slightly efflorescent. Sol. in 0.75 pt  $H_2O$  at  $12.5^\circ$ ; in 0.54 pt.  $H_2O$  at  $15^\circ$ .

Sat. solution at  $15^\circ$  has sp gr. = 1.366. (Stolba, J. pr. 94. 406.)

Decomp. by recrystallizing from  $H_2O$ , but crystallizes undecomposed from sat.  $K_2CO_3 + Aq$ .

Sol. in  $H_2O$  (Osaka, C. A. 1911. 2601.)  
See  $K_2CO_3 + Na_2CO_3$  under  $Na_2CO_3$ .

+  $3H_2O$ . (Kreman and Zitey, M. 1909. 30. 317.) Does not exist (Osaka.)

$K_2CO_3 \cdot 2Na_2CO_3 + 18H_2O$ . Sl. efflorescent. Very sol. in  $H_2O$ . (Marignac.)

Potassium stannous carbonate,  $K_2CO_3 \cdot 2SnCO_3 + 2H_2O$

Decomp. by  $H_2O$  (Deville)

Potassium uranyl carbonate,  $2K_2CO_3 \cdot (UO_2)_2CO_3$ .

Sol. without decomp. in 13.5 pts.  $H_2O$  at  $16^\circ$ , and in somewhat less warm  $H_2O$ . Sol. in boiling  $H_2O$  with decomp.

More sol. in  $K_2CO_3$ , or  $KHCO_3 + Aq$  than in  $H_2O$ . (Rose.)

Insol. in alcohol. (Ebelmen, A. ch. (3) 5. 189.)

Potassium zinc carbonate,  $4K_2O \cdot 6ZnO \cdot 11CO_2 + 8H_2O$ .

Can be washed with cold  $H_2O$  without decomp. (Deville, A. ch. (3) 33. 99.)

Praseodymium carbonate,  $Pr_2(CO_3)_3 + 8H_2O$ .

Sol. in  $H_2O$ . (von Schule, Z. anorg. 1898, 18. 362.)

Praseodymium sodium carbonate,  
 $2Pr_2(CO_3)_3 \cdot 3Na_2CO_3 + 22H_2O(?)$ .

Ppt. Easily decomp. (Meyer, Z. anorg. 1904, 41. 105.)

Radium carbonate.

Less sol. in  $H_2O$  than corresponding Ba comp. (Curne, Dissert 1903.)

Rubidium carbonate,  $Rb_2CO_3$ .

Very deliquescent, and sol. in  $H_2O$ . 100 pts. absolute alcohol dissolve 0.74 pt.  $Rb_2CO_3$ . (Bunsen.)

Rubidium hydrogen carbonate,  $RbHCO_3$ .

Not deliquescent. Easily sol. in  $H_2O$ . (Bunsen.)

Samarium carbonate,  $Sm_2(CO_3)_3 + 3H_2O$ .  
Insol. in  $H_2O$ . (Cleve, Bull. Soc. (2) 43. 168.)

Samarium sodium carbonate,  $Sm_2(CO_3)_3 \cdot Na_2CO_3 + 16H_2O$ .

Ppt. (Cleve.)

Scandium carbonate,  $Sc_2(CO_3)_3 + 12H_2O$ .

(Crookes, Roy. Soc. Proc. 1908, 80, A. 518.)

Scandium sodium carbonate,  $Sc_2(CO_3)_3 \cdot 4Na_2CO_3 + 6H_2O$ .

Difficultly sol. in  $H_2O$ .

Sol. in cold, less sol. in hot alkali carbonates +  $Aq$  (R. Meyer, Z. anorg. 1910, 67. 410.)

Silver carbonate,  $Ag_2CO_3$ .

Somewhat sol. in  $H_2O$ . Sol. in 31,978 pts.  $H_2O$  at  $15^\circ$ . (Kremers, Pogg. 85. 248.) 1 g.  $Ag_2CO_3$  dissolves in 21 boiling  $H_2O$ . (Joulin, A. ch. (4) 30. 260.)

Solubility in  $H_2O$  at  $25^\circ = 1.16 \times 10^{-4}$  mol./l. (Spencer and Le Pla, Z. anorg. 1910, 65. 14.)

1 l.  $H_2O$  at  $25^\circ$  dissolves  $1.2 \times 10^{-4}$  gram atoms of silver. (Abegg and Cox, Z. phys. Ch. 1903, 46. 11.)

Insol. in  $H_2CO_3 + Aq$  (Beigman.) Sol. in 961 pts.  $H_2CO_3 + Aq$ . (Lassagne.) 1 l. sat.  $H_2CO_3 + Aq$  dissolves 0.846 g.  $Ag_2CO_3$  at  $15^\circ$ . (Johnson, C. N. 54. 75.)

Sol. in  $(NH_4)_2CO_3 + Aq$  or  $NH_4OH + Aq$ ; sl. sol. in  $K_2CO_3 + Aq$  (Wittstaten.) Easily sol. in  $Na_2S_2O_3 + Aq$  (Herschel, 1819.) Sol. in hot  $NH_4Cl + Aq$ , and sl. sol. in  $NH_4NO_3 + Aq$ . (Brett, 1837.) Not pptd. in presence of  $Na$  citrate (Spiller.) Decomp. by  $HCl + Aq$ , and chlorides +  $Aq$ .

Somewhat sol. in conc.  $NaNO_3 + Aq$ . (de Connick, Belg. Acad. Bull. 1909, 333.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in alcohol

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

Silver carbonate ammonia.

Easily sol. in  $H_2O$ . Sol. in  $NH_4OH + Aq$ , from which it is precipitated by absolute alcohol. (Berzelius.)

$Ag_2CO_3 \cdot 4NH_3$ . Ppt. Insol. in alcohol. (Kcen, C. N. 31. 231.)

Sodium carbonate,  $Na_2CO_3$ .

Anhydrous. Sol. in  $H_2O$  with evolution of heat.

Sol. in 5.967 pts.  $H_2O$  at  $15^\circ$ . (Freemant.) 100 pts.  $H_2O$  at  $14^\circ$  dissolve 7.74 pts.  $Na_2CO_3$ , or 20.64 pts.  $Na_2CO_3 \cdot 10H_2O$  is sol. in rather less than 1 pt. boiling  $H_2O$ . (Thomson, 1831.)

Sol. in 2 pts.  $H_2O$  (Bogman.)

Sol. in 2 pts.  $H_2O$  at  $18.75^\circ$ . (Abl.)

Solubility in 100 pts  $H_2O$  at  $t^\circ$ 

$t^\circ$	Pts $Na_2CO_3$	Pts $Na_2CO_3 + 10H_2O$	$t^\circ$	Pts $Na_2CO_3$	Pts $Na_2CO_3 + 10H_2O$
0	7 08	21 52	25	35 90	171 33
10	10 06	61 04	30	35 90	241 57
20	30 83	123 12	104 6	48 50	420 68

(Poggend., A. ch. (3) 8 468)

Possesses four different degrees of solubility, according to different states of molecular constitution and degrees of hydration (Lowel, A. ch. (3) 44, 330)

Little more sol. at 34–38° than at 104°, but maximum of solubility is probably at 15° (Lowel.)

Solubility of  $Na_2CO_3$ ,  $Na_2CO_3 + 10H_2O$ ,  $Na_2CO_3 + 7H_2O$  (a), and  $Na_2CO_3 + 7H_2O$  (b) in  $H_2O$ .

$t^\circ$	Sat. solution of $Na_2CO_3 + 10H_2O$ contains—		Sat. solution of $Na_2CO_3 + 7H_2O$ (b) contains—			Sat. solution of $Na_2CO_3 + 7H_2O$ (a) contains—		
	Pts $Na_2CO_3$ in 100 pts $H_2O$	Pts $Na_2CO_3 + 10H_2O$ in 100 pts $H_2O$	Pts $Na_2CO_3$ in 100 pts $H_2O$	Pts $Na_2CO_3 + 7H_2O$ (b) in 100 pts $H_2O$	Pts $Na_2CO_3 + 10H_2O$ in 100 pts $H_2O$	Pts $Na_2CO_3$ in 100 pts $H_2O$	Pts $Na_2CO_3 + 7H_2O$ (a) in 100 pts $H_2O$	Pts $Na_2CO_3 + 10H_2O$ in 100 pts $H_2O$
0	6 97	21 33	20 30	58 03	84 28	31 93	112 94	188 37
10	12 06	40 94	26 33	83 94	128 57	37 85	150 77	286 13
15	16 20	63 20	29 58	100 00	160 51	41 65	179 90	381 29
20	21 71	92 82	38 55	122 25	210 58	45 79	220 20	556 71
25	28 50	149 13	38 07	152 36	290 91			
30	37 24	273 64	43 45	196 93	447 93			
38	51.67	1142 17						
104	45 47	539 63						

(Lowel, A. ch. (3) 33, 382)

100 pts  $H_2O$  at 14° dissolve 60.4 pts.  $Na_2CO_3 + 10H_2O$ ; at 36°, 833 pts.; at 104°, 445 pts. Solubility increases to 36°, then diminishes (Payen, A. ch. (3) 43, 233.)

There are apparently two maxima of solubility; the one occurring at 15°, or even lower, as warm solutions cool; the other at 34–38°, when cold solutions are warmed (Payen, A. ch. (3) 44, 330)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts $Na_2CO_3$	$t^\circ$	Pts $Na_2CO_3$	$t^\circ$	Pts $Na_2CO_3$
0	7.1	22	23 8	43	46.2
1	7.5	23	25 1	44	46.2
2	7.8	24	26 5	45	46 2
3	8 4	25	28 0	46	46 2
4	8 9	26	29 7	47	46 2
5	9 5	27	31 6	48	46 2
6	10 0	28	33 6	49	46 2
7	10 6	29	35 8	50	46 2
8	11 2	30	38 1	51	46 2
9	11 9	31	41.4	52	46 2
10	12 6	32	46.2	53	46.2
11	13 3	32.5	59 0	54	46 2
12	14.0	33	46 2	55	46 2
13	14 8	34	46.2	56	46 2
14	15 0	35	46 2	57	46 2
15	16 5	36	46 2	58	46 2
16	17.4	37	46 2	59	46 2
17	18.3	38	46 2	60	46 2
18	19.3	39	46 2	61	46 2
19	20.3	40	46 2	62	46 2
20	21.4	41	46 2	63	46 2
21	22 6	42	46 2	64	46.2

Solubility in 100 pts  $H_2O$  at  $t^\circ$ —Continued

$t^\circ$	Pts $Na_2CO_3$	$t^\circ$	Pts $Na_2CO_3$	$t^\circ$	Pts $Na_2CO_3$
65	46 2	79	46 2	93	45.0
66	46 2	80	46 1	94	45.0
67	46 2	81	46 1	95	45 6
68	46 2	82	46 1	96	45 6
69	46 2	83	46 0	97	45 5
70	46 2	84	46 0	98	45 5
71	46 2	85	45 9	99	45 5
72	46 2	86	45 9	100	45 4
73	46 2	87	45 8	101	45 4
74	46 2	88	45 8	102	45 3
75	46 2	89	45 8	103	45 3
76	46 2	90	45 7	104	45 2
77	46 2	91	45 7	105	45 1
78	46 2	92	45 7		

(Mulder, Scheik Verhand. 1864, 129.)

Unable to form supersaturated solutions.

Supersat.  $Na_2CO_3 + Aq$  (2 pts.  $Na_2CO_3$ ,  $10H_2O$ : 1 pt.  $H_2O$ ) may be kept in a flask closed with cotton wool. (Schroder.)

When supersat.  $Na_2CO_3 + Aq$  is exposed to low temperatures, the  $10H_2O$  salt crystallizes out; but under other circumstances two other salts are formed, each containing  $7H_2O$ ; one is four times as sol. at 10° as the  $10H_2O$  salt, and the other twice as sol. See above. (Lowel, A. ch. (3) 33, 337.)

See also  $Na_2CO_3 + H_2O$ ,  $7H_2O$ , and  $10H_2O$ .

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $15^\circ$ 

% $\text{Na}_2\text{CO}_3$	Sp. gr.	% $\text{Na}_2\text{CO}_3$	Sp. gr.
0.372	1.0040	7.812	1.0892
0.744	1.0081	8.154	1.0847
1.116	1.0121	8.556	1.0882
1.488	1.0163	8.928	1.1028
1.850	1.0204	9.300	1.1074
2.232	1.0245	9.672	1.1120
2.504	1.0286	10.044	1.1167
2.876	1.0327	10.416	1.1214
3.248	1.0368	10.788	1.1261
3.620	1.0410	11.160	1.1308
4.000	1.0452	11.532	1.1356
4.464	1.0494	11.904	1.1404
4.836	1.0537	12.276	1.1452
5.208	1.0579	12.648	1.1500
5.580	1.0625	13.020	1.1549
5.952	1.0669	13.392	1.1598
6.324	1.0711	13.764	1.1648
6.696	1.0757	14.136	1.1698
6.708	1.0802	14.508	1.1748
7.440	1.0847	14.880	1.1816

(Tännerman)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $15^\circ$ .

%	Sp. gr. if % is $\text{Na}_2\text{CO}_3$	Sp. gr. if % is $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$
1	1.0105	1.004
2	1.0210	1.008
3	1.0315	1.012
4	1.0420	1.016
5	1.0525	1.020
6	1.0631	1.023
7	1.0737	1.027
8	1.0843	1.031
9	1.0950	1.035
10	1.1057	1.039
11	1.1165	1.043
12	1.1274	1.047
13	1.1384	1.050
14	1.1495	1.054
15		1.058
16		1.062
17		1.066
18		1.070
19		1.074
20		1.078
21		1.082
22		1.086
23		1.090
24		1.094
25		1.099
26		1.103
27		1.106
28		1.110
29		1.114
30		1.119
31		1.123
32		1.126
33		1.130
34		1.135
35		1.139
36		1.143
37		1.147
38		1.150

(Gerlach, Z. anal. 8. 279.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $17.5^\circ$ .

% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	Sp. gr.	% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	Sp. gr.
1	2.70	1.010	9	24.30	1.095
2	5.40	1.020	10	27.00	1.105
3	8.10	1.031	11	29.70	1.116
4	10.18	1.041	12	32.40	1.127
5	13.50	1.052	13	35.10	1.137
6	16.20	1.063	14	37.80	1.148
7	18.90	1.073	15	40.50	1.157
8	21.60	1.084			

(Hager.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  increases or diminishes by a change of temperature of  $1^\circ$  by the following amounts—

Corr	% $\text{Na}_2\text{CO}_3$
0.0004	13-15
0.00033	8-12
0.00026	3-7

(Hager, Comm 1883.)

Sp. gr. of conc  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $30^\circ$ .

Sp. gr.	% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3$ in 1 l.	Sp. gr.	% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3$ in 1 l.
1.310	28.13	368.5	1.220	20.47	249.7
1.300	27.30	354.9	1.210	19.61	237.3
1.290	26.46	341.3	1.200	18.76	225.1
1.280	25.62	327.9	1.190	17.90	214.0
1.270	24.78	314.7	1.180	17.04	201.1
1.260	23.93	301.5	1.170	16.18	189.3
1.250	23.08	288.5	1.160	15.32	177.7
1.240	22.21	275.4	1.150	14.47	166.4
1.230	21.33	262.3	1.140	13.62	155.3

(Lunge, Chem. Ind 1882. 320)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $23^\circ$ 

% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	% $\text{Na}_2\text{CO}_3$	Sp. gr.	% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	% $\text{Na}_2\text{CO}_3$	Sp. gr.
1	0.370	1.0038	16	5.929	1.0628
2	0.741	1.0076	17	6.299	1.0668
3	1.112	1.0114	18	6.670	1.0708
4	1.482	1.0153	19	7.041	1.0748
5	1.853	1.0192	20	7.412	1.0789
6	2.223	1.0231	21	7.782	1.0836
7	2.594	1.0271	22	8.153	1.0871
8	2.965	1.0309	23	8.523	1.0912
9	3.335	1.0348	24	8.894	1.0953
10	3.706	1.0388	25	9.264	1.0994
11	4.076	1.0428	26	9.635	1.1035
12	4.447	1.0468	27	10.005	1.1076
13	4.817	1.0508	28	10.376	1.1117
14	5.188	1.0548	29	10.746	1.1158
15	5.558	1.0588	30	11.118	1.1200

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $23^\circ$ —*Continued.*

$\frac{\% \text{Na}_2\text{CO}_3}{\% + 10\text{H}_2\text{O}}$	$\frac{\% \text{Na}_2\text{CO}_3}{\% \text{Na}_2\text{CO}_3}$	Sp. gr.	$\frac{\% \text{Na}_2\text{CO}_3}{\% + 10\text{H}_2\text{O}}$	$\frac{\% \text{Na}_2\text{CO}_3}{\% \text{Na}_2\text{CO}_3}$	Sp. gr.
31	11 488	1 1242	41	15 195	1 1662
32	11 859	1 1284	42	15 556	1 1704
33	12 230	1 1326	43	15 936	1 1746
34	12 600	1 1368	44	16 307	1 1788
35	12 971	1 1410	45	16 677	1 1830
36	13 341	1 1452	46	17 048	1 1873
37	13 712	1 1494	47	17 418	1 1916
38	14 082	1 1536	48	17 789	1 1959
39	14 530	1 1578	49	18 159	1 2002
40	14 824	1 1620	50	18 530	1 2045

(Schiff, A. 113. 186.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $23.3^\circ$ .  $\alpha$  = number of grms.  $\times \frac{1}{2}$  mol. wt., dissolved in 1000 grms.  $\text{H}_2\text{O}$ ;  $b$  = sp. gr. if  $\alpha = \text{Na}_2\text{CO}_3$ ,  $10\text{H}_2\text{O}$  ( $\frac{1}{2}$  mol. wt. = 143);  $c$  = sp. gr. if  $\alpha = \text{Na}_2\text{CO}_3$  ( $\frac{1}{2}$  mol. wt. = 53).

$\alpha$	$b$	$c$	$\alpha$	$b$	$c$
1	1 048	1 052	5	1 163	1 226
2	1 086	1 100	6	1 182	.
3	1 117	1 145	7	1 198	.
4	1 142	1 187			..

(Favre and Vaisson, C. R. 79. 968.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $18^\circ$ .

$\frac{\% \text{Na}_2\text{CO}_3}{\% \text{Na}_2\text{CO}_3}$	Sp. gr.	$\frac{\% \text{Na}_2\text{CO}_3}{\% \text{Na}_2\text{CO}_3}$	Sp. gr.
5	1 0511	15	1 1590
10	1 1044	..	.

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$ .

g-equivalents $\text{Na}_2\text{CO}_3$ per l.	$t^\circ$	Sp. gr. $t^\circ/t^\circ$
0 002524	16 004	1 0001418
0 005041	16 026	1 0002844
0 01006	16 049	1 000568
0 02501	16 028	1 001413
0 04954	16 050	1 002789
0 10188	16 030	1 005699
0 24646	16 041	1 013598
0 002628	16 051	1 0001473
0 003948	16 088	1 0002216
0 009182	16 081	1 0005181
0 01830	16 089	1 001033
0 10842	16 042	1 008048
0 21570	16 055	1 011910
0 4297	15 14	1 02346
2 5015	16 05	1 12533

(Kohlrausch, W. Ann. 1894, 53. 26.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $t^\circ$ .  $\text{H}_2\text{O}$  at  $4^\circ = 1$ .

$t^\circ$	$\% \text{Na}_2\text{CO}_3$	Sp. gr.
60°	28 74	1 2971
	25 20	1 2546
	22 25	1 2191
	18 23	1 1746
	14 06	1 1277
80°	28 59	1 2807
	18 26	1 1607

(Wegscheider, M. 1905, 26. 690.)

Sp. gr. of dil  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $20.004^\circ$   
 Conc. = g. equiv.  $\text{Na}_2\text{CO}_3$  per l. at  $20.004^\circ$   
 and 730 mm.

Sp. gr. compared with  $\text{H}_2\text{O}$  at  $20.004^\circ = 1$ .

Conc.	Sp. gr.
0.0000	1 000,000,0
0.0001	1 000,005,8
0.0002	1 000,011,2
0.0004	1 000,022,5
0.0005	1 000,028,1
0.0010	1 000,056,3
0.0020	1 000,112,7
0.0040	1 000,225,8
0.0050	1 000,282,4
0.0100	1 000,564,8

(Lamb and Lee, J. Am. Chem. Soc. 1913, 35. 1685.)

$\text{Na}_2\text{CO}_3 + \text{Aq}$  containing 5%  $\text{Na}_2\text{CO}_3$  boils at  $100.5^\circ$ ; 10%  $\text{Na}_2\text{CO}_3$  at  $101.1^\circ$ ; 15%  $\text{Na}_2\text{CO}_3$  at  $101.8^\circ$ . (Gerlach.)

Sat. solution boils at  $104.4^\circ$  (Griffiths, 1825);  $106^\circ$  (Kremer);  $104^\circ$  (Payen.)

Sat. solution forms a crust at  $104.1^\circ$ , and contains 42.2 pts.  $\text{Na}_2\text{CO}_3$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temperature observed,  $105^\circ$ . (Gerlach, Z. anal. 28. 427.)

B-pt. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  containing pts.  $\text{Na}_2\text{CO}_3$  to 100 pts.  $\text{H}_2\text{O}$ . G = according to Gerlach (Z. anal. 26. 458); L = according to Legrand (A. ch. (2) 59. 426).

B-pt	G	L	B-pt	G	L
100 5°	5 2	7 5	103 5°	36 2	41 0
101 0	10 4	14 4	104 0	41 2	44 7
101.5	15 6	20 8	104 5	46 2	47 9
102.0	20 8	26 7	104 63		48.5
102 5	26 0	32 0	105 0	51 2	..
103 0	31.1	36 8	..	..	..

Less sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Fresenius.)

See also under *Ammonia*.  
 Solubility of  $\text{Na}_2\text{CO}_3 + \text{NH}_4\text{Cl}$ . See under *Ammonium Chloride*.

Solubility of  $\text{Na}_2\text{CO}_3 + \text{K}_2\text{CO}_3$ . See under *Carbonate, potassium*.

The reciprocal solubility of sodium carbonate and sodium hydrogen carbonate in  $H_2O$  has been determined. (de Paepe, C. A. 1911, 2603, and 1912, 2723.)

Solubility of  $Na_2CO_3 + NaHCO_3$  in  $H_2O$  at  $25^\circ$ .

g per 100 g $H_2O$		Solid phase
$NaHCO_3$	$Na_2CO_3$	
0	28.3	$Na_2CO_3 \cdot 10H_2O$
2.1	27.3	"
4.2	26.5	$Na_2CO_3 \cdot 10H_2O + NaHCO_3$
5.7	19.2	$NaHCO_3$
7.3	12.4	"
9.0	6.2	"
10.1	1.0	"

(de Paepe, Bull. Soc. Chim. Belg. 1911, 25, 174.)

Solubility of  $Na_2CO_3 + NaHCO_3$  in  $H_2O$  at  $25^\circ$ .

g per l		Solid phase
$NaHCO_3$	$Na_2CO_3$	
98.7	0.0	$NaHCO_3$
50.8	216.6	$NaHCO_3 + Na_2CO_3 \cdot 2H_2O$
27.6	276.3	$Na_2CO_3 \cdot 10H_2O + NaHCO_3$
0.0	276.4	$Na_2CO_3 \cdot 10H_2O$

(McCoy and Test, J. Am. Chem. Soc. 1911, 33, 474.)

Equilibrium between  $Na_2CO_3$ ,  $NaHCO_3$ , and  $CO_2$ . See under Carbonate, sodium hydrogen.

Solubility of  $NaNO_3$  in  $Na_2CO_3 + Aq$  at  $10^\circ$ .

In 1000 cem. $H_2O$		Solid phase
$NaNO_3$	$Na_2CO_3$	
805.0	...	$NaNO_3$
704.8	87.5	$NaNO_3, Na_2CO_3$
...	119.8	$Na_2CO_3$

(Kremann, M. 1909, 30, 325.)

Solubility of  $NaNO_3$  in  $Na_2CO_3 + Aq$  at  $24.2^\circ$ .

In 1000 cem. $H_2O$		Solid phase
$NaNO_3$	$Na_2CO_3$	
913.58	...	$NaNO_3$
844.50	59.61	"
627.75	217.85	$NaNO_3 + Na_2CO_3 \cdot 7H_2O$
544.8	246.30	"
459.6	263.30	$Na_2CO_3 \cdot 7H_2O$
...	28.55	$Na_2CO_3 \cdot 10H_2O$
...	...	$Na_2CO_3 \cdot 10H_2O$

(Kremann.)

Solubility of  $Na_2CO_3 + NaBr$  in  $H_2O$  at  $30^\circ$ .

$\frac{g}{100g}$ $Na_2CO_3$	$\frac{g}{100g}$ $NaBr$	Solid phase
27.98	0	$Na_2CO_3 \cdot 10H_2O$
27.54	2.41	"
26.72	4.06	"
26.23	6.26	$Na_2CO_3 \cdot 10H_2O + Na_2CO_3 \cdot 7H_2O$
23.40	11.00	$Na_2CO_3 \cdot 7H_2O$
22.68	12.22	"
19.86	16.88	"
19.57	16.95	$Na_2CO_3 \cdot 7H_2O + Na_2CO_3 \cdot H_2O$
18.11	19.32	$Na_2CO_3 \cdot H_2O$
8.45	33.39	"
6.90	36.13	"
3.04	44.75	"
2.99	45.31	$NaBr \cdot 2H_2O + Na_2CO_3 \cdot H_2O$
2.60	45.68	$NaBr \cdot 2H_2O$
0	49.40	"

(Cocheret, Dissert. 1911.)

Solubility in  $NaCl + Aq$ . 100 pts.  $H_2O$  dissolve pts.  $NaCl$  and pts.  $Na_2CO_3 + 10H_2O$ , when that salt is in excess at  $15^\circ$ .

Pts $NaCl$	Pts $Na_2CO_3 + 10H_2O$	Pts $NaCl$	Pts $Na_2CO_3 + 10H_2O$
0.00	61.42	23.70	39.06
4.03	53.86	27.93	39.73
8.02	48.00	31.65	41.44
12.02	43.78	35.46	43.77
16.05	40.96	sat.	
19.82	39.46	37.27	45.32

Solubility of anhydrous  $Na_2CO_3$  in 100 pts.  $NaCl + Aq$  containing %  $NaCl$  at  $15^\circ$ .

% $NaCl$	Pts $Na_2CO_3$	% $NaCl$	Pts $Na_2CO_3$
0	16.408	12	10.488
1	15.717	13	10.244
2	15.060	14	10.041
3	14.438	15	9.880
4	13.851	16	9.762
5	13.299	17	9.686
6	12.783	18	9.655
7	12.305	19	9.667
8	11.864	20	9.725
9	11.461	21	9.828
10	11.097	22	9.997
11	10.773	.	.

(Reich, W. A. B. 99, 2b, 433.)

Solubility of  $Na_2CO_3 + NaCl$  in  $H_2O$  at  $30^\circ$ .

$\frac{g}{100g}$ $Na_2CO_3$	$\frac{g}{100g}$ $NaCl$	Solid phase
27.98	0	$Na_2CO_3 \cdot 10H_2O$
27.48	0.9	"
27.12	3.33	"
26.82	4.15	$Na_2CO_3 \cdot 10H_2O + Na_2CO_3 \cdot 7H_2O$
25.59	5.17	$Na_2CO_3 \cdot 7H_2O$
24.26	5.93	"

Solubility of  $\text{Na}_2\text{CO}_3 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at  $30^\circ$ —Continued.

% $\text{Na}_2\text{CO}_3$	% $\text{NaCl}$	Solid phase
22.75	10.24	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
30.72	11.49	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
18.00	14.12	$\text{NaCl} + \text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
14.81	16.26	$\text{NaCl}$
9.71	18.76	"
5.05	21.94	"
0	26.47	"

(Cocheret, Dissert. 1911.)

Solubility of  $\text{Na}_2\text{CO}_3 + \text{NaI}$  in  $\text{H}_2\text{O}$  at  $30^\circ$ .

% $\text{Na}_2\text{CO}_3$	% $\text{NaI}$	Solid phase
27.4	0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
28.5	2.4	"
25.5	4.7	"
25.2	5.2	"
24.4	8.6	"
24.3	9.5	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
23.0	11.2	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
20.8	14.0	"
20.0	15.7	"
18.7	18.4	"
15.3	25.4	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
13.1	29.1	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
10.4	33.3	"
6.4	40.4	"
4.2	46.0	"
3.1	49.5	"
2.7	51.0	"
1.5	54.6	"
0.9	57.6	"
0.6	61.2	"
0.3	65.6	$\text{NaI} \cdot 2\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
0.0	65.5	$\text{NaI} \cdot 2\text{H}_2\text{O}$

(Cocheret, Dissert. 1911.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54, 874.)Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 829.)

Insol. in alcohol. (Fresenius.)

Sl. sol. in absolute alcohol, apparently insol. in an alcoholic solution of soap. (Duffy, Chem. Soc. 5, 305.)

Solubility of  $\text{Na}_2\text{CO}_3$  in ethyl alcohol at  $20^\circ$ .

Alcohol, wt per cent	g $\text{Na}_2\text{CO}_3$ per 100 g solution
44	1.7
46	1.13
48	0.9
50	0.84
54	0.80

(Lanebarger, A. Ch. J. 1892, 14, 380.)

Solubility of  $\text{Na}_2\text{CO}_3$  in alcohol +  $\text{H}_2\text{O}$  at  $30^\circ$ .

% $\text{Na}_2\text{CO}_3$	% alcohol	Hold phase
27.4	0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
26.61	2.64	"
26.14*	3.41	"
1.38	44.81	"
0.62	52.99	"
0.61	53.26	"
0.53	55.70	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
0.51	56.56	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
0.47	62.61	"
0.40	63.20	"
0.15	72.80	"
0.11	73.06	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot 11\text{H}_2\text{O}$
0.07	78.19	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
0.07	82.26	"
0.06	86.76	"
0.06	90.95	"
0.04	93.09	"
0.03	95.03	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O} + \text{Na}_2\text{CO}_3$
	95.65	$\text{Na}_2\text{CO}_3$
	98.46	"

\* Congugated liquid phases.

(Cocheret, Dissert. 1911.)

See also under  $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$ ,  $+7\text{H}_2\text{O}$  and  $+10\text{H}_2\text{O}$ Not decomp. by 1 pt.  $\text{H}_2\text{SO}_4 + 6$  pts. absolute alcohol.Not decomp. by alcoholic solutions of racemic, tartaric, or glacial acetic acids; slowly decomp. by  $\text{HNO}_3$  + absolute alcohol.Solubility of  $\text{Na}_2\text{CO}_3 + \text{NaBr}$ ,  $\text{NaCl}$  and  $\text{NaI}$  in alcohol. Numerical data given by Cocheret (Dissert. 1911), reported in Tables annuelles internationales des Constantes, etc. for 1911.Solubility of  $\text{Na}_2\text{CO}_3$  in propyl alcohol at  $20^\circ$ .

Alcohol, wt per cent	g $\text{Na}_2\text{CO}_3$ per 100 g solution
28	4.4
38	2.7
44	1.7
46	1.5
48	1.3
50	1.2
54	0.9
62	0.4

(Lanebarger, A. Ch. J. 1892, 14, 380.)

A full discussion of the solubility of  $\text{Na}_2\text{CO}_3$  in propyl, and allyl alcohol is given by Frankforter and Temple (J. Am. Ch. Soc. 1915, 37, 2697).Insol. in  $\text{CS}_2$ . (Aretowski, Z. anorg. 1894, 6, 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1904, 37, 3602.)

Solubility in mixtures of pyridine and  $H_2O$  from  $-65^\circ$  to  $+200^\circ$ . Solubility curves are given. (Limboosch, Chem. Soc. 1909, 96 (2), 472.)

Insol. in acetone and in methylal. (Edmann, C. C. 1899, II 1014.)

100 g. glycerine (sp. gr.=1.262) dissolve 98.3 g.  $Na_2CO_3$  at  $15-16^\circ$ . (Ossendowski, Pharm J 1907, 79, 575.)

100 g. sat. solution in glycol contain 3.28-3.4 g.  $Na_2CO_3$  (de Coninck, Bull. Soc. Belg. 1907, 21, 141.)

100 g. sat.  $Na_2CO_3$ +sugar+ $Aq$  contain 6.89 g.  $Na_2CO_3$ +64.73 g. sugar at  $31.25^\circ$ . (Kohler, Z. Ver. Zuckerind 1897, 47, 447.)

+ $H_2O$ . Takes up  $H_2O$  from the air. Less sol. in  $H_2O$  at  $104^\circ$  than at  $38^\circ$ ; at  $15-20^\circ$ , 100 pts.  $H_2O$  dissolve 52.4 pts. of this salt, calculated as  $Na_2CO_3$ . Insol. in alcohol. (Lowel.)

#### Solubility in 100 pts. $H_2O$ at $t^\circ$ .

Corrected $t^\circ$ (Hydrogen scale)	Pts anhydrous salt
29.86	50.53
29.89	50.75
31.80	50.31
35.17	49.63
35.37	49.67
35.66	49.37
35.88	49.44
36.45	49.36
36.90	49.29
37.91	49.11
38.92	49.09
40.94	48.51
40.93	48.52
43.94	47.98

(Wells and McAdam, J. Am. Chem. Soc. 1907, 29, 726.)

#### Solubility in alcohol+ $Aq$ .

Composition of the alcohol and water layers in contact with the solid phase  $Na_2CO_3+H_2O$ .

$t^\circ$	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
68	55.8	0.9	43.3	2.3	28.8	68.9
49	61.0	0.4	38.6	1.2	31.5	67.3
40	61.0	0.4	38.6	1.2	31.9	66.9
36	62.0	0.3	37.7	1.1	32.1	66.8
35	62.9	0.3	36.8	1.0	32.4	66.6

(Ketner, Z. phys. Ch. 1902, 39, 651.)

+ $3H_2O$ . (Schickendantz, A. 155, 359.)

+ $5H_2O$ . (Persoz, Pogg. 32, 303.)

Not efflorescent. Sol. in  $H_2O$ .

+ $6H_2O$ . (Mitscherlich, Pogg. 8, 441.)

+ $7H_2O$ . Efflorescent. Two salts,  $7H_2O$

(b) (= +  $8H_2O$  of Thomson), and  $7H_2O$

(a). See also under  $Na_2CO_3$ .

#### Solubility in 100 pts. $H_2O$ at $t^\circ$ .

Corrected $t^\circ$ (Hydrogen scale)	Pts anhydrous salt
30.35	43.50
31.82	45.16
32.86	46.28
34.37	48.22
34.76	48.98
35.15	49.23
35.17	49.34
35.62	50.08

(Wells and McAdam, J. Am. Chem. Soc. 1907, 29, 726.)

Composition of the solutions which can be in equilibrium with  $Na_2CO_3+7H_2O$  at different temperatures.

$t^\circ$	% $Na_2CO_3$
32.1	31.8
32.5	32.1
33.3	32.7
33.9	33.0
34.5	33.9

(Ketner, Z. phys. Ch. 1902, 39, 646.)

Composition of the alcohol and water layers in contact with the solid phase,  $Na_2CO_3+7H_2O$ , at different temperatures.

$t^\circ$	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
33.2	58.1	0.5	42.4	1.4	31.0	67.6
32.3	56.1	0.6	43.3	1.5	30.2	68.3
31.9	54.8	0.7	44.5	1.7	29.8	68.5
31.45	53.5	0.7	45.8	...	29.3	...
31.2	52.4	0.8	46.8	...	29.3	...

(Ketner.)

Composition of the two liquid layers which at different temperatures can be in metastable equilibrium with  $Na_2CO_3+7H_2O$ .

$t^\circ$	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
28.9	46.9	1.3	51.8	2.3	26.3	71.4
26.6	39.1	1.3	59.6	3.3	25.4	71.3
23.0	24.5	6.7	68.8	7.0	20.2	72.8

(Ketner.)

+ $10H_2O$ . Efflorescent. Sol. in 1.05 pts.  $H_2O$  at  $23^\circ$ , and sat. solution has sp. gr. 1.1995. (Schiff, A. 109, 326.)

Melts in crystal  $H_2O$  at  $34^\circ$ . (Tilden, Chem. Soc. 45, 409.)

See above under  $Na_2CO_3$  for further data.

Solubility in 100 pts. H<sub>2</sub>O at t°.

Corrected t° (Hydrogen scale)	Pts. anhydrous salt
27.84	34 20
29 33	37 40
29 85	38 89
30 35	40 12
31 45	43.25
31 66	43 05
31 72	44 21
32.06	45 64

(Wells and McAdam, J. Am. Chem. Soc. 1907, 29. 725.)

Sat. solution at 25° contains 29.37 g. anhyd. Na<sub>2</sub>CO<sub>3</sub> in 100 g. H<sub>2</sub>O. (Osaka, J. Tok. Ch. Soc. 1911, 32. 870.)

Sat. solution at 25° contains 28.3 g. anhyd. Na<sub>2</sub>CO<sub>3</sub> in 100 g. H<sub>2</sub>O. (de Paese, Bull. Soc. Chim. Belg. 1911, 25. 174.)

Sat. solution at 30° contains 27.4-27.98 g. anhyd. Na<sub>2</sub>CO<sub>3</sub> in 100 g. of the solution. (Cocheret, Dissert. 1911.)

Sat. solution at 25° contains 27.64 g. anhyd. Na<sub>2</sub>CO<sub>3</sub> in 100 cc of the solution (McCoy and Test, J. Am. Chem. Soc. 1911, 33. 474.)

## Solubility in alcohol.

Composition of the alcohol and water layers in contact with the solid phase, Na<sub>2</sub>CO<sub>3</sub>+10H<sub>2</sub>O, at different temperatures.

t°	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
30.6	47 8	1.2	51 0	2.3	27 8	69 9
29 7	40 0	2.1	57 9	2 9	25 5	71 6
29 0	32.7	3.8	63 5	4 3	22 7	73.0
28 2	23 5	7.3	69 2	7 9	18 6	73 5

(Ketner, Z. phys. Ch. 1902, 39. 651.)

## Solubility in alcohol+Aq.

Liquids which can be in equilibrium with Na<sub>2</sub>CO<sub>3</sub>+10H<sub>2</sub>O at 21°.

% alcohol	% salt	% water
0	18.5	81.5
6.2	12.7	81 1
15.3	6.9	77 8
26.1	3 2	70 7
39.2	1 2	59 6
58.2	0 2	41 6
67 1	0 1	32.8
73.3	0 06	26.64

(Ketner.)

Composition of the alcohol liquids which can be in equilibrium with Na<sub>2</sub>CO<sub>3</sub>+10H<sub>2</sub>O and Na<sub>2</sub>CO<sub>3</sub>+7H<sub>2</sub>O at different temperatures.

t°	% alcohol	% salt	% water
29°	62 3	0 3	37 4
26°	67 8	0.1	32 1
21°	73 3	0 06	26.6

(Ketner.)

See also under Na<sub>2</sub>CO<sub>3</sub>.  
+15H<sub>2</sub>O. (Jacquelin, A. 80. 241.)

Sodium hydrogen carbonate, NaHCO<sub>3</sub>.

100 pts. cold H<sub>2</sub>O dissolve 7.7 pts. NaHCO<sub>3</sub>. (Rose, Schw. J. 6. 52.)

100 pts. H<sub>2</sub>O at 11.23° dissolve 8.27 pts. NaHCO<sub>3</sub> to form solution of 1.0613 sp. gr. (Anthon, Dingl. 161 216.)

100 pts. H<sub>2</sub>O dissolve at—  
 0° 10° 20° 30°  
 8.95 10.04 11.15 12.24 pts. NaHCO<sub>3</sub>,  
 40° 50° 60° 70°  
 13.35 14.45 15.57 16.69 pts. NaHCO<sub>3</sub>  
 (Poggiale, A. ch. (3) 8. 468.)

100 pts. H<sub>2</sub>O dissolve pts. NaHCO<sub>3</sub> at t°.

t°	Pts. NaHCO <sub>3</sub>	t°	Pts. NaHCO <sub>3</sub>	t°	Pts. NaHCO <sub>3</sub>
0	6.90	21	9.75	42	13.05
1	7.00	22	9.90	43	13.20
2	7.10	23	10.05	44	13.40
3	7.20	24	10.20	45	13.55
4	7.25	25	10.35	46	13.75
5	7.45	26	10.50	47	13.90
6	7.60	27	10.65	48	14.10
7	7.70	28	10.80	49	14.30
8	7.85	29	10.95	50	14.45
9	8.00	30	11.10	51	14.65
10	8.15	31	11.25	52	14.85
11	8.25	32	11.40	53	15.00
12	8.40	33	11.55	54	15.20
13	8.55	34	11.70	55	15.40
14	8.70	35	11.90	56	15.60
15	8.85	36	12.05	57	15.80
16	9.00	37	12.20	58	16.00
17	9.15	38	12.35	59	16.20
18	9.30	39	12.50	60	16.40
19	9.40	40	12.70	...	...
20	9.60	41	12.90	...	...

(Dibbitts, J. pr. (2) 10. 417.)

Experiments with solutions of sodium hydrogen carbonate show that they gradually decompose after a time. (Treadwell, Z. anorg. 1898, 17. 204.)

The source of error of many solubility determinations of this substance is due to loss of CO<sub>2</sub>. Solutions exposed to the air lose CO<sub>2</sub>. (McCoy, Am. Ch. J. 1903, 29. 438.)

1 l. sat. solution at 25° contains 98.4 g. NaHCO<sub>3</sub>. (McCoy and Test, J. Am. Chem. Soc. 1911, 33. 474.)

$\text{NaHCO}_3 + \text{Aq. sat. at } 16^\circ \text{ has sp. gr.} = 1.06904. \text{ (Stolba.)}$

Nearly insol. in sat.  $\text{NaCl}$ , or  $\text{Na}_2\text{SO}_4 + \text{Aq.}$  (Balman, B. 6. 121.)

Equilibrium between  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$  in  $\text{H}_2\text{O}$  and in contact with the air  
System:  $\text{Na}_2\text{CO}_3$ ,  $\text{NaHCO}_3$ , and  $\text{CO}_2$ .  
Temperature,  $25^\circ \text{C.}$

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.0044	50	8.7	91.3
	50		
0.0143	20	20.0	80.0
	20		
0.0562	10	37.3	62.7
	10		
0.2248	10	59.3	40.7
	10		
0.8847	2	64.0	36.0
	2		
	3		

Temperature,  $37^\circ \text{C.}$

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.0019	50	10.5	89.5
	50		
0.0071	20	21.1	78.9
	20		
0.0276	10	41.3	58.7
	10		
0.030	10	64.5	35.5
	10		
0.421	2	81.9	18.1
	2		
0.815	2	86.5	13.5
	2		
1.795	2+	83.4	16.6
	2		

Temperature,  $50^\circ \text{C.}$

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.0017	50	22.2	77.8
	25		
0.0071	20	32.9	67.1
	20		
0.0266	10	50.7	49.3
	20		
0.1014	10	70.0	30.0
	10		
0.4066	10	81.0	19.0
	2		
0.8068	2	86.8	13.2
	2		
1.7486	2.1	87.1	12.9
	2		

Temperature,  $75^\circ \text{C.}$

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.003	50	25.7	74.3
	25		
0.019	20	34.8	65.2
	20		
0.036	10	55.7	44.3
	10		
0.270	5	79.5	20.5
	5		
0.702	1	85.0	15.0
	1		
6.56	1	84.8	15.2
	1		

System:  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$  at  $25^\circ \text{C.}$

Total salts dissolved grams	$\text{Na}_2\text{CO}_3$		$\text{NaHCO}_3$	
	Weight Grams	Per cent	Weight Grams	Per cent
0.3555	0.0208	5.71	0.3352	94.29
1.1053	0.1505	13.62	0.9548	86.38
4.0443	1.1041	27.30	2.9402	72.70
14.6553	7.0212	47.91	7.6346	52.09
56.3982	29.8223	52.88	26.5759	47.12

(Cameron and Briggs, J. phys. Chem. 1901, 5. 540.)

100 g. a.cohol of 0.941 sp. gr. dissolve 1.2 g.  $\text{NaHCO}_3$  at  $15^\circ$

100 g. glycerol dissolve 8 g.  $\text{NaHCO}_3$  at  $15^\circ$ . (Ossendowski, Pharm. J. 1907, 79. 575.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Sodium dihydrogen tricarbonates,



More sol. than  $\text{NaHCO}_3$ , less sol. than  $\text{Na}_2\text{CO}_3$  in  $\text{H}_2\text{O}$ . (Rose, Pogg. 34. 160.)

100 pts.  $\text{H}_2\text{O}$  dissolve, calculated as  $2\text{Na}_2\text{O}$ ,  $3\text{CO}_2$ —

at $0^\circ$	12.63 pts.	at $60^\circ$	29.68 pts.
" $10^\circ$	15.50 "	" $70^\circ$	32.55 "
" $20^\circ$	18.30 "	" $80^\circ$	35.8 "
" $30^\circ$	21.15 "	" $90^\circ$	38.63 "
" $40^\circ$	23.95 "	" $100^\circ$	41.59 "
" $50^\circ$	26.78 "		

(Poggiale, A. ch. (3) 8. 468.)

Min. *Trona*, *Urao*. See  $\text{Na}_2\text{H}(\text{CO}_3)_2 + 2\text{H}_2\text{O}$ .

**Trisodium hydrogen carbonate**,  $\text{Na}_3\text{H}(\text{CO}_3)_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

True formula of "Trona" and "Urao" (Zepharovich, *Zet. Kryst.* 13. 135, de Mondesir, C. R. 104. 1595.)

**Sodium thorium carbonate**,  $3\text{Na}_2\text{CO}_3 \cdot \text{Th}(\text{CO}_3)_2 + 12\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Cleve.)

**Sodium uranyl carbonate**,  $2\text{Na}_2\text{CO}_3 \cdot (\text{UO}_2)_2\text{CO}_3$ .

Slowly sol. in  $\text{H}_2\text{O}$ . Solution sat. at  $15^\circ$  has sp gr = 1.161 (Anthon, *Dingl.* 166. 207.)

**Sodium yttrium carbonate**,  $\text{Na}_2\text{CO}_3 \cdot \text{Y}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Ppt. Not decomp. by cold  $\text{H}_2\text{O}$  (Cleve.)

**Sodium zinc carbonate**,  $3\text{Na}_2\text{O} \cdot 8\text{ZnO} \cdot 11\text{CO}_2 + 8\text{H}_2\text{O} = 3\text{Na}_2\text{CO}_3 \cdot 8\text{ZnCO}_3 + 8\text{H}_2\text{O}$ .

Sl. decomp. by pure  $\text{H}_2\text{O}$  (Wohler.)

Less easily decomp. by  $\text{H}_2\text{O}$  than most double carbonates. (Deville, A. ch. (3) 33. 101.)

$\text{Na}_2\text{O} \cdot 3\text{ZnO} \cdot 4\text{CO}_2 + 3\text{H}_2\text{O}$ . (Kraut, Z. anorg. 1897, 13. 13.)

**Sodium carbonate sulphite**,  $\text{Na}_2\text{CO}_3 \cdot 2\text{Na}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ , sl. sol. in cold  $\text{H}_2\text{O}$ . (Johnson, J. Soc. Chem. Ind. 1895, 14. 271.)

**Strontium carbonate**,  $\text{SrCO}_3$ .

Sol. in 18,045 pts.  $\text{H}_2\text{O}$  at ordinary temp. (Fresenius.)

Sol. in 12,522 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Kremers, *Pogg.* 85. 247.)

Sol. in 33,000 pts.  $\text{H}_2\text{O}$ . (Bineau, C. R. 41. 511.)

Less sol. in  $\text{H}_2\text{O}$  than  $\text{SrSO}_4$ . (Dulong.)

Sol. in 1536 pts. boiling  $\text{H}_2\text{O}$  (Hope, *Edinb. Trans.* 4. 5.)

Calculated from electrical conductivity of  $\text{SrCO}_3 + \text{Aq}$ ,  $\text{SrCO}_3$  is sol. in 121,760 pts.  $\text{H}_2\text{O}$  at  $8.8^\circ$  and 91,468 pts. at  $24.3^\circ$  (Holleman, Z. phys. Ch. 12. 130.)

1 l.  $\text{H}_2\text{O}$  dissolves 11 mg.  $\text{SrCO}_3$  at  $18^\circ$  (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

"Solubility product" =  $15.67 \times 10^{-10}$  mol. litre. (McCoy and Smith, J. Am. Chem. Soc. 1911, 33. 473.)

Sol. in 833 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$  at  $10^\circ$ . (Gmelin.)

Sol. in 56,545 pts.  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3$ .

Quite sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ , but reprecipitated on addition of  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Fresenius.)

Partially decomp. by boiling with aqueous solutions of  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{CaSO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{MgSO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{HPO}_4$ ,  $\text{K}_2\text{SO}_3$ ,  $\text{Na}_2\text{SO}_3$ ,  $(\text{NH}_4)_2\text{SO}_3$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ ,

$\text{Na}_2\text{AsO}_3$ ,  $\text{K}_2\text{AsO}_3$ ,  $\text{K}_2\text{C}_2\text{O}_4$ ,  $\text{Na}_2\text{C}_2\text{O}_4$ ,  $\text{NaF}$ , and  $\text{K}_2\text{CrO}_4$ . Decomp. is complete with the  $\text{NH}_4$  salts. (Dulong, A. ch. 82. 286.)

Sl. decomp. by  $\text{Na}_2\text{SO}_4$ , or  $\text{K}_2\text{SO}_4 + \text{Aq}$ . (Persoz.)

Easily sol. in  $\text{NH}_4$  chloride, nitrate, or succinate +  $\text{Aq}$ , but less so than  $\text{BaCO}_3$ . (Fresenius.) Sol. in ferric salts +  $\text{Aq}$ , with pptn of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Sol. in Na citrate +  $\text{Aq}$ . (Spiller.) Not decomp. by a mixture of 1 pt.  $\text{H}_2\text{SO}_4$  and 6 pts. absolute alcohol, or by alcoholic solutions of tartaric, racemic, citric, or glacial acetic acids; immediately decomp. by  $\text{HNO}_3$  + absolute alcohol, or  $\text{H}_2\text{C}_2\text{O}_4$  + abs. alcohol.

Solubility of  $\text{SrCO}_3$  in  $\text{NH}_4\text{Cl} + \text{Aq}$ .

% $\text{NH}_4\text{Cl}$	% $\text{SrCO}_3$
5.35	0.179
10	0.259
20	0.358

(Cantoni and Goguelin, *Bull. Soc.* 1905, (3) 33. 13.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3602.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in acetone and in methylal (Eidmann, C. C. 1899, II. 1014.)

Min. *Strontianite*.

**Strontium hydrogen carbonate.**

$\text{SrCO}_3$  is sol. in 850 pts. of a sat. solution of  $\text{CO}_2$  in  $\text{H}_2\text{O}$ .

**Strontium uranyl carbonate**,  $\text{SrO} \cdot 2\text{UO}_3 \cdot 2\text{CO}_2 + 16\text{H}_2\text{O}$ .

As  $\text{Ba}$  comp. (Blmkoff, *Dissert.* 1900.)

**Terbium carbonate.**

Ppt. Insol. in excess  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Potratz, C. N. 1905, 92. 3.)

**Thallous carbonate**,  $\text{Tl}_2\text{CO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Tl}_2\text{CO}_3$  (C = according to Crookes; L = according to Lamy) at—

$15.5^\circ$	$18^\circ$	$62^\circ$	$100^\circ$	$100.8^\circ$
4.2	5.23	12.85	27.2	22.4
C	L	L	C	L

Insol. in absolute alcohol (L), and ether (C).

Insol. in acetone and pyridine. (Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790.)

**Thallous carbonate, acid**,  $\text{Tl}_2\text{O} \cdot 2\text{CO}_2$ .

Rather easily sol. in cold  $\text{H}_2\text{O}$ . (Carstanjen.)

$\text{TiHCO}_3$ . (Giorgia, Gazz. ch. it. 1894, 24, 474-479.)

Thallous carbonate platinoeyanide,  $\text{Ti}_2\text{CO}_3 \cdot \text{Ti}_2\text{Pt}(\text{CN})_4$ .

Sl. sol. in hot, insol. in cold  $\text{H}_2\text{O}$ . (Friswell, Chem. Soc. (2) 9, 461.)

Thorium carbonate, basic,  $2\text{ThO}_2 \cdot \text{CO}_2 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{CO}_2 + \text{Aq}$ , but sol. in excess of alkali carbonates +  $\text{Aq}$ , if conc.

Tin (stannous) carbonate,  $2\text{SnO}_2 \cdot \text{CO}_2$ .

Easily decomp. on air; insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{CO}_3 + \text{Aq}$ . (Deville, A. ch. (3) 35, 448.)

Uranyl carbonate, basic,  $5(\text{UO}_2)(\text{OH})_2 \cdot 3(\text{UO}_2)\text{CO}_2 + 6\text{H}_2\text{O}$ .

Ppt. (Seubert and Elten, Z. anorg. 1893, 4, 80.)

Ytterbium carbonate, basic,  $\text{Yb}(\text{OH})\text{CO}_3 + \text{H}_2\text{O}$ .

Ppt. (Cleve, Z. anorg. 1902, 32, 146.)

Ytterbium carbonate,  $\text{Yb}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Ppt. (Cleve, Z. anorg. 1902, 32, 146.)

Yttrium carbonate,  $\text{Y}_2(\text{CO}_3)_3 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , very sl. sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ . Sol. in  $\text{SO}_2 + \text{Aq}$  and all mineral acids. Sol. in  $\text{NH}_4$  salts, and alkali carbonates +  $\text{Aq}$  to some extent. More sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  than in  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Berlin.) More sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  than cerium, but 5 or 6 times less sol. than glucinum carbonate (Vauquelin.) Sol. in large excess of  $\text{KHCO}_3 + \text{Aq}$ . (Rose.) Slowly sol. in  $\text{NH}_4$  salts +  $\text{Aq}$ . (Berzelius.)

Zinc carbonates, basic,  $8\text{ZnO} \cdot \text{CO}_2 + 2\text{H}_2\text{O}$ ;  $5\text{ZnO} \cdot 2\text{CO}_2 + 3$ , or  $7\text{H}_2\text{O}$ ;  $3\text{ZnO} \cdot \text{CO}_2 + \text{H}_2\text{O}$ ;  $11\text{ZnO} \cdot 4\text{CO}_2 + 14\text{H}_2\text{O}$ ;  $14\text{ZnO} \cdot 5\text{CO}_2 + 9\text{H}_2\text{O}$ ;  $2\text{ZnO} \cdot \text{CO}_2 + \text{H}_2\text{O}$ ;  $8\text{ZnO} \cdot 3\text{CO}_2 + 5\text{H}_2\text{O}$ , etc.

All ppts formed from Zn salts and carbonates +  $\text{Aq}$ . Sol. in 2000-3000 pts. cold  $\text{H}_2\text{O}$ , separates out on heating and does not redissolve on cooling. (Schindler.) Sol. in 20,895 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Kremers, Pogg. 85, 248) Sol. in 44,600 pts.  $\text{H}_2\text{O}$  at ord. temp. (Fresenius)

Sol. in 1428 pts. sat.  $\text{H}_2\text{CO}_3 + \text{Aq}$ . (Lassaigne.) Sol. in 189 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat. at 4-6 atmos. (Wagner, Z. anal. 6, 107.) Easily sol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ ,  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , and in acids. Somewhat sol. in alkali bicarbonates and  $\text{NH}_4$  salts +  $\text{Aq}$ . (Fresenius.) Sol. in hot (Fuchs), also cold (Brett, 1837)  $\text{NH}_4\text{Cl} + \text{Aq}$ ; less sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett.)

Sol. in all  $\text{NH}_4$  salts +  $\text{Aq}$  excepting  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Terreil, Bull. Soc. (2) 9, 441.)

Insol. in  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$ . Sol. in ferric salts +  $\text{Aq}$  with pptn. of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . (Fuchs, 1831.)

The carbonates described by Boussingault, Waackroder, Rose, and probably all salts between  $\text{ZnO}$ ,  $\text{CO}_2$  and  $5\text{ZnO} \cdot 2\text{CO}_2$  are mixtures. (Kraut, Z. anorg. 1897, 13, 1-15.)

$3\text{ZnO} \cdot \text{CO}_2 + 2\text{H}_2\text{O}$ . Min. Zinc bloom, Hydrazinide.

$\text{ZnCO}_3$ ,  $3\text{ZnO} \cdot \text{H}_2\text{O}$ . Min. Auriscalcic.

Zinc carbonate,  $\text{ZnCO}_3$ .

1 l.  $\text{H}_2\text{O}$  at  $15^\circ$  dissolves 0.01 g.; 1 l.  $\text{H}_2\text{O}$  dissolves  $1.64 \times 10^{-4}$  mols., or 0.206 g.  $\text{ZnCO}_3$  at  $25^\circ$ . (Agono and Valla, Att. acc. Line. 1911, 20, II 706.)

1 l. 5.85%  $\text{NaCl} + \text{Aq}$  dissolves 0.0583 g.; 1 l. 7.45%  $\text{KCl} + \text{Aq}$  dissolves 0.0477 g.  $\text{ZnCO}_3$ . (Essen, Gm.-K. 4, 1, 680.)

Sol. in acids,  $\text{KOH} + \text{Aq}$ , and  $\text{NH}_4$  salts +  $\text{Aq}$ .

Sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ .

Solubility in various salts +  $\text{Aq}$ .

Solvent	g $\text{ZnCO}_3$ sol in 1 l. of the solvent
10% $\text{NaNO}_3 + \text{Aq}$	0.058981
sat. $\text{NaNO}_3 + \text{Aq}$	0.149000
5% $\text{NaCl} + \text{Aq}$	0.021730
10% $\text{NaCl} + \text{Aq}$	0.046564
sat. $\text{NaCl} + \text{Aq}$	0.130380
10% $\text{Na}_2\text{SO}_4 + \text{Aq}$	0.009513
sat. $\text{Na}_2\text{SO}_4 + \text{Aq}$	0.015521

(Ehlers, Z. Elektrochem. 1912, 18, 728.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 830.)

Insol. in acetone. (Eidmann, C. C. 1899, II 1014; Naumann, B. 1904, 37, 4329.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1910, 43, 314.)

Min. Calamine, Smithsonite.

Calamine is sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  only in the presence of  $\text{NH}_4$  salts (Brandhorst, Zeit. angew. Ch. 1904, 17, 513.)

+  $1/6\text{H}_2\text{O}$ . (Mikusch, Z. anorg. 1908, 58, 366.)

+  $\text{H}_2\text{O}$ . (Belar, Zeit. Kryst. 1890, 17, 126.)

Zinc carbonate ammonia,  $\text{ZnCO}_3 \cdot \text{NH}_3$ .

Slowly decomp. by  $\text{H}_2\text{O}$ , but not on the air, or by boiling with alcohol (Favre, A. ch. (3) 10, 474.)

Zinc carbonate hydroxylamine,  $\text{ZnCO}_3 \cdot 2\text{NH}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids. (Goldschmidt and Syngros, Z. anorg. 5, 129.)

Zirconium carbonate,  $3\text{ZrO}_2 \cdot \text{CO}_2 + 6\text{H}_2\text{O}$ .

Decomp. by hot  $\text{H}_2\text{O}$ , all  $\text{CO}_2$  being given off. (Hermann.)

Sol. in alkali carbonates +  $\text{Aq}$ .

**Percarbonic acid.**

See Percarbonic acid.

**Carbonic anhydride, CO<sub>2</sub>.**

See Carbon dioxide.

**Carbonophosphoric acid.**

Potassium carbonophosphate, (K<sub>2</sub>HPO<sub>4</sub>)<sub>2</sub>, 2CO<sub>2</sub>, 2KHCO<sub>3</sub>.

Known only in solution. (Baillé, C. R. 1903, 137. 566.)

**Carbonyl bromide, COBr<sub>2</sub>.**

Decomp. by H<sub>2</sub>O (Besson, C. R. 1895, 120. 192)

**Carbonyl platinumous bromide, CO, PtBr<sub>2</sub>.**

Sol. in H<sub>2</sub>O with almost instant decomp. Sol. in absolute alcohol. (Pullinger, Chem. Soc. 59. 603)

Quite easily sol. in hot C<sub>6</sub>H<sub>6</sub>, insol. in ligroune, and can be crystallized from CCl<sub>4</sub>. Very easily sol. in HBr + Aq. (Mylus and Forster, B 24. 2432)

**Carbonyl bromochloride, COClBr.**

Decomp. by H<sub>2</sub>O. (Besson.)

**Carbonyl chloride, COCl<sub>2</sub>.**

Phosgene. Cold H<sub>2</sub>O dissolves 1-2 vols. COCl<sub>2</sub> gas with slow decomposition. Alcohol decomp. immediately. Immediately absorbed by KOH, or NH<sub>4</sub>OH + Aq. Very sol. in glacial HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, benzene, and most liquid hydrocarbons (Berthelot, Bull. Soc. (2) 13. 14.)

Sol. in SCl<sub>2</sub>

1 vol. AsCl<sub>3</sub> absorbs 10 vols. COCl<sub>2</sub>

**Dicarbonyl cuprous chloride, Cu<sub>2</sub>Cl<sub>2</sub>, 2CO + 4H<sub>2</sub>O.**

Decomp. by air (Jones, Am. Ch. J. 1899, 22. 305)

**Carbonyl platinumous chloride, 2COCl<sub>2</sub>, PtCl<sub>2</sub>**

Sl. deliquescent. Easily sol. in H<sub>2</sub>O without decomp.; sl. sol. in alcohol. Almost insol. in CCl<sub>4</sub>. (Pullinger, Chem. Soc. 59. 600.)

**Monocarbonyl platinumous chloride, CO, PtCl<sub>2</sub>.**

Decomp. by H<sub>2</sub>O and alcohol; sol. in hot CCl<sub>4</sub>. (Schützenberger, A. ch. (4) 15. 100)

Sol. in conc. HCl + Aq. (Mylus and Forster)

**Dicarbonyl platinumous chloride, 2CO, PtCl<sub>2</sub>.**

Decomp. by H<sub>2</sub>O and alcohol. Sol. in CCl<sub>4</sub>. (Schützenberger)

Decomp. by conc. HCl + Aq. into CO and CO, PtCl<sub>2</sub>. (Mylus and Forster.)

**Sesquicarbonyl platinumous chloride, 3CO, 2PtCl<sub>2</sub>.**

Decomp. by H<sub>2</sub>O or alcohol. Much more sol. in CCl<sub>4</sub> than 2CO, PtCl<sub>2</sub>

**Carbonyl platinumous iodide, CO, PtI<sub>2</sub>.**

Not hygroscopic. Insol. in, but slowly decomp. by, H<sub>2</sub>O. Easily sol. in benzene or ether, also in alcohol, which decomp. on warming; sol. in HI + Aq. (Mylus and Forster.)

**Carbonyl platinumous sulphide, CO, PtS.**

Easily decomp. Insol. in ordinary solvents. (Mylus and Forster)

**Carbonyl sulphide, COS.**

H<sub>2</sub>O absorbs 1 vol. COS.

Absorption of COS by H<sub>2</sub>O at t°

t°	Coefficient of absorption
0	1 333
10	0 835
20	0 561
30	0 403

(Winkler, Z. phys. Ch. 1906, 55. 351.)

1 ccm. H<sub>2</sub>O at 13.5° and 756 mm. pres. dissolves 0.8 ccm. COS. (Hempel, Zeit. angew. ch. 1901, 14. 867.)

1 ccm. of a hydrochloric acid solution of Cu<sub>2</sub>Cl<sub>2</sub> absorbs about 0.2 ccm. COS (Hempel.)

**Carbonyl ferrocyanhydric acid.**

H<sub>2</sub>Fe(CO)(CN)<sub>5</sub>

Very sol. in H<sub>2</sub>O; decomp. on heating. (Müller, A. ch. (6) 17. 94.)

**Cobalt carbonyl ferrocyanide.**

Sl. sol. in H<sub>2</sub>O, very sol. in dil. HNO<sub>3</sub> + Aq. (M.)

**Cupric carbonyl ferrocyanide,**

Cu<sub>2</sub>[Fe(CO)(CN)<sub>5</sub>]<sub>2</sub>.

Insol. in H<sub>2</sub>O, H<sub>2</sub>SO<sub>4</sub>, or dil. HNO<sub>3</sub> + Aq. (M.)

**Iron (ferric) carbonyl ferrocyanide,**

Fe<sub>2</sub>[Fe(CO)(CN)<sub>5</sub>]<sub>2</sub>.

Insol. in H<sub>2</sub>O. Sol. in H<sub>2</sub>C<sub>2</sub>O<sub>4</sub> + Aq. Insol. in acetic, lactic, succinic, tartaric, and citric acids + Aq, but easily sol. in the neutral salts of those acids. Insol. in KCl, or KNO<sub>3</sub> + Aq, but sensibly sol. in Na<sub>2</sub>HPO<sub>4</sub> + Aq. Insol. even on warming in very dil. H<sub>2</sub>SO<sub>4</sub>, or H<sub>2</sub>PO<sub>4</sub> + Aq. (Müller.)

**Potassium carbonyl ferrocyanide,**

K<sub>2</sub>[Fe(CO)(CN)<sub>5</sub>]<sub>2</sub> + 3½ H<sub>2</sub>O.

100 pts. H<sub>2</sub>O dissolve 148 pts. at 16°. (Müller, C. R. 104. 992.)

**Silver carbonyl ferrocyanide,**  
 $\text{Ag}_3\text{Fe}(\text{CO})(\text{CN})_5$ 

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3$ +Aq; scarcely attacked by conc.  $\text{HCl}$ + $\text{H}_2\text{O}_2$ +Aq. (Müller.)

**Sodium carbonyl ferrocyanide,**  
 $\text{Na}_3\text{Fe}(\text{CO})(\text{CN})_5+6\text{H}_2\text{O}$ 

Sol. in  $\text{H}_2\text{O}$  (Müller.)

**Uranyl carbonyl ferrocyanide,**  
 $(\text{UO}_2)_2[\text{FeCO}(\text{CN})_5]+5\text{H}_2\text{O}$ 

Sl. sol. in  $\text{H}_2\text{O}$ , but more easily if  $\text{H}_2\text{O}$  is acidified with  $\text{HCl}$ + $\text{H}_2\text{O}_2$ .

**Cericotungstic acid.****Ammonium cericotungstate,**  $2(\text{NH}_4)_2\text{O}$ ,  
 $\text{Ce}_2\text{O}_3$ ,  $16\text{WO}_3+2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling therewith (Smith, J. Am. Chem. Soc. 1904, 26, 1481.)

**Cerium, Ce.**

Decomp. pure  $\text{H}_2\text{O}$  very slowly at ordinary temp. Not attacked by cold conc.  $\text{H}_2\text{SO}_4$  or red fuming  $\text{HNO}_3$ . Sol. in dil.  $\text{H}_2\text{SO}_4$ +Aq,  $\text{HNO}_3$ +Aq, and conc. or dil.  $\text{HCl}$ +Aq. (Hillebrand and Norton, Pogg. 155, 633.)

**Cerous bromide,  $\text{CeBr}_3$ .**

*Anhydrous.* As the chloride. (Robinson, Proc. Roy. Soc. 37, 150.)

Sol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37, 4328.)

Sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

+ $x\text{H}_2\text{O}$ . Very deliquescent. (Jolin.)

**Cerium gold bromide,  $\text{CeBr}_3$ ,  $\text{AuBr}_3+8\text{H}_2\text{O}$ .**

See Bromaurate, cerium.

**Cerium carbide,  $\text{CeC}_2$ .**

Decomp. by fused alkali nitrates, chlorates, hydroxides and carbonates; and by conc.  $\text{H}_2\text{SO}_4$  on heating. Insol. in conc.  $\text{HNO}_3$ ; decomp. by  $\text{H}_2\text{O}$  and dil. acids (Moussan, C. R. 1896, 123, 359.)

$\text{CeC}_2$ . Not attacked by hot conc. acids. (Delefontaine, J. B. 1865, 176.)

**Cerous chloride,  $\text{CeCl}_3$ .**

*Anhydrous.* Deliquescent. Sol. in  $\text{H}_2\text{O}$  with hissing and evolution of heat; sol. in alcohol.

Sol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37, 4328.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

+ $7\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{OH}$ +Aq. (Den-  
nis, Z. anorg. 1894, 7, 280.)

+ $7\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent. (Berzelius.)

Decomp. by boiling with  $\text{H}_2\text{O}$ . Sol. in 1 pt.  $\text{H}_2\text{O}$  at ord. temp. and 3-4 pts. alcohol. (Dumas.)

**Ceric chloride.**

Known only in solution, which decomposes by slight heat. (Berzelius.)

**Cerous mercuric chloride.**

Not deliquescent. (v. Bonsdorff.)

$\text{CeCl}_3$ ,  $4\text{HgCl}_2+10\text{H}_2\text{O}$ . Permanent; easily sol. in  $\text{H}_2\text{O}$ . (Jolin, Bull. Soc. (2) 21, 533.)

**Cerium stannic chloride.**

See Chlorostannate, cerium.

**Cerous chloride zinc iodide.**

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Holzmann, J. pr. 84, 76.)

**Cerous fluoride,  $\text{CeF}_3$ .**

Insol. ppt.

+ $\frac{1}{2}\text{H}_2\text{O}$ .

**Ceric fluoride,  $\text{CeF}_4$ .**

Insoluble precipitate (Berzelius.)

+ $\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ . (Brauner, B. 14, 1944.)

**Ceric cobaltous fluoride,  $2\text{CeF}_4$ ,  $\text{CoF}_2+7\text{H}_2\text{O}$ .**

Ppt. Easily decomp. by  $\text{H}_2\text{O}$  (Rimbach, A. 1909, 368, 107.)

**Ceric cupric fluoride,  $2\text{CeF}_4$ ,  $\text{CuF}_2+7\text{H}_2\text{O}$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Rimbach, l. c.)

**Ceric nickel fluoride,  $2\text{CeF}_4$ ,  $\text{NiF}_2+7\text{H}_2\text{O}$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Rimbach, l. c.)

**Ceric potassium fluoride,  $2\text{CeF}_4$ ,  $3\text{KF}+2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Brauner, B. 14, 1944; 15, 109.)

Could not be obtained pure. (Rimbach, l. c.)

**Ceric zinc fluoride,  $2\text{CeF}_4$ ,  $\text{ZnF}_2+7\text{H}_2\text{O}$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Rimbach, l. c.)

**Ceroctic fluoride,  $2\text{CeF}_3$ ,  $\text{CeF}_4$ .**

Mm. Fluoceric.

**Cerium hydride,  $\text{CeH}_3$ .**

Decomp. by acids. (Winkler, B. 24, 873.)

$\text{CeH}_3$ . Decomp. in moist air; decomp. by hot or cold  $\text{H}_2\text{O}$ ; sol. in acids with evolution of  $\text{H}_2$ . Decomp. by alkalis. (Muthmann, A. 1902, 325, 286.)

**Cerous hydroxide,  $\text{Ce}_2\text{O}_3$ ,  $x\text{H}_2\text{O}$ .**

Easily sol. in acids. Insol. in excess of alkali hydroxides+Aq. Sol. in  $(\text{NH}_4)_2\text{CO}_3$ +Aq

100 cem. of a solution in glycerine+Aq containing about 60% by vol. of glycerine contain 7.9 g.  $\text{Ce}_2\text{O}_3$ . (Müller, Z. anorg. 1905, 43, 322.)

Exists in two modifications: one insol. in

cold  $\text{HCl} + \text{Aq.}$ ; the other sol. in cold  $\text{HCl} + \text{Aq.}$  (Brauner, C. N. 1895, 71. 283.)

### Ceric hydroxide, $2\text{CeO}_2, 3\text{H}_2\text{O}$ .

Sol. in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ ; also in  $\text{HCl} + \text{Aq.}$ , forming cerous chloride and free chlorine. Insol. in hydrofluoric, acetic, or formic acids +  $\text{Aq.}$  Somewhat sol. in dil.  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq.}$  (Ordway, Am. J. Sci. (2) 26. 205.) Insol. in  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq.}$  Sl. sol. in alkali carbonates +  $\text{Aq.}$  (Dumas.)

Sl. sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Ordway.)  
100 ccm. of a solution in glycerine +  $\text{Aq.}$  containing about 60% by vol. of glycerine contain 0.08 g.  $\text{CeO}_2$ . (Müller, Z. anorg. 1905, 43. 232.)

### Cerous iodide, $\text{CeI}_2$ .

Sol. in acetone. (Eidmann, C. C. 1899, II 1014; Naumann, B. 1904, 37. 4328.)  
+  $9\text{H}_2\text{O}$ . Very deliquescent and sol. in  $\text{H}_2\text{O}$ . (Lange, J. pr. 82. 134.)  
Sol. in alcohol.

### Cerium nitride, $\text{CeN}$ .

Decomp. by  $\text{H}_2\text{O}$  and alkali. Sol. in mineral acids with formation of cerous and ammonium salts. (Muthmann, A. 1902, 325. 272.)

### Cerous oxide, $\text{Ce}_2\text{O}_3$ .

When ignited, insol. in  $\text{HCl} + \text{Aq.}$ , when long digested with  $\text{H}_2\text{SO}_4$ , is sol. in  $\text{HCl} + \text{Aq.}$  with addition of alcohol.

### Ceric oxide, $\text{CeO}_2$ .

When ignited, is only dissolved in traces, even on heating, by  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$  Sol. in conc.  $\text{H}_2\text{SO}_4$  when warmed. Sol. in the cold in a solution of  $\text{KI}$  in  $\text{HCl} + \text{Aq.}$  (Bunsen), in a mixture of  $\text{HCl}$  and  $\text{FeCl}_3 + \text{Aq.}$ , or any reducing substance.

### Cerium peroxide, $\text{Ce}_2\text{O}_6$ .

Insol. in boiling conc. acids. Sol. in  $\text{H}_2\text{SO}_4$  by long digestion. (Popp, A. 131. 361.)

Probably does not exist. (Rammelsberg, Pogg. 108. 40.)

$\text{Ce}_2\text{O}_5$ . (Hermann, J. pr. 30. 184.)

Probably does not exist. (Rammelsberg.)

$\text{CeO}_2 + x\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq.}$  (Popp, A. 131. 361); (Lecoq de Boisbaudran, C. R. 100. 605.)

$\text{CeO}_2 + \text{H}_2\text{O}_2$ , according to Cleve (Bull. Soc. (2) 43. 57.)

### Cerium oxycarbide, $\text{CeC}_2, 2\text{CeO}_2$ .

Stable in the air. Slowly attacked by cold  $\text{H}_2\text{O}$ . With hot  $\text{H}_2\text{O}$  and with acids, it gives unsat. hydrocarbons. (Sterba, C. R. 1902, 134. 1058.)

### Cerium oxychloride, $\text{CeOCl}$ .

Slightly attacked by hot conc.  $\text{HCl} + \text{Aq.}$  Slowly sol. in conc.  $\text{HNO}_3 + \text{Aq.}$  (Wöhler.)

Easily sol. in dil. acids. (Didier, C. R. 101. 882.)

### Cerium oxychloride tungsten trioxide, $\text{CeOCl}, \text{WO}_3$ .

(Didier, C. R. 102. 823.)

### Cerium selenide.

Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in acids. (Berzelius.)

### Cerium silicide, $\text{CeSi}_2$ .

Insol. in  $\text{H}_2\text{O}$ , by which it is acted upon only very slowly.

Sol. in  $\text{HCl}$  and  $\text{HF} + \text{Aq.}$  with evolution of  $\text{H}_2$ .

Not attacked by alkalis +  $\text{Aq.}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$

Insol. in organic solvents. (Sterba, C. R. 1902, 135. 170.)

### Cerium silicide, $\text{Ce}_2\text{Si}_3$ .

Insol. in acids (Ullik, W. A. B. 52. 2. 115.)

### Cerium disulphide, $\text{CeS}_2$ .

Not decomp. by cold  $\text{H}_2\text{O}$ .

Slowly sol. in cold dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and acetic acid. Rapidly sol. in warm dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and acetic acid with decomp. (Biltz, B. 1908, 41. 3342.)

### Cerium sesquisulphide, $\text{Ce}_2\text{S}_3$ .

Insol. in, and not decomp. by,  $\text{H}_2\text{O}$ , but easily decomp. by the weakest acids. (Mosander); (Didier, C. R. 100. 1461.)

### Monochloramine, $\text{NH}_2\text{Cl}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Raschig, Ch. Z. 1907, 31. 926.)

### Chlorotetramine comps.

See Chlorotetramine comps.

### Metachlorantimonie acid, $\text{HSbCl}_4 + 4\frac{1}{2}\text{H}_2\text{O}$ .

Hydroscopic. Sol. in  $\text{H}_2\text{O}$  with decomp.; sol. in alcohol, acetone, and acetic acid (Weinland, Z. anorg. 1905, 44. 43.)

### Metachlorantimonie acid ammonia, $\text{HSbCl}_4, 2\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Weinland and Schmid, Z. anorg. 1905, 44. 59.)

### Aluminum metachlorantimonate, $\text{Al}(\text{SbCl}_4)_3 + 15\text{H}_2\text{O}$ .

Hydroscopic.

Sol. in dil.  $\text{HCl} + \text{Aq.}$  (Weinland, B. 1903, 36. 254.)

- Ammonium metachlorantimonate**,  $\text{NH}_4\text{SbCl}_6 + \text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in  $\text{H}_2\text{O}$ . Solution decomp. slowly when cold, rapidly on warming.  
Sol. in dil.  $\text{HCl}$ . (Weinland, B. 1903, 36, 251.)
- Cadmium metachlorantimonate ammonia**,  $\text{Cd}(\text{SbCl}_4)_2 \cdot 7\text{NH}_3$ .  
Ppt. (Weinland and Schmid, Z. anorg. 1905, 44, 56.)
- Calcium metachlorantimonate**,  $\text{Ca}(\text{SbCl}_4)_2 + 9\text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq}$  (Weinland, B. 1903, 36, 253.)
- Chromium metachlorantimonate**,  $\text{Cr}(\text{SbCl}_4)_3 + 13\text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq}$ . (Weinland.)
- Chromium orthochlorantimonate**,  $\text{CrSbCl}_6 + 10\text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq}$ . (Weinland.)
- Cupric metachlorantimonate ammonia**,  $\text{Cu}(\text{SbCl}_4)_2 \cdot 5\text{NH}_3$ .  
(Weinland and Schmid, Z. anorg. 1905, 44, 55.)
- Glucinum metachlorantimonate**,  $\text{Gl}(\text{SbCl}_4)_2 + 10\text{H}_2\text{O}$ .  
Very hydroscopic.  
Sol. in dil.  $\text{HCl}$ . (Weinland, B. 1903, 36, 252.)
- Iron (ferric) orthochlorantimonate**,  $\text{FeSbCl}_6 + 8\text{H}_2\text{O}$ .  
Hydroscopic.  
Can easily be cryst. from dil.  $\text{HCl} + \text{Aq}$ . (Weinland.)
- Lithium metachlorantimonate**,  $\text{LiSbCl}_6 + 4\text{H}_2\text{O}$ .  
Very hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq}$ . (Weinland, l. c.)
- Magnesium pyrochlorantimonate**,  $\text{MgSbCl}_4 + 9\text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq}$ . (Weinland.)
- Nickel metachlorantimonate ammonia**,  $\text{Ni}(\text{SbCl}_4)_2 \cdot 6\text{NH}_3$ .  
Sol. in  $\text{H}_2\text{O}$ . (Weinland and Schmid, Z. anorg. 1905, 44, 57.)
- Potassium metachlorantimonate**,  $\text{KSbCl}_6 + \text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in  $\text{H}_2\text{O}$ . Solution decomp. slowly when cold, rapidly when warmed.
- Sol. in dil.  $\text{HCl} + \text{Aq}$ . (Weinland, B. 1903, 36, 250.)
- Rubidium metachlorantimonate**,  $\text{RbSbCl}_6$ .  
Hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq}$  (Weinland.)
- Silver metachlorantimonate ammonia**,  $\text{AgSbCl}_6 \cdot 2\text{NH}_3$ .  
Decomp. by  $\text{H}_2\text{O}$ . (Weinland and Schmid.)
- Zinc metachlorantimonate ammonia**,  $\text{Zn}(\text{SbCl}_4)_2 \cdot 4\text{NH}_3$ .  
(Weinland and Schmid.)
- Chlorarsenious acid**.  
See Arsenyl chloride.
- Chlorauric acid**,  $\text{HAuCl}_4 + 4\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether.  
Sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25, 212.)  
Difficultly sol. in  $\text{PCl}_5$ . (Walden.)  
Cryst. with  $3\text{H}_2\text{O}$  as stated by Weber and Schettlander and not with  $4\text{H}_2\text{O}$  as stated by Thomsen. (Schmidt, C. C. 1906, II, 855.)
- Chloraurates**.  
All chloraurates are easily sol. in  $\text{H}_2\text{O}$  and in alcohol. (v. Bonsdorff, 1829.)
- Ammonium chloraurate**,  $\text{NH}_4\text{AuCl}_4 + \text{H}_2\text{O}$ .  
Very easily sol. in  $\text{H}_2\text{O}$ .  
 $+ 2\text{H}_2\text{O}$ . Very easily sol. in  $\text{H}_2\text{O}$ .
- Barium chloraurate**,  $\text{Ba}(\text{AuCl}_4)_2 + 2\text{H}_2\text{O}$ .  
Deliquescent in moist air. Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff, Pogg. 17, 261.)
- Cadmium chloraurate**.  
Not deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)
- Cæsium chloraurate**,  $\text{CsAuCl}_4$ .  
100 pts. aqueous sat. solution contain at:  

10°	20°	30°	40°	50°
0.5	0.8	1.7	3.2	5.4

 pts. anhydrous salt,  

60°	70°	80°	90°	100°
8.2	12.0	16.3	21.7	27.5

 pts. anhydrous salt.  
(Rosenblatt, B. 19, 2538.)  
 $+ \frac{1}{2}\text{H}_2\text{O}$ . (Wells and Wheeler, Am. J. (3) 44, 157.)
- Calcium chloraurate**,  $\text{Ca}(\text{AuCl}_4)_2 + 6\text{H}_2\text{O}$ .  
Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)
- Cerium chloraurate**,  $\text{CeCl}_3 \cdot \text{AuCl}_3 + 10\text{H}_2\text{O}$ .  
Extremely deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Holzmann, C. C. 1863, 206.)  
 $+ 13\text{H}_2\text{O}$ . (Jolin, Bull. Soc. (2) 21, 534.)

**Cobalt chloraurate,  $\text{Co}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol (Topsoe).

**Didymium chloraurate,  $\text{DiCl}_2, \text{AuCl}_3 + 10\text{H}_2\text{O}$**

Very deliquescent. (Cleve, Bull. Soc. (2) 43. 361.)

$2\text{DiCl}_2, 3\text{AuCl}_3 + 20\text{H}_2\text{C}$ . (Cleve)

**Gadolinium chloraurate,  $\text{GdCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$**

Sol. in  $\text{H}_2\text{C}$ . (Benedicks, Z anorg 1900, 22. 404.)

**Lanthanum chloraurate,  $\text{LaCl}_3, \text{AuCl}_3 + 5\text{H}_2\text{O}$ .**

Deliquescent in moist air Sol. in  $\text{H}_2\text{O}$ . (Cleve, B. 8. 128.)

**Lithium chloraurate,  $\text{LiAuCl}_4$ .**

100 pts. aqueous solution contain at:

10° 20° 30° 40°  
53.1 57.7 62.5 67.3 pts. anhydrous salt,

50° 60° 70° 80°  
72.0 76.4 81.0 85.7 pts. anhydrous salt.

(Rosenbladt.)

+  $2\text{H}_2\text{O}$  (Antony and Lucchesi, Gazz. ch. it. 1890, 20. 601)

+  $4\text{H}_2\text{O}$ . Not stable

Sol. in  $\text{H}_2\text{O}$  and alcohol (Fasbender, C. C. 1894, I. 409.)

**Magnesium chloraurate,  $\text{Mg}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$ .**

Somewhat deliquescent Sol. in  $\text{H}_2\text{O}$  and alcohol. (Topsoe.)

+  $12\text{H}_2\text{O}$ .

**Manganese chloraurate,  $\text{Mn}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$**

Deliquescent Sol. in  $\text{H}_2\text{O}$  and alcohol. (Topsoe.)

+  $12\text{H}_2\text{O}$ .

**Nickel chloraurate,  $\text{Ni}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol (Topsoe.)

**Potassium chloraurate,  $\text{KAuCl}_4$ .**

Anhydrous. Very stable. (Lainer, W. A. B. 99, 2b. 247.)

100 pts. solution in  $\text{H}_2\text{O}$  contain at:

10° 20° 30°  
27.7 38.2 48.7 pts. anhydrous salt.

40° 50° 60°  
59.2 70.0 80.2 pts. anhydrous salt.

(Rosenbladt, B. 19. 2538.)

Sol. in  $\text{H}_2\text{O}$  and alcohol; insol. in ether. (Fasbender, C. C. 1894, I. 409.)

1 pt. is sol. in 4 pts. 98% alcohol. (Fasbender, C. C. 1894, II 609.)

+  $2\text{H}_2\text{O}$  Efflorescent

+  $\frac{1}{2}\text{H}_2\text{O}$ .

**Praseodymium chloraurate,  $\text{PrCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$**

Very sol. in  $\text{H}_2\text{O}$ ; sol. in conc.  $\text{HCl}$ . (von Schule, Z anorg 1898, 18. 354.)

**Rubidium chloraurate,  $\text{RbAuCl}_4$ .**

100 pts. sat.  $\text{RbAuCl}_4 + \text{Aq}$  contain at:

10° 20° 30° 40° 50°  
4.6 9.0 13.4 17.7 22.2 pts. anhydrous salt,

60° 70° 80° 90° 100°  
26.6 31.0 35.3 39.7 44.2 pts. anhydrous salt.

(Rosenbladt.)

1 pt. sol. in 54 pts. 98% alcohol. Insol. in ether (Fasbender, C. C. 1894, II 609.)

**Samarium chloraurate,  $\text{SmCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$ .**

Deliquescent Easily sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 43. 165.)

**Scandium chloraurate,  $3\text{ScCl}_3, 2\text{AuCl}_3 + 21\text{H}_2\text{O}$ .**

Very deliquescent. (Crookes, Phil. Trans. 1910, 210. A, 365.)

**Silver chloraurate,  $\text{AgAuCl}_4$ .**

Decomp. in the air.

Decomp. by  $\text{H}_2\text{O}$ ,  $\text{HCl}$  and  $\text{NH}_3$ . (Herrmann, B. 1894, 27. 597.)

**Sodium chloraurate,  $\text{NaAuCl}_4 + 2\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$  and absolute alcohol.

100 pts. aqueous solution contain at:

10° 20° 30°  
58.2 60.2 64.0 pts. anhydrous salt,

40° 50° 60°  
69.4 77.5 90.0 pts. anhydrous salt.

(Rosenbladt.)

Easily sol. in  $\text{NaCl} + \text{Aq}$ .

Easily sol. in  $\text{H}_2\text{O}$ , alcohol and ether. (Fasbender, C. C. 1894, I. 409.)

**Strontium chloraurate.**

Sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)

**Thallium chloraurate.**

(Carstanjen.)

**Ytterbium chloraurate,  $\text{YbCl}_3, \text{AuCl}_3 + 9\text{H}_2\text{O}$ .**

Ppt. (Cleve, Z anorg. 1902, 32. 138.)

**Yttrium chloraurate,  $\text{YtCl}_3, 2\text{AuCl}_3 + 16\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Zinc chloraurate,  $\text{Zn}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsoe.)

+  $12\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)

**Chlorauricyanhydric acid.**

Barium chlorauricyanide,  $\text{Ba}[\text{Au}(\text{CN})_2\text{Cl}_2]_2 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  or alcohol. (Landbom, Lund Univ. Arsk. 12. No. 6.)

Potassium chlorauricyanide,  $\text{KAu}(\text{CN})_2\text{Cl}_2 + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  or alcohol.

Strontium chlorauricyanide,  $\text{Sr}[\text{Au}(\text{CN})_2\text{Cl}_2]_2 + 8\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ .

Zinc chlorauricyanide,  $\text{Zn}[\text{Au}(\text{CN})_2\text{Cl}_2]_2 + 7\text{H}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$

**Chlorhydric acid, HCl**

*Liquid* Miscible with liquid  $\text{CO}_2$ , and  $\text{H}_2\text{S}$ .

*Gas* Absorbed by  $\text{H}_2\text{O}$  with production of much heat.

$\text{H}_2\text{O}$  absorbs 400–500 vols at ord. temp and pressure or a little less than 1 pt. by weight. (Dalton.)

1 vol  $\text{H}_2\text{O}$  absorbs 480 vols at  $0^\circ$ , sp. gr. of sat. solution is 1.2109 (Davis).

1 vol  $\text{H}_2\text{O}$  absorbs 417 822 vols at  $20^\circ$ , the vol. increasing to 1 4138 vols., 1 vol of  $\text{HCl} + \text{Aq}$  then contains 311 vols  $\text{HCl}$ , has sp. gr. 1.1958, and contains 40 30%  $\text{HCl}$  by weight. (Thompson, 1831.)

1 vol  $\text{H}_2\text{O}$  absorbs 404 vols and sat. solution has 1 21 sp. gr. and contains 42 4%  $\text{HCl}$  by weight. (Wirsten.)

$\text{H}_2\text{O}$  sat. at  $0^\circ$  contains 480 times its vol of  $\text{HCl}$  and sp. gr. = 1.2109, sat. at ord. temp. contains 38 4% of its weight in  $\text{HCl}$ , and sp. gr. = 1.192 (Berzelius).

1 vol  $\text{H}_2\text{O}$  absorbs 5 vols  $\text{HCl}$  at  $0^\circ$ , and 700 mm. pressure, and the liquid formed has the given sp. gr., and contains the given per cent  $\text{HCl}$ .

$t^\circ$	$\gamma$	Sp. gr.	% $\text{HCl}$
0	325.2	1.2257	45.148
4	494.7	1.2265	44.361
8	480.3	1.2187	43.828
12	471.3	1.2148	43.277
14	462.4	1.2074	42.829
18	451.2	1.2064	42.314
18.25	450.7	1.2056	42.283
23	435.0	1.2014	41.536

(Deicke, Pogg. 119 156)

At 760 mm. pressure 1 g.  $\text{H}_2\text{O}$  absorbs g  $\text{HCl}$  at  $t^\circ$ .

$t^\circ$	g. $\text{HCl}$	$t^\circ$	g. $\text{HCl}$	$t^\circ$	g. $\text{HCl}$
0	0.825	22	0.710	44	0.618
2	0.814	24	0.700	46	0.611
4	0.804	26	0.691	48	0.603
6	0.793	28	0.682	50	0.596
8	0.783	30	0.673	52	0.589
10	0.772	32	0.665	54	0.582
12	0.762	34	0.657	56	0.575
14	0.752	36	0.649	58	0.568
16	0.742	38	0.641	60	0.561
18	0.731	40	0.633	.	..
20	0.721	42	0.626	.	.

(Roscoe and Dittmar.)

Conc.  $\text{HCl} + \text{Aq}$  loses  $\text{HCl}$ , and dil  $\text{HCl} + \text{Aq}$  loses  $\text{H}_2\text{O}$  on warming, until an acid of constant composition is formed, containing 20.18%  $\text{HCl}$ , with a sp. gr. of 1.101 at  $15^\circ$ , which can be distilled unchanged at  $110^\circ$  (Bineau, A. ch (3) 7. 257.)

The above is true if barometer is at 760 mm., but the composition changes with the pressure as follows—

mm Hg	% $\text{HCl}$	mm Hg	% $\text{HCl}$	mm Hg	% $\text{HCl}$
50	23.2	800	20.2	1700	18.8
100	22.9	900	19.9	1800	18.7
200	22.3	1000	19.7	1900	18.6
300	21.8	1100	19.5	2000	18.5
400	21.4	1200	19.4	2100	18.4
500	21.1	1300	19.3	2200	18.3
600	20.7	1400	19.1	2300	18.2
700	20.4	1500	19.0	2400	18.1
760	20.24	1600	18.9	2500	18.0

(Roscoe and Dittmar.)

Conc.  $\text{HCl} + \text{Aq}$  gradually gives off  $\text{HCl}$  on the air until it has a sp. gr. 1.128 at  $15^\circ$ , and contains 25 2%  $\text{HCl}$ . (Bineau, l. c.)

According to Roscoe and Dittmar, this depends on the temperature. If a current of air is passed through  $\text{HCl} + \text{Aq}$ , acid or water is given off according as the acid is strong or weak, until an acid of constant composition for a given temperature is formed, as follows—

Temp	% $\text{HCl}$	Temp	% $\text{HCl}$	Temp	% $\text{HCl}$
$0^\circ$	25.0	$35^\circ$	23.9	$70^\circ$	22.6
5	24.9	40	23.8	75	22.3
10	24.7	45	23.6	80	22.0
15	24.6	50	23.4	85	21.7
20	24.4	55	23.2	90	21.4
25	24.3	60	23.0	95	21.1
30	24.1	65	22.8	100	20.7

From the above it is seen that the acid which distills unchanged at a given pressure, that is, boils at a certain constant temperature, is identical with the acid which undergoes no change in composition by a current of dry air at the same temperature, and under the ordinary pressure, thus—

mm Hg	B - pt	% $\text{HCl}$	Temp of air current	% $\text{HCl}$
100	61–62°	22.8	62°	22.9
200	76–77	22.1	77	22.2
300	84–85	21.7	85	21.7
380	91	21.3	91	21.4
490	97	20.9	98	21.1
620	103	20.6		

(Roscoe and Dittmar.)

Solubility of HCl in H<sub>2</sub>O at 0° under different degrees of pressure. P=partial pressure in mm. Hg,  $\pm$  e., total pressure minus the tension of aqueous vapour at the given temp.; G=grammes of HCl dissolved in 1 g. H<sub>2</sub>O at the pressure P and 0° temp.

P	G	P	G
60	0.613	350	0.751
70	0.628	400	0.763
80	0.640	450	0.772
90	0.649	500	0.782
100	0.657	550	0.791
110	0.664	600	0.800
120	0.670	650	0.808
130	0.676	700	0.817
140	0.681	750	0.824
150	0.686	800	0.831
175	0.697	900	0.844
200	0.707	1000	0.856
225	0.716	1100	0.869
250	0.724	1200	0.882
275	0.732	1300	0.895
300	0.738		

(Roscoe and Dittmar, A. 112. 334.)

1 vol. H<sub>2</sub>O dissolves 560 vols. HCl at -12°

" " 500 " " 0°

" " 440 " " +20°

(Berthelot, C. R. 78. 779.)

1 vol. H<sub>2</sub>O absorbs 480 vols. HCl at 15° to form a solution containing 42.85% HCl with a sp. gr. of 1.215. (Hager.)

Solubility of HCl at low temperatures, and 760 mm. pressure.

t°	Pts. HCl in 1 pt. H <sub>2</sub> O	t°	Pts. HCl in 1 pt. H <sub>2</sub> O
0	0.842	-18	0.957
-5	0.864	-19	0.965
-10	0.898	-20	0.974
-15	0.933	-21	0.983
-17	0.949	-24	1.012

(Roozeboom, R. t. c. 1884, 3. 79.)

Solubility in H<sub>2</sub>O at t°.

t°	% HCl
50	61.65
45	61.76
40	62.27
35	62.90
30	63.21
20	64.10
15	64.70
10	65.18
5	65.48
0	65.85
-5	66.44
-10	66.71
-50	67.29
-20	67.65

(Rupert, J. Am. Chem. Soc. 1909, 31. 860.)

Sp gr of HCl+Aq

Sp gr	% HCl	Sp gr	% HCl	Sp gr	% HCl
1.203	10.66	1.1283	27.21	1.0060	20.44
1.179	37.00	1.1197	25.52	1.0002	19.47
1.162	33.05	1.1127	24.03	1.0000	18.60
1.149	31.37	1.1060	22.70	1.0020	17.79
1.139	29.13	1.1008	21.51	1.0780	17.05

(Thomson, in his System, 2. 180.)

Sp gr of HCl+Aq

Sp gr.	% HCl	Sp gr.	% HCl
1.21	12.43	1.10	20.20
1.20	40.80	1.09	18.18
1.19	38.35	1.08	16.16
1.18	36.36	1.07	14.14
1.17	34.34	1.06	12.12
1.16	32.32	1.05	10.10
1.15	30.30	1.04	8.08
1.14	28.28	1.03	6.06
1.13	26.26	1.02	4.04
1.12	24.24	1.01	2.02
1.11	20.30		

(Edm. Davy)

Sp gr of HCl+Aq

Sp gr	% HCl	B-pt	Sp gr	% HCl	B-pt
1.109	34.01	40°	1.094	16.08	111°
1.181	31.09	65	1.075	18.16	109
1.106	28.20	77	1.064	11.10	107
1.154	26.57	80	1.047	8.02	105
1.144	24.84	100	1.035	6.92	104
1.130	23.25	103	1.018	3.52	102
1.127	21.06	105	1.000	1.86	101
1.121	20.74	109			

(Kirwan and Dalton)

Sp gr of HCl+Aq at 15°

% HCl	Sp gr.	% HCl	Sp gr
2.22	1.0103	99.72	1.1504
3.80	1.0180	31.50	1.1588
6.26	1.0310	34.24	1.1730
11.02	1.0557	36.63	1.1841
15.20	1.0751	38.67	1.1935
18.07	1.0912	40.51	1.2021
20.94	1.1048	41.72	1.2074
23.72	1.1106	43.00	1.2124
25.96	1.1308		

(Kolb, C. R. 74. 837.)

Sp gr. of HCl+Aq at 15°.

Sp gr.	% HCl	Sp gr.	% HCl	Sp gr.	% HCl
1.2000	40.777	1.1020	32.021	1.1206	24.406
1.1982	40.360	1.1099	32.213	1.1183	24.058
1.1964	39.961	1.1178	31.805	1.1164	23.660
1.1946	39.554	1.1257	31.398	1.1143	23.242
1.1928	39.146	1.1336	30.990	1.1123	22.834
1.1910	38.733	1.1415	30.582	1.1102	22.426
1.1893	38.320	1.1494	30.174	1.1082	22.019
1.1875	37.923	1.1573	29.767	1.1061	21.611
1.1859	37.516	1.1652	29.359	1.1041	21.204
1.1846	37.106	1.1731	28.951	1.1020	20.796
1.1829	36.700	1.1810	28.544	1.1000	20.388
1.1802	36.292	1.1889	28.136	1.0980	19.980
1.1782	35.884	1.1969	27.728	1.0960	19.573
1.1702	35.476	1.1949	27.321	1.0939	19.165
1.1741	35.068	1.1328	26.913	1.0919	18.757
1.1721	34.660	1.1308	26.505	1.0899	18.349
1.1701	34.252	1.1287	26.098	1.0879	17.941
1.1681	33.845	1.1267	25.690	1.0859	17.534
1.1661	33.437	1.1247	25.282	1.0838	17.126
1.1641	33.029	1.1226	24.874	1.0818	16.718

Sp. gr. of HCl+Aq at 15°—Continued.

Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl
1.0708	16.310	1.0517	10.002	1.0259	5.301
1.0778	15.902	1.0497	10.194	1.0239	4.803
1.0754	15.494	1.0477	9.708	1.0220	4.186
1.0738	15.087	1.0457	9.379	1.0200	4.074
1.0718	14.679	1.0437	8.971	1.0180	3.670
1.0697	14.271	1.0417	8.563	1.0160	3.262
1.0677	13.863	1.0397	8.155	1.0140	2.854
1.0657	13.456	1.0377	7.747	1.0120	2.447
1.0637	13.049	1.0357	7.340	1.0100	2.039
1.0617	12.641	1.0337	6.932	1.0080	1.631
1.0597	12.233	1.0318	6.524	1.0060	1.224
1.0577	11.825	1.0298	6.116	1.0040	0.816
1.0557	11.418	1.0279	5.709	1.0020	0.408
1.0537	11.010	..	..	..	..

(Ure, Handwörterbuch.)

Sp. gr. of HCl+Aq. U=sp. gr. at 15.55° according to Ure; K=sp. gr. at 15° according to Kramers

% HCl	U	K	% HCl	U	K
1	1.005	1.005	22	1.109	1.111
2	1.010	1.010	23	1.114	1.116
3	1.015	1.015	24	1.119	1.121
4	1.020	1.020	25	1.124	1.126
5	1.025	1.025	26	1.128	1.131
6	1.030	1.030	27	1.133	1.136
7	1.034	1.034	28	1.138	1.141
8	1.039	1.039	29	1.143	1.146
9	1.044	1.044	30	1.147	1.151
10	1.048	1.048	31	1.153	1.157
11	1.053	1.053	32	1.157	1.163
12	1.059	1.059	33	1.163	1.169
13	1.064	1.065	34	1.169	1.179
14	1.069	1.070	35	1.174	..
15	1.074	1.075	36	1.179	..
16	1.079	1.080	37	1.183	..
17	1.084	1.085	38	1.188	..
18	1.089	1.090	39	1.193	..
19	1.094	1.095	40	1.197	..
20	1.098	1.100	41	1.203	..
21	1.104	1.105	..	..	..

(Calculated by Gerlach, Z. anal. 8. 292.)

Sp. gr. of HCl+Aq at 15° (H<sub>2</sub>O at 0°=1).

% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.
0	0.9992	15	1.07539	30	1.15079
1	1.00503	16	1.08042	31	1.15581
2	1.01005	17	1.08545	32	1.16084
3	1.01508	18	1.09047	33	1.16587
4	1.02010	19	1.09550	34	1.17089
5	1.02513	20	1.10052	35	1.17592
6	1.03016	21	1.10555	36	1.18095
7	1.03518	22	1.11058	37	1.18597
8	1.04021	23	1.11560	38	1.191
9	1.04524	24	1.12063	39	1.196
10	1.05026	25	1.12566	40	1.200
11	1.05529	26	1.13068	41	1.204
12	1.06031	27	1.13571	42	1.208
13	1.06534	28	1.14074	43	1.212
14	1.07037	29	1.14576	..	..

(Kolb, recalculated by Gerlach, Z. anal. 27. 316.)

Sp. gr. of HCl+Aq at 15°.

% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.
5	1.0244	20	1.0982	35	1.1739
10	1.0488	25	1.1234	40	1.1969
15	1.0733	30	1.1488	41	1.2013

(Hager, Adjumenta varia, Leipzig, 1876.)

Sp. gr. of HCl+Aq at 15° (H<sub>2</sub>O at 15°=1).

% HCl	Sp. gr.	% HCl	Sp. gr.
44.345	1.21479	34.464	1.17138
43.136	1.21076	25.260	1.12479
41.901	1.20430	19.688	1.09675
41.212	1.20204	14.788	1.07255
39.831	1.19703	6.382	1.03150
37.596	1.18687	..	..

(Pickering, B. 26. 277.)

Most accurate table.

Sp. gr. of HCl+Aq at 15° (H<sub>2</sub>O at 4°=1).

Sp. gr.	% HCl	K <sub>2</sub> HCl in 1 l	Sp. gr.	% HCl	K <sub>2</sub> HCl in 1 l
1.000	0.16	0.016	1.105	20.97	0.232
1.005	1.15	0.012	1.110	21.92	0.243
1.010	2.14	0.022	1.115	22.86	0.255
1.015	3.12	0.032	1.120	23.82	0.267
1.020	4.13	0.042	1.125	24.78	0.278
1.025	5.15	0.053	1.130	25.75	0.291
1.030	6.15	0.064	1.135	26.70	0.303
1.035	7.15	0.074	1.140	27.66	0.315
1.040	8.16	0.085	1.145	28.61	0.322
1.045	9.16	0.096	1.150	29.57	0.340
1.050	10.17	0.107	1.155	30.55	0.353
1.055	11.18	0.118	1.160	31.52	0.366
1.060	12.19	0.129	1.165	32.49	0.379
1.065	13.19	0.141	1.170	33.46	0.392
1.070	14.17	0.152	1.175	34.42	0.404
1.075	15.16	0.163	1.180	35.39	0.418
1.080	16.15	0.174	1.185	36.31	0.430
1.085	17.13	0.185	1.190	37.23	0.443
1.090	18.11	0.197	1.195	38.16	0.456
1.095	19.08	0.209	1.200	39.11	0.469
1.100	20.01	0.220	..	..	..

(Lunge and Marchlewski, Z. angew. Ch. 1891. 133.)

Sp. gr. of HCl+Aq at room temp.

% HCl	Sp. gr.
8.14	1.0370
16.125	1.0843
23.045	1.1138

(Wagner, W. Ann 1883, 18. 264.)

Relation of sp gr of HCl + Aq at  $t^{\circ}$  to sp. gr. at  $19.5^{\circ} = 1.0$ .

$t^{\circ}$	89 % HCl sp gr = 1.0401	10.6 % HCl sp gr = 1.0704	25.5 % HCl sp gr = 1.101	35.8 % HCl sp gr = 1.133	46.0 % HCl sp gr = 1.1608
0	0.99557	0.99379	0.99221	0.99079	0.98982
19.5	1.00000	1.00000	1.00000	1.00000	1.00000
40	1.00707	1.00781	1.00877	1.00990	1.01063
60	1.01538	1.01665	1.01794	1.01969	1.02180
80	1.02639	1.02676	1.02791	1.02986	
100	1.03855	1.03801	1.03867	1.04059	

(Kremers, Pogg 108. 115.)

Sp. gr. of HCl + Aq

G. equivale nts HCl per liter	$t^{\circ}$	Sp gr $t^{\circ}/t^{\circ}$
0.005036	17.111	1.0000943
0.01006	17.125	1.0001892
0.02008	17.148	1.0003775
0.04990	17.138	1.000935
0.09885	17.133	1.001843
0.19641	17.162	1.003633
0.29347	17.147	1.005382
0.48278	17.140	1.008811
0.4994	17.28	1.00908
4.094	17.35	1.08390

(Kohlrausch, W. Ann 1894, 53. 28.)

Sp. gr. of a normal solution of HCl + Aq at  $18^{\circ}/4^{\circ} = 1.0165$ . (Loomis, W Ann 1896, 60. 550.)

Sp. gr. of HCl + Aq at  $19.5^{\circ}$ , when  $p$  = per cent strength of solution;  $d$  = observed density;  $w$  = volume conc. in grams per cc.  $\left(\frac{pd}{100} = w\right)$

$p$	$d$	$w$
30.0	1.1818	0.4255
29.97	1.1511	0.3450
24.35	1.1207	0.2729
18.55	1.0910	0.2024
12.22	1.0587	0.1294
9.148	1.0433	0.0954
6.559	1.0305	0.0676
3.540	1.0159	0.0360
5.345	1.0246	0.0548
1.356	1.0051	0.0136

(Barnes, J. Phys. Chem. 1898, 2. 546.)

Sp. gr. of HCl + Aq at  $18^{\circ}/4^{\circ}$ .

g HCl in 100 g of solution	Sp gr
0.12149	0.99928
0.080757	0.99900
0.040609	0.99887
0.030328	0.99881

(Jahn, Z. phys. Ch. 1900, 33. 567.)

Sp. gr. of HCl + Aq at  $20^{\circ}$ .

Normality of HCl + Aq	% HCl	Sp gr
8.42	27.10	1.1336
5.784	19.30	1.0936
3.77	12.94	1.0618
2.031	7.17	1.0334
1.588	5.65	1.0261
1.138	4.05	1.0187
0.523	1.90	1.0076

(Forchheimer, Z. phys. Ch 1900, 34. 28.)

Sp. gr. at  $20^{\circ}$  of HCl + Aq containing M g. mola. HCl per liter.

M 0.025 0.05 0.075 0.10  
Sp gr 1.00034 1.00101 1.00135 1.00180

M 0.25 0.50 0.75 1.0  
Sp gr 1.00425 1.00849 1.01264 1.01749

M 1.5 2.0  
Sp gr 1.02542 1.03414  
(Jones and Pearce, Am. Ch. J 1907, 35. 730.)

HCl is not absorbed by conc.  $H_2SO_4$  + Aq, but in large amounts by anhydrous  $H_2SO_4$  (Aimé.)

Absorption of HCl by  $H_2SO_4$  + AqTemp =  $17^{\circ}$ .

Sp gr.	g per l.		g. per 100 g.	
	HCl	$H_2SO_4$	HCl	$H_2SO_4$
1.211	517.8		42.7	
1.220	487.3	22.7	39.9	1.86
1.220	478.8	58.0	39.2	4.75
1.235	455.3	99.3	36.9	8.04
1.260	418.0	161.7	33.2	12.8
1.305	371.4	273.2	28.5	20.9
1.355	306.6	417.7	22.6	30.8
1.430	215.3	638.2	15.0	44.6
1.545	96.7	917.6	6.26	59.4
1.580	51.3	1033.5	3.25	65.4
1.660	10.3	1224.0	0.62	73.7
1.735	1.89	1344.9	0.11	77.5
1.815	1.24	1615.3	0.068	89.0

Absorption of HCl by  $H_2SO_4 + Aq$ —Cont  
Temp = 40°

Sp. gr	g per l		g per 100 g	
	HCl	$H_2SO_4$	HCl	$H_2SO_4$
1.185	421.4	42.2	35.6	3.56
1.195	416.4	70.0	34.8	5.86
1.210	392.1	107.7	32.4	8.90
1.255	346.3	211.2	27.6	16.8
1.255	325.4	236.3	25.9	18.8
1.340	247.4	383.7	18.5	28.6
1.400	161.6	619.4	11.5	44.2
1.520	50.9	929.3	3.35	61.1
1.575	18.5	1046.0	1.17	66.4
1.650	2.9	1207.6	0.17	73.2
1.725	1.4	1370.5	0.081	79.4
1.755	0.57	1428.4	0.032	81.4
1.770	0.52	1478.4	0.029	83.5

Temp. = 70°

Sp. gr	g per l		g per 100 g	
	HCl	$H_2SO_4$	HCl	$H_2SO_4$
1.145	374.1	18.4	32.7	1.61
1.150	357.3	38.9	31.1	3.38
1.160	353.8	55.7	30.5	4.80
1.180	341.3	93.6	28.9	7.93
1.225	277.7	231.9	22.8	18.9
1.230	274.3	246.4	22.3	20.0
1.315	173.7	476.7	13.2	36.2
1.380	96.5	661.8	6.99	48.0
1.510	23.6	946.1	1.56	62.7
1.560	8.4	1055.0	0.54	67.6
1.700	0.86	1371.3	0.05	80.7
1.745	0.02	1448.2	0.035	83.0
1.745	0.57	1455.2	0.032	83.4

(Coppadoro, Gazz. ch. it. 1910, 39, II, 626.)

100 pts alcohol of 36° B absorb 68 pts. HCl at 12.5°. (Boullay.)

Alcohol of 0.838 sp. gr. dissolves 327 vols. HCl at 17.5° and 758 mm. pressure, and the solution has sp. gr. = 1.005. (Pierre, A. ch. (3) 31, 135.)

Solubility of HCl in methyl alcohol (absolute) at t°.

t°	% HCl	t°	% HCl
-10.3	54.6	18	46.9
0	51.3	31.7	43

(de Bruyn, R. t. c. 11, 112.)

Solubility of HCl in ethyl alcohol (absolute) at t°.

t°	% HCl	t°	% HCl
0	45.4	19.2	41
6.5	44.2	23.5	40.2
11.5	42.7	32.0	38.1

(de Bruyn, l.c.)

Solubility of HCl in ether at t° and 760 mm pressure

t°	% HCl	t°	% HCl
-9.2	37.51	15	27.62
-5	37.0	20	24.9
0	35.6	25	22.18
+5	33.1	30	19.47
10	30.35		

(Schuncke, Z. phys. Ch. 1894, 14, 336.)

Sol. in glacial  $HC_2H_3O_2$ , ether, hexane, benzene, xylene, etc.

Oil of turpentine absorbs 50% HCl. (Thénard.)

Oil of turpentine absorbs 163 vols. HCl at 22° and 724 mm.; isoterebenthene absorbs 34% at 24° and 724 mm.; metaterebenthene absorbs 17.7% at 24° and 724 mm. (Berthelot.)

Oil of lavender absorbs 68.7 vols. at 24°. (Thénard.)

Oil of lavender absorbs 210 vols. without being saturated; oil of rosemary absorbs 218 vols. at 22°; sol. in 0.1 vol petroleum (Sausure.)

Absorbed by caprylic alcohol (Bouis)  
Fuming HCl + Aq is sol. in glycerine and miscible with conc  $H_2C_2H_4O_2$ .

Solubility of HCl in phenol + Aq at 12°.

Comp of $H_2O$ layer		Comp of phenol layer	
% HCl	% phenol	% HCl	% phenol
0	7.45	0	72
3.1	6.6	0.09	78
6.6	5.3	0.2	80.3
8.0	5.1	0.36	82.6
10.7	4.8	0.52	84.5

Composition of solution in contact with solid phenol

% $H_2O$	% HCl	% phenol
11.22	0	88.78
14.98	0.52	84.5
84.5	10.7	4.8
80.38	15.64	3.98
72.43	24.37	3.2
60.25	36.25	3.5

(Schrenemakers, Z. phys. Ch. 1912, 79, 553.)

+  $H_2O$ . F.-pt. -15.35°.

Very sol. in  $H_2O$  but only slightly sol. in HCl. (Rupert, J. Am. Chem. Soc. 1909, 31, 866.)

+  $2H_2O$ . M.-pt. -17.4°

+  $3H_2O$ . M.-pt. -24.8° (Pickering, B. 1893, 26, 280.)

The composition of the hydrates formed by HCl at different dilutions is calculated

from determinations of the lowering of the f.-pt. produced by HCl, and of the conductivity and sp. gr. of HCl+Aq (Jones, Am. Ch. J. 1905, 34. 323.)

**Chlorhydric cyanhydric acid, 3HCl, 2HCN.**

Decomp. by H<sub>2</sub>O or alcohol; sol. in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>. Insol. in ether, chloroform, or acetic ether. (Claisen, B. 16. 309.)

HCl, HCN Sol. in H<sub>2</sub>O, absolute alcohol, HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, and CHCl<sub>3</sub>, with decomp; decomp. is especially rapid in H<sub>2</sub>O (Gautier, A. ch (4) 17. 130)

**Chloric acid, HClO<sub>3</sub>.**

Known only in aqueous solution, which can be concentrated in vacuo to a sp gr. of 1.282 at 14.2°, and then contains 40.10% HClO<sub>3</sub>, corresponding to HClO<sub>3</sub>+7H<sub>2</sub>O; if left longer in vacuo over H<sub>2</sub>SO<sub>4</sub> an acid corresponding to HClO<sub>3</sub>+4½H<sub>2</sub>O is obtained. Aqueous solution of HClO<sub>3</sub> decomp. at 40°. (Kammerer, Pogg. 138. 390.)

**Chlorates.**

All chlorates except mercurous chlorate are sol. in H<sub>2</sub>O, most of them are deliquescent; many are sol. in alcohol.

**Aluminum chlorate, Al(ClO<sub>3</sub>)<sub>3</sub>+6H<sub>2</sub>O.**

Very hygroscopic. (Dobroserdow, C. C. 1904, II 177.)

+9H<sub>2</sub>O. Very sol. in cold but much less than in hot H<sub>2</sub>O. (Dobroserdow.)

**Ammonium chlorate, NH<sub>4</sub>ClO<sub>3</sub>**

Easily sol. in H<sub>2</sub>O; less sol. in alcohol.

Much less sol. in H<sub>2</sub>O at 0° than NaClO<sub>3</sub>. (Storer.)

Very sl. sol. in absolute alcohol. (Wachter, J. pr. 30. 321)

**Barium chlorate, Ba(ClO<sub>3</sub>)<sub>2</sub>+H<sub>2</sub>O.**

Sol. in 4 pts. cold, and less hot H<sub>2</sub>O. (Chevenux.)

100 pts. H<sub>2</sub>O dissolve at:

0° 20° 40° 60° 80° 100°

22.8 37.0 52.1 77.5 98.0 126.4 pts. Ba(ClO<sub>3</sub>)<sub>2</sub>.

100 grams sat. Ba(ClO<sub>3</sub>)<sub>2</sub>+Aq at t° contain grams anhydrous Ba(ClO<sub>3</sub>)<sub>2</sub>

t°	Grams Ba(ClO <sub>3</sub> ) <sub>2</sub>	t°	Grams Ba(ClO <sub>3</sub> ) <sub>2</sub>
Eutectic point.			
-2.749 ± 0.004	15 28	50	36.69
0	16 90	60	40 05
+10	21 °3	70	43.04
20	25 26	80	45 90
25	27.53	90	48 70
30	29.43	99 1	51.17
40	33.16	*104 6	52 67

\* 104.6° is bpt. at 740 mm. pressure=105.0° at 760 mm. pressure.

(Anschütz, Z. phys. Ch. 1906, 56. 238.)

**Solubility of Ba(ClO<sub>3</sub>)<sub>2</sub> in H<sub>2</sub>O.**

t°	g. Ba(ClO <sub>3</sub> ) <sub>2</sub> in 100 g H <sub>2</sub> O	Sp gr
0	25.5	1.195
20	39.3	1.274
40	55.9	1.355
60	74.1	1.433
80	92.1	1.508
100	113.2	1.580
105.6 *	120	1.600

\* Bpt. of sat. solution.

(Carlson, Dissert. 1910.)

Only slight traces dissolve in absolute alcohol. (Wachter, J. pr. 30. 334.)

Sol in acetone. (Eidmann, C. C. 1899, II. 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethylacetate (Naumann, B. 1910, 43. 314.)

**Bismuth chlorate.**

Known only in solution, which decomp. on evaporation

**Cadmium chlorate, Cd(ClO<sub>3</sub>)<sub>2</sub>+2H<sub>2</sub>O.**

Very deliquescent; sol. in H<sub>2</sub>O and alcohol. Melts in crystal H<sub>2</sub>O at 80°. (Wachter, J. pr. 30. 321.)

**Solubility in H<sub>2</sub>O.**

Sat. solution contains at:

-20°	-15°	0°	+18°
72 18	72.53	74 95	76.36
49°	65°		
80.08	82.95%	Cd(ClO <sub>3</sub> ) <sub>2</sub> .	

Sp. gr. of solution containing 76.36% Cd(ClO<sub>3</sub>)<sub>2</sub> at 18°=2.284 (Meusser, B. 1902, 35. 1422.)

Sol in acetone. (Naumann, B. 1904, 37. 4328.)

**Cadmium chlorate ammonia, Cd(ClO<sub>3</sub>)<sub>2</sub>, 6NH<sub>3</sub>.**

Ppt. (Ephraim, B. 1915, 48. 49.)

**Cæsium chlorate, CsClO<sub>3</sub>.**

100 g. H<sub>2</sub>O dissolve at:

0°	8°	19.8°	30°	42.2°
2 46	3.50	6 28	9 53	14.94
50°	77°	99°		
19.40	41 65	76.5 g	CsClO <sub>3</sub> .	

(Calzolari, Acc. Sc. med di Ferrara, 1911, 85. 150.)

**Calcium chlorate, Ca(ClO<sub>3</sub>)<sub>2</sub>+2H<sub>2</sub>O.**

Deliquescent; very sol. in H<sub>2</sub>O and alcohol. (Wachter, J. pr. 30. 323)

Melts in its water of crystallization at over 100°.

Sp. gr. of solution sat at 18° = 1.729, containing 64%  $\text{Ca}(\text{ClO}_3)_2$ . (Mylius B. 1897, 30; 1718.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014, Naumann, B. 1904, 37. 4328.)

#### Chromic chlorate.

Easily sol. in  $\text{H}_2\text{O}$ . (Prudhomme, C. C. 1890, I. 668.)

#### Cobaltous chlorate, $\text{Co}(\text{ClO}_3)_2 \cdot 2\text{H}_2\text{O}$ .

(Meusser, B. 1902, 35. 1418.)

+4 $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

18°	21°	35°	47°	61°
64.19	64.39	67.09	69.66	76.12%

Sp. gr. of solution containing 64.19%  $\text{Co}(\text{ClO}_3)_2$  at 18° = 1.861. (Meusser, B. 1902, 35. 1418.)

+6 $\text{H}_2\text{O}$ . Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. Melts in crystal  $\text{H}_2\text{O}$  at 50°. (Wächter, J. pr. 30. 321.)

Solubility in  $\text{H}_2\text{O}$

Sat. solution contains at:

-21°	-19°	0°	+10.5°
53.30	53.61	57.45	61.83%

(Meusser, B. 1902, 35. 1418.)

#### Cupric chlorate, basic, $\text{Cu}(\text{ClO}_3)_2 \cdot 3\text{Cu}(\text{OH})_2$ .

Insol. in  $\text{H}_2\text{O}$ . Very sol. in dil. acids. Sol. in warm conc.  $\text{Cu}(\text{ClO}_3)_2 + \text{Aq}$ , the solubility increasing with the conc. and temp. (Bourgeois, Bull. Soc. 1898, (3) 19. 950.)

#### Cupric chlorate, $\text{Cu}(\text{ClO}_3)_2 \cdot 4\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$

Sat. solution contains at:

-31°	-21°	+0.8°	18°	45°
54.59	57.12	58.51	62.17	66.17

59.6° 71°  
69.42 76.9%  $\text{Cu}(\text{ClO}_3)_2$ .

Sp. gr. of the solution containing 62.17%  $\text{Cu}(\text{ClO}_3)_2$  at 18° = 1.695. (Meusser, B. 1902, 35. 1420.)

+6 $\text{H}_2\text{O}$ . Very deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Melts in its crystal  $\text{H}_2\text{O}$  at 65°. (Wächter, J. pr. 30. 321.)

Sp. gr. of  $\text{Cu}(\text{ClO}_3)_2 + \text{Aq}$  at 15°.

% $\text{Cu}(\text{ClO}_3)_2$	2.106	4.778	6.945
Sp. gr.	1.01620	1.03857	1.05714

% $\text{Cu}(\text{ClO}_3)_2$	10.016	14.387
Sp. gr.	1.0844	1.12531

(Traube, Gm.-K. 5. I, 921.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

#### Cupric chlorate ammonia, $\text{Cu}(\text{ClO}_3)_2 \cdot 4\text{NH}_3$ .

Ppt. Not hygroscopic. Insol. in alcohol.  $\text{Cu}(\text{ClO}_3)_2 \cdot 6\text{NH}_3$ . Not hygroscopic. (Ephraïm, B. 1915, 48. 46.)

#### Erbium chlorate, $\text{Er}(\text{ClO}_3)_3 \cdot 8\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol.

#### Glucinum chlorate.

Known only in aqueous solution, which decomposes on evaporation.

#### Ferrous chlorate.

Known only in solution.

#### Ferric chlorate, $\text{Fe}(\text{ClO}_3)_3$ .

Sol. in  $\text{H}_2\text{O}$ .

Basic salt. Insol. in  $\text{H}_2\text{O}$ .

#### Lanthanum chlorate, $\text{La}(\text{ClO}_3)_3$ .

Deliquescent. (Cleve.)

#### Lead chlorate, $\text{Pb}(\text{ClO}_3)_2 \cdot \text{H}_2\text{O}$ .

Deliquescent; easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Wächter, J. pr. 30. 321.)

Sp. gr. of solution sat at 18° = 1.947 and contains 60.2%  $\text{Pb}(\text{ClO}_3)_2$ . (Mylius, B. 1897, 30. 1718.)

100 g.  $\text{H}_2\text{O}$  dissolve 440 g.  $\text{Pb}(\text{ClO}_3)_2$  at 18°; sp. gr. of sat. solution = 1.63. (Carlson, Dissert. 1910.)

#### Lithium chlorate, $\text{LiClO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Very deliquescent and sol. in  $\text{H}_2\text{O}$ . Very easily sol. in alcohol. Melts at 50° in its crystal water. (Wächter, J. pr. 30. 321.)

$\text{LiClO}_3 + \text{Aq}$  sat. at 18° contains 75.8%  $\text{LiClO}_3$ . Sp. gr. = 1.815. (Mylius, B. 1897, 30. 1718.)

483 g.  $\text{LiClO}_3$  dissolve in 100 g.  $\text{H}_2\text{O}$  at 15°; sp. gr. of solution = 1.82. (Carlson, Dissert. 1910.)

Contains 3 $\text{H}_2\text{O}$  and is not deliquescent. (Lagorio, Zeit. f. Kryst. 15. 80.)

Salt is anhydrous. (Retgers, Z. phys. Ch. 5. 449.)

#### Magnesium chlorate, $\text{Mg}(\text{ClO}_3)_2$ .

128.1 g.  $\text{Mg}(\text{ClO}_3)_2$  dissolve in 100 g.  $\text{H}_2\text{O}$  at 19°; sp. gr. of solution = 1.59. (Carlson, Dissert. 1910.)

Sp. gr. of solution containing 56.5%  $\text{Mg}(\text{ClO}_3)_2$  at 18° = 1.564. (Meusser, l.c.)

Sp. gr. of solution sat at 18° = 1.594, containing 56.3%  $\text{Mg}(\text{ClO}_3)_2$ . (Mylius, B. 1897, 30. 1718.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

+2 $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

39.5°	61°	68°	93°
65.37	69.46	70.69	73.71%

(Meusser, B. 1902, 35. 1416.)

+4H<sub>2</sub>O. Solubility in H<sub>2</sub>O.

Sat. solution contains at:

42°	65.5°
63.82	69.12% Mg(ClO <sub>4</sub> ) <sub>2</sub> .

(Meusser, l.c.)

+6H<sub>2</sub>O. Very deliquescent and sol in H<sub>2</sub>O. Very easily sol. in alcohol. Melts at 40° in its crystal water. (Wächter, J. pr. 30. 325.)

Solubility in H<sub>2</sub>O.

Sat. solution contains at:

-18°	0°	+18°	29°	35°
51.64	53.27	59.50	60.23	63.65% Mg(ClO <sub>4</sub> ) <sub>2</sub> .

(Meusser)

Manganous chlorate, Mn(ClO<sub>3</sub>)<sub>2</sub>.

Known only in solution which decomposes on evaporation. (Wächter.)

Mercurous chlorate, Hg<sub>2</sub>(ClO<sub>3</sub>)<sub>2</sub>.

a. Easily sol. in alcohol and H<sub>2</sub>O. (Wächter, J. pr. 30. 321.)

β. Insol. in H<sub>2</sub>O; easily sol. in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (Wächter.) Decomp. by boiling H<sub>2</sub>O.

Mercuric chlorate, 2HgO, Cl<sub>2</sub>O<sub>2</sub> + H<sub>2</sub>O

Deliquescent. Decomp. by H<sub>2</sub>O into oxide and an acid salt. (Wächter.)

Sol. in 4 pts. cold H<sub>2</sub>O (Chevenix, 1802.)

Nickel chlorate, Ni(ClO<sub>3</sub>)<sub>2</sub> + 4H<sub>2</sub>O.

Solubility in H<sub>2</sub>O

Sat. solution contains at:

48.5°	55°	65°	79.5°
67.60	68.78	69.05	75.50% Ni(ClO <sub>3</sub> ) <sub>2</sub> .

(Meusser, B. 1902, 35. 1419.)

+6H<sub>2</sub>O. Deliquescent. Easily sol in H<sub>2</sub>O and alcohol. Melts in crystal H<sub>2</sub>O at 80°. (Wächter, J. pr. 30. 321.)

Solubility in H<sub>2</sub>O.

Sat. solution contains at:

-18°	-8°	0°	+18°	40°
49.55	51.52	52.66	56.74	64.47% Ni(ClO <sub>3</sub> ) <sub>2</sub> .

Sp. gr. of solution containing 56.74% Ni(ClO<sub>3</sub>)<sub>2</sub> at 18° = 1.661.

Goes over into 4H<sub>2</sub>O salt at 39°. (Meusser.)

156 g. Ni(ClO<sub>3</sub>)<sub>2</sub> dissolve in 100 g. H<sub>2</sub>O at 16°; sp. gr. of solution = 1.76. (Carlson, Dissert. 1910.)

Nickel chlorate ammonia, Ni(ClO<sub>3</sub>)<sub>2</sub>, 6NH<sub>3</sub>.

Ppt. (Ephraim, B. 1915, 48. 47.)

Potassium chlorate, KClO<sub>3</sub>.

Sol. in H<sub>2</sub>O with absorption of heat.

Sol. in about 10 pts cold, and in much less hot H<sub>2</sub>O. (Chevenix, 1802.)

Sol. in 30.03 pts H<sub>2</sub>O at 0°, 17.85 pts. at 13.3°, and in 1.66 pts at 104.78°. (M. R. and F.)

Sol in 16 pts H<sub>2</sub>O at 18.73°. (Abt.)  
100 pts H<sub>2</sub>O at 15.5° dissolve 6.2 pts., at 100°, 40 pts. (Uic'n Diet.)

100 pts H<sub>2</sub>O dissolve pts KClO<sub>3</sub> at t°

t°	Pts KClO <sub>3</sub>	t°	Pts KClO <sub>3</sub>	t°	Pts KClO <sub>3</sub>	t°	Pts KClO <sub>3</sub>
28	9.5	35	12.3	40	14.4	47	18.3
55	29.1						

(Gerardin)

100 pts H<sub>2</sub>O dissolve pts KClO<sub>3</sub> at t°

t°	Pts KClO <sub>3</sub>	t°	Pts KClO <sub>3</sub>
0	3.33	35.0	12.05
13.32	3.00	40.08	18.05
13.37	6.03	74.80	35.40
24.43	8.41	104.78	60.24

(Gay-Lussac, A. ch 11 314.)

100 pts H<sub>2</sub>O dissolve pts. KClO<sub>3</sub> at t°.

t°	Pts KClO <sub>3</sub>	t°	Pts KClO <sub>3</sub>
0	3.3	130	88.5
100	56.5	180	190

(Tilden and Shenstone, Roy. Soc. Proc. 35. 345.)

100 pts. H<sub>2</sub>O dissolve pts KClO<sub>3</sub> at t°.

t°	Pts KClO <sub>3</sub>	t°	Pts KClO <sub>3</sub>
120	73.7	160	148
136	98.9	190	183

(Tilden and Shenstone, Phil. Trans. 1884. 23.)

Coefficient of solubility is 3.2+0.109t+0.0043t<sup>2</sup> between 0° and 35° (Blarez, C. R. 112. 1213.)

Sat. KClO<sub>3</sub> + Aq contains % KClO<sub>3</sub> at t°.

t°	% KClO <sub>3</sub>	t°	% KClO <sub>3</sub>
-0.5	2.6	92	31.2
-0.3	2.4	106	37.2
+4.5	3.5	130	47.0
4.5	2.9	171	59.8
11	4.7	180	62.1
19	6.1	190	63.1
29	8.9	200	64.2
36	9.9	207	66.0
42	11.4	300	87.0
56	15.1	330	96.7
58	16.6		

(Etard, A. ch 1894, (7) 2. 528.)

Solubility in  $H_2O$ .

Temp.	% $KClO_3$ in a sat. sol.	Pts. sol. in 100 pts. $H_2O$	Pts. $H_2O$ to 1 pt. $KClO_3$
0°	3.06	3.14	31.8
5	3.67	3.82	26.2
10	4.27	4.45	22.5
15	5.11	5.35	18.5
20	6.76	7.22	13.6
25	7.56	8.17	12.2
30	8.46	9.26	10.8
35	10.29	11.47	8.7
40	11.75	13.31	7.5
45	13.16	14.97	6.6
50	15.18	17.95	5.6
55	16.85	20.27	4.9
60	18.97	23.42	4.2
65	20.32	25.50	3.9
70	22.55	29.16	3.4
75	24.82	32.09	3.0
80	26.97	36.93	2.6
85	29.25	41.35	2.4
90	31.36	46.11	2.1
95	33.76	51.39	1.9
100	35.83	55.54	1.8

(Pawlewski, B. 1899, 32, 1041.)

1 l.  $KClO_3$  + Aq at 25° contains 675 milli-mols.  $KClO_3$ . (Calvert, Z. phys. Ch. 1901, 38, 541.)

100 g.  $H_2O$  dissolve at:

	0°	20°	40°	60°
Sp. gr.	1.021	1.045	1.073	1.115

	80°	100°	104°*
Sp. gr.	1.165	1.219	1.230

\* Bpt. of sat. solution.

(Carlson, Dissert 1910)

100 g  $H_2O$  dissolve at:

	8°	19.8°	30°	99°
	4.48	7.15	10.27	57.3 g. $KClO_3$

(Calzolari, Acc. Sc. med. di Ferrara, 1911, 85, 150)

Sat.  $KClO_3$  + Aq contains at:

	53°	68°	81°	86° (?)
	17.37	23.25	23.53	30.46% $KClO_3$

(Tschugaeff, Z. anorg. 1914, 86, 161.)

Sp. gr. of  $KClO_3$  + Aq, according to Kremer's experiments (Pogg. 36, 62), and Gerlach's calculations. (Z. anal. 8, 290.)

% $KClO_3$	Sp. gr.	% $KClO_3$	Sp. gr.
1	1.007	6	1.039
2	1.014	7	1.045
3	1.020	8	1.052
4	1.026	9	1.059
5	1.033	10	1.066

Sp. gr. of  $KClO_3$  + Aq at 20° containing 1 mol  $KClO_3$  to 100 mols  $H_2O$  = 1.04122. (Nieol, Phil. Mag. (5) 16, 122.)

Sp. gr. of  $KClO_3$  + Aq at 15° containing 5%  $KClO_3$  = 1.0316 (Kohfrausch, W. Ann. 1879, 1)

B.-pt. of  $KClO_3$  + Aq containing pts.  $KClO_3$  to 100 pts.  $H_2O$ .

Pts. $KClO_3$	B. pt.	Pts. $KClO_3$	B.-pt.
6.5	100.5°	44.6	103.0°
13.2	101.0	53.4	103.5
20.2	101.5	62.2	104.0
27.8	102.0	69.2	104.4
35.8	102.5		

(Gerlach, Z. anal. 28, 450.)

Saturated solution boils at 105°. (Kremer.)

Saturated solution boils at 104.2°, and contains 61.5 pts.  $KClO_3$  to 100 pts.  $H_2O$ . (Legrand.)

Saturated solution boils at 103.3°, and contains 60.6 pts.  $KClO_3$  to 100 pts.  $H_2O$  (Griffiths.)

Saturated solution boils at 104.4°. (Gerlach, Z. anal. 28, 427.)

Sol. in pure  $HNO_3$  without decomp., but decomp. at once by  $HNO_3$  containing  $NO_2$  (Millon, A. ch. (3) 6, 92.)

Sol. in sat.  $NH_4Cl$  + Aq without causing pptn.

1 mol. (= 129 pts.)  $KClO_3$  dissolves in 2493 vols.  $H_2O$ ; in 2208 vols.  $H_2O$  when 1 mol. (= 59 pts.)  $NaCl$  is added; in 2060 vols.  $H_2O$  with 2 mols. (= 118 pts.)  $NaCl$ ; and in 1910 vols.  $H_2O$  with 4 mols. (= 236 pts.)  $NaCl$ . (Gladstone, Chem. Soc. 16, 302)

$KClO_3$  is sol. in about—

29.50 pts.  $H_2O$ .

35.50 pts.  $NH_4OH$  + Aq conc.

39.00 pts. dil.  $NH_4OH$  + Aq (1 vol. conc. : 3 vols.  $H_2O$ ).

30.50 pts.  $HNO_3$  + Aq (1 vol. conc.  $HNO_3$  : 5 vols.  $H_2O$ ).

33.0 pts.  $HCl$  + Aq (1 vol. conc.  $HCl$  : 4 vols.  $H_2O$ ).

48.00 pts.  $HC_2H_3O_2$  + Aq (1 vol. commercial  $HC_2H_3O_2$  : 1 vol.  $H_2O$ ).

31.50 pts.  $NH_4Cl$  + Aq (1 pt.  $NH_4Cl$  : 10 pts.  $H_2O$ ).

18.00 pts.  $NH_4NO_3$  + Aq (1 pt.  $NH_4NO_3$  : 10 pts.  $H_2O$ ).

34.00 pts.  $NH_4C_2H_3O_2$  + Aq (dil.  $NH_4OH$  + Aq + dil.  $HC_2H_3O_2$  + Aq).

32.50 pts.  $Na_2C_2O_4$  + Aq (commercial  $HC_2H_3O_2$  +  $Na_2CO_3$  diluted with 4 vols.  $H_2O$ ).

31.50 pts.  $Cu(C_2H_3O_2)_2$  + Aq (See Stolba, Z. anal. 2, 390.)

33.50 pts. cane-sugar (1 pt. cane-sugar : 10 pts.  $H_2O$ ).

36.50 pts. grape-sugar (1 pt. grape-sugar : 10 pts.  $H_2O$ ). (Pearson, Zeit. Chem. 1869, 662.)

Addition of K salts to sat.  $KClO_3$  + Aq ppts  $KClO_3$  in such a way, that the sum of the

KClO<sub>3</sub> remaining in solution and the K in the salt added, is a constant, which constant is equal to the solubility of KClO<sub>3</sub>, so that the following formula represents the coefficient of solubility of KClO<sub>3</sub> after addition of a K salt,  $3.2 + 0.109t + 0.0043t^2$  - K of salt added. (Blarez, C. R. 112. 1213)

Solubility of KClO <sub>3</sub> +TiClO <sub>3</sub>		
100 g H <sub>2</sub> O dissolve g salts		
t°	g. TiClO <sub>3</sub>	g KClO <sub>3</sub>
0	2 8	3 3
15	10	1 5
50	12 67	16 2
100	57 3	48 2

(Rabe, Z. anorg. 1902, 31. 156)

Solubility of KClO <sub>3</sub> in KNO <sub>3</sub> +Aq		
t°	g per l	
	KNO <sub>3</sub>	KClO <sub>3</sub>
19 85	0 00	60 88
	12 65	64 86
	25 29	60 83
	101 19	45 85
	202.38	40 20
23 87	0 00	79 09
	50.59	63 14

(Arrhenius, Z. phys. Ch. 1893, 11. 397)

Solubility in KCl+Aq at 20° C.		
G KCl in 1 litre	G KClO <sub>3</sub> in 1 litre	Sp gr
0	71.1	1.050
10	55	1.050
20	49	1.050
30	43	1.050
40	39.5	1.054
50	36.5	1.058
60	34	1.064
70	32	1.070
80	30	1.075
90	28	1.081
100	27	1.086
110	25.5	1.091
120	24.5	1.098
130	23.5	1.103
140	22.5	1.108
150	21.5	1.113
160	21.0	1.119
170	20.5	1.124
180	20.0	1.130
190	20.0	1.135
200	20	1.140
210	20	1.145
220	20	1.150
230	20	1.156
240	20	1.161
250	20	1.168

(Winteler, Z. Elektrochem. 1900, 7 361.)

Solubility in KOH+Aq at 25°.

KOH+Aq	Millimols KClO <sub>3</sub> per litre of the solution
1/4-normal	624
1/8-normal	573

(Calvert, Z. phys. Ch. 1901, 38. 541.)

Solubility in H<sub>2</sub>O<sub>2</sub> at 25°.

Concentration of H <sub>2</sub> O <sub>2</sub> millimols per litre	Millimols KClO <sub>3</sub> per litre of the solution
1260	730
1310	737

(Calvert, l.c.)

Solubility in 1/4 normal KOH+Aq in presence of H<sub>2</sub>O<sub>2</sub> at 25°.

Concentration of H <sub>2</sub> O <sub>2</sub> millimols per litre	Millimols KClO <sub>3</sub> per litre of the solution
15	578
276	584
954	618
1073	678

(Calvert, l.c.)

Moderately sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 828)

Neither dissolved nor attacked by liquid NO<sub>2</sub>. (Frankland, Chem. Soc. 1901, 79. 1361.)

Sol. in 120 pts. alcohol of 83% at 10°.

(Wittstein)

Sol. in 120 pts. alcohol of 77 1%. (Pohl, W. A. B. 6. 595.)

Insol. in absolute alcohol. (Gerardin.)

Solubility of KClO<sub>3</sub> in dil. alcohol. D=sp.

gr of alcohol, S=solubility in 100 pts alcohol at t°.

D = 0.9904		D = 0.9848		D = 0.9793	
t°	S	t°	S	t°	S
13	4 9	14	4 7	14	3.2
21	6 3	26	7 1	26	5 4
25	7 5	39	9 3	38	7.9
30	9 1	47	12 8	46	10 8
35	10 2	55	16 1	51	12 2
44	13.6	65	22 3	63	17 5
50	16 2	66	22 5	65	19 0

D = 0.9726		D = 0.9573		D = 0.9390	
t°	S	t°	S	t°	S
13	2 2	13	1.9	14.5	1.1
20	3 3	20	2 7	28	2.2
33	5 8	29	3 6	40	3.4
43	7 2	36	4 3	50	4.3
56	11.4	55	7 9	62	6.6
59	12 9	60	9 7	67	7.6
.	.	63	10.5	.	.

Solubility of  $\text{KClO}_3$  in dil. alcohol—Continued.

D = 0.9111		D = 0.8967		D = 0.8429	
$\gamma^\circ$	S	$t^\circ$	S	$t^\circ$	S
13	0 74	12	6 46	25	0 09
25	1 08	31	1 28	34	0 12
32	1 78	43	1 95	56	0 24
52	3 35	58	3 10	64	0 32

(Gerardin, A. ch. (4) 5, 148.)

Solubility of  $\text{KClO}_3$  in alcohol + Aq.

wt % alcohol	$\pi \text{ KClO}_3$ per 100 g. solution	
	$t = 30^\circ$	$t = 40^\circ$
0	9 23	12 23
5	7 72	10 43
10	6 44	8 84
20	4 51	6 40
30	3 21	4 67
40	2 35	3 41
50	1 64	2 41
60	1 01	1 41
70	0 54	0 78
80	0 24	0 34
90	0 06	0 12

(Taylor, J. phys. Ch. 1897, 1, 301.)

Insol. in benzonitrile (Naumann, B. 1914, 47, 1370.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)

Insol. in acetone (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014.)

Solubility of  $\text{KClO}_3$  in acetone + Aq.

wt. % acetone	$\pi \text{ KClO}_3$ per 100 g. solution	
	$t = 30^\circ$	$t = 40^\circ$
0	9.23	12.23
5	8.32	11.10
9.00	7.63	10.28
20	6.09	8.27
30	4.93	6.69
40	3.90	5.36
50	2.90	4.03
60	2.03	2.86
70	1.24	1.68
80	0.57	0.79
90	0.18	0.24

(Taylor, J. phys. Ch. 1897, 1, 301.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1904, 37, 3601.)

Solubility in glycol = 0.9% at ord. temp. (de Coumick, Belg. Acad. Bull. 1905, 359.)

100 g. glycerol (sp. gr. 1.256) dissolve 3.54 g.  $\text{KClO}_3$  at 15–16°. (Ossendowski, Pharm. J. 1907, 79, 575.)Potassium silver chlorate,  $\text{KClO}_3$ ,  $\text{AgClO}_3$ . (Pfaundler, W. A. B. 46, 2, 266.)Rubidium chlorate,  $\text{RbClO}_3$ .100 pts.  $\text{H}_2\text{O}$  dissolve 2.8 pts. at 47°; 3.9 pts. at 13°; 4.9 pts. at 18.2°; 5.1 pts. at 19°. (Reussing, A. 127, 33.)100 g.  $\text{H}_2\text{O}$  dissolve 3.1  $\text{RbClO}_3$  at 15°; sp. gr. of solution = 1.07 (Carlson, Dissert. 1910.)100 g.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$	$8^\circ$	$19.8^\circ$	$30^\circ$
2.138	3.07	5.36	8.00 g. $\text{RbClO}_3$ ,

$42.2^\circ$	$50^\circ$	$76^\circ$	$99^\circ$
12.48	15.98	34.12	62.8 g. $\text{RbClO}_3$ .

(Calzolari, Acc. Sc. med. di Ferrara, 1911, 85, 150.)

Scandium chlorate.

(Crookes, Roy. Soc. Proc. 1908, 80, A, 518.)

Silver chlorate,  $\text{AgClO}_3$ .Sol. in 10–12 pts. cold  $\text{H}_2\text{O}$  (Vauquelin); in 8–10 pts. cold, and 2 pts. hot  $\text{H}_2\text{O}$  (Chevenux), in 5 pts. cold  $\text{H}_2\text{O}$  (Wachter). Sl. sol. in alcohol (Chevenux); easily sol. in alcohol (Wachter).Silver chlorate ammonia,  $\text{AgClO}_3$ ,  $2\text{NH}_3$ .Easily sol. in  $\text{H}_2\text{O}$  or alcohol. (Wachter, 1843.)Sodium chlorate,  $\text{NaClO}_3$ .

Deliquescent.

Sol. in 3 pts. cold and less hot  $\text{H}_2\text{O}$ . (Wachter, Chevenux.)Sol. in 3 pts.  $\text{H}_2\text{O}$  at 18.75° (Uhl.)100 pts.  $\text{H}_2\text{O}$  dissolve 35.5 pts.  $\text{NaClO}_3$  (Ure's Diet.)100 pts.  $\text{H}_2\text{O}$  dissolve at.

$0^\circ$	$20^\circ$	$40^\circ$	$60^\circ$
81.9	99	123.5	147.1 pts. $\text{NaClO}_3$ ,

$80^\circ$	$100^\circ$	$120^\circ$
175.6	232.6	333.3 pts. $\text{NaClO}_3$ .

(Kremers, Pogg. 97, 4.)

100 pts.  $\text{H}_2\text{O}$  dissolve 80.3 pts.  $\text{NaClO}_3$  at 12°. (Schlossing.)100 g.  $\text{H}_2\text{O}$  dissolve at:

$-15^\circ$	$0^\circ$	$20^\circ$	$40^\circ$
72	79	101	126 pts. $\text{NaClO}_3$ ,
Sp. gr. 1.380	1.389	1.430	1.472

$60^\circ$	$80^\circ$	$100^\circ$	$122^\circ$ *
155	189	230	286 pts. $\text{NaClO}_3$ .

Sp. gr. 1.514 1.559 1.604 1.654

\* Bpt. of sat. solution.

(Carlson, Dissert., 1910.)

100 g.  $\text{NaClO}_3 + \text{Aq}$  contain at:  
 4.78° 19.85° 30.05° 35.10° 44.72°  
 45.47 48.91 51.22 52.36 54.50 g.  $\text{NaClO}_3$   
 (Le Blanc and Schmandt, Z. phys. Ch. 1911,  
 77. 614.)

Sp. gr. of  $\text{NaClO}_3 + \text{Aq}$ , containing:  
 10 15 20 25 30 25%  $\text{NaClO}_3$   
 1.070 1.108 1.147 1.190 1.235 1.282  
 (Gerlach, Z. anal. 8. 390.)

Sp. gr. of  $\text{NaClO}_3 + \text{Aq}$  at 20° containing 1  
 mol  $\text{NaClO}_3$  in 100 mols  $\text{H}_2\text{O} = 1.03844$   
 (Nicol, Phil. Mag. (5) 16. 122.)

$\text{NaClO}_3 + \text{Aq}$  containing 7.23%  $\text{NaClO}_3$   
 has sp. gr. 20°/20° = 1.0496. (Le Blanc and  
 Rohland, Z. phys. Ch. 1896, 19. 278.)

Set, solution boils at 132°, and temp. can  
 be raised to 135° by supersaturation. (Krem-  
 ers, Pogg. 97. 4.)

Easily sol. in liquid  $\text{HF}$ . (Franklin, Z.  
 anorg. 1905, 46. 2.)

$\text{NaClO}_3 + \text{NaCl}$   
 100 pts.  $\text{H}_2\text{O}$  dissolve 50.75 pts.  $\text{NaClO}_3 +$   
 24.4 pts.  $\text{NaCl}$  at 12°; 100 pts.  $\text{H}_2\text{O}$  dissolve  
 249.6 pts.  $\text{NaClO}_3 + 11.5$  pts.  $\text{NaCl}$  at 122°,  
 and when cooled to 12° contain 68.6 pts.  
 $\text{NaClO}_3 + 11.5$  pts.  $\text{NaCl}$ . (Schlosing, C R.  
 78. 1372.)

#### Solubility in $\text{NaCl} + \text{Aq}$ at 20° C

G $\text{NaCl}$ in 1 litre	G $\text{NaClO}_3$ in 1 litre	Sp. gr.
5	608	1.426
10	661	1.424
15	653	1.423
20	645	1.421
25	638	1.419
30	630	1.418
35	622	1.417
40	615	1.415
45	607	1.414
50	599	1.412
55	590	1.411
60	582	1.409
65	574	1.408
70	566	1.406
75	559	1.405
80	551	1.404
85	544	1.402
90	537	1.401
95	529	1.399
100	522	1.398
105	514	1.396
110	507	1.394
115	499	1.392
120	491	1.391
125	484	1.389
130	476	1.387
135	467	1.385
140	459	1.383
145	451	1.381

#### Solubility in $\text{NaCl} + \text{Aq}$ at 20° C.—Continued

G $\text{NaCl}$ in 1 litre	G $\text{NaClO}_3$ in 1 litre	Sp. gr.
150	442	1.379
155	432	1.377
160	423	1.374
165	414	1.372
170	403	1.369
175	393	1.365
180	382	1.362
185	371	1.359
190	360	1.355
195	349	1.350
200	338	1.345
205	326	1.340
210	315	1.335
215	302	1.330
220	287	1.324
225	271	1.319
230	257	1.313
235	243	1.307
240	228	1.301
245	211	1.295
250	197	1.289
255	184	1.283
260	170	1.276
265	150	1.270
270	135	1.263
275	120	1.256
280	105	1.249
285	91	1.241
290	78	1.235
295	67	1.226
300	55	1.217

(Winteler, Z. Elektrochem. 1900, 7. 361.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am.  
 Ch. J. 1898, 20. 829.)

Sol. in 34 pts. alcohol of 83% at 16° and in  
 less hot alcohol. (Wittstein.)

Somewhat more easily sol. in alcohol than  
 $\text{NaCl}$ . (Berzelius.)

#### Solubility of $\text{NaClO}_3$ in alcohol. (g. $\text{NaClO}_3$ per l. of solution)

t°	Alcohol		
	90 %	75 %	50 %
20	16.1	110.8	311.3
40	22.9	133.5	321.8
60	29.0	155.8	326.8
70	.	161.3	...

(Carlson, Dissert. 1910.)

Insol. in methyl acetate. (Naumann, B.  
 1909, 42. 3790); ethyl acetate. (Naumann,  
 B. 1910, 43. 314.)

100 g. glycerol dissolve 20 g.  $\text{NaClO}_3$  at  
 15.5°. (Ossendowski, Pharm. J. 1907, 79.  
 575.)

Strontium chlorate,  $\text{Sr}(\text{ClO}_3)_2 \cdot 5\text{H}_2\text{O}$ .

Very deliquescent, and sol in  $\text{H}_2\text{O}$ . (Topsoe, W. A. B. 66, 2, 29.)

Sp. gr. of solution sat. at  $18^\circ$  containing 63.3%  $\text{Sr}(\text{ClO}_3)_2 = 1.839$ . (Mylius, B. 1897, 90, 1718.)

Easily sol in  $\text{H}_2\text{O}$ , less in alcohol, but more sol in alcohol than  $\text{SrCl}_2$ . (Souclay, A. 102, 381.)

Insol in absolute alcohol (Wachter)

Thallous chlorate,  $\text{TlClO}_3$ .

Sol. in  $\text{H}_2\text{O}$ , but decomp. by heating

100 pts  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$   $20^\circ$   $50^\circ$   $80^\circ$   $100^\circ$

2.80 3.92 12.67 36.65 57.31 pts.  $\text{TlClO}_3$

(Muir, Chem. Soc. 29, 857.)

1 l.  $\text{TlClO}_3 + \text{Aq}$  sat. at  $10^\circ$  contains 25.637 g.  $\text{TlClO}_3$ . (Roozeboom, Z. phys. Ch. 8, 532.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.134 equivalents  $\text{TlClO}_3$  at  $20^\circ$ , or 38.51 g. in 1 l. of the solution (mean of 10 experiments). (Noyes and Farrell, J. Am. Chem. Soc. 1911, 33, 1657.)

Solubility in  $\text{Ti}_2\text{SO}_4 + \text{Aq}$  at  $20^\circ$ .

G equiv. per l.		Solid phase
$\text{TiClO}_3$	$\text{Ti}_2\text{SO}_4$	
0.1058	0.1366	$\text{TiClO}_3 + \text{Ti}_2\text{SO}_4$

(Noyes and Farrell, *l.c.*.)

Thallie chlorate,  $\text{Th}(\text{ClO}_3)_3 + 4\text{H}_2\text{O}$ .

Very deliquescent; sol. in  $\text{H}_2\text{O}$ . Decomp. slowly in the air. (Gewecke, Z. anorg. 1912, 75, 273.)

Ytterbium chlorate.

Sol. in  $\text{H}_2\text{O}$  (Popp, A. 131, 179.)

Yttrium chlorate,  $\text{Y}(\text{ClO}_3)_3 + 8\text{H}_2\text{O}$

Deliquescent. Easily sol. in alcohol. Sl. sol. in ether. (Cleve.)

Zinc chlorate,  $\text{Zn}(\text{ClO}_3)_2 + 4\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

$+18^\circ$   $30^\circ$   $40^\circ$   $55^\circ$   
66.52 67.66 69.06 75.44%  $\text{Zn}(\text{ClO}_3)_2$ .

Sp. gr. of solution containing 66.52%  $\text{Zn}(\text{ClO}_3)_2$  at  $18^\circ = 1.916$ .

(Meusser, B. 1902, 35, 1417.)

More sol. in  $\text{H}_2\text{O}$  than chlorates of Mg, Co, Ni or Cu, less sol than chlorate of Cd; more sol. than  $\text{Zn}(\text{NO}_3)_2$  (Meusser, *l.c.*)

$+6\text{H}_2\text{O}$ . Very deliquescent. Easily sol in  $\text{H}_2\text{O}$  and alcohol. Melts in crystal  $\text{H}_2\text{O}$  at  $60^\circ$ . (Vauquelin, A. ch. 95, 113.)

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

$-18^\circ$   $0^\circ$   $8^\circ$   $15^\circ$   
55.62 59.19 60.20 67.32%  $\text{Zn}(\text{ClO}_3)_2$   
(Meusser, *l.c.*)

Sp. gr. of solution sat. at  $18^\circ$  containing 65%  $\text{Zn}(\text{ClO}_3)_2 = 1.914$  (Mylius, B. 1897, 90, 1718.)

Zinc chlorate ammonia,  $\text{Zr}(\text{ClO}_3)_2 \cdot 4\text{NH}_3$ .

$\text{Zn}(\text{ClO}_3)_2 \cdot 6\text{NH}_3$ . Ppt. (Ephraim, B. 1915, 48, 48.)

Perchloric acid

See Perchloric acid.

Chlorides.

Most chlorides are sol. in  $\text{H}_2\text{O}$ ; a few, however, are insol or nearly so therein, the chief of which are  $\text{AgCl}$ ,  $\text{Hg}_2\text{Cl}_2$ ,  $\text{Cu}_2\text{Cl}_2$ ,  $\text{PtCl}_2$ , and  $\text{AuCl}$ . Several chlorides are decomp into insol. basic salts or hydroxides, either by the addition of  $\text{H}_2\text{O}$ , as in the case of  $\text{BiCl}_3$  and  $\text{SbCl}_3$ , or on evaporating the aqueous solution, as  $\text{AlCl}_3$ ,  $\text{ZnCl}_2$ ,  $\text{MgCl}_2$ , etc.

Some chlorides are sol. in alcohol or ether.

See under each element

Chlorine,  $\text{Cl}_2$ .

The maximum solubility of  $\text{Cl}$  in  $\text{H}_2\text{O}$  is at  $10^\circ$  (Schonfeld); at  $8-10^\circ$  (Gay-Lussac); at  $9-10^\circ$  (Pelouze).

Solubility decreases from  $0-0^\circ$ ; at  $100^\circ$  the solubility = 0 (Gay-Lussac.)

$\text{Cl}_2 + \text{Aq}$  sat. at  $6^\circ$  has sp. gr. = 1.003 (Berthelot)

1 vol.  $\text{H}_2\text{O}$  at  $t^\circ$  absorbs vols  $\text{Cl}$  reduced to  $0^\circ$  and 760 mm. pressure.

$t^\circ$	Vols $\text{Cl}$	$t^\circ$	Vols $\text{Cl}$
10	2.5852	26	1.9099
11	2.5413	27	1.8695
12	2.4977	28	1.8295
13	2.4543	29	1.7895
14	2.4111	30	1.7499
15	2.3681	31	1.7104
16	2.3253	32	1.6712
17	2.2828	33	1.6322
18	2.2405	34	1.5934
19	2.1984	35	1.5550
20	2.1565	36	1.5166
21	2.1148	37	1.4785
22	2.0734	38	1.4406
23	2.0322	39	1.4029
24	1.9912	40	1.3655
25	1.9504		

(Schonfeld, A. 93, 26.)

1 vol. H<sub>2</sub>O absorbs vols. Cl at t° (not corrected)

Vols Cl	t°	Vols Cl	t°	Vols Cl	t°
1.43	0	3 04	8	1 19	50
1 52	3	3 00	10	0 71	70
2 08	6 5	2 37	17	0 15	100
2 17	7	1 61	35		

(Gay-Lussac, A. ch. (3) 7. 124.)

1 vol H<sub>2</sub>O at 8° absorbs 3 04 vols Cl, which is the maximum of solubility. At 50°, 1 00 vols are absorbed, and at 0°, 1 5 vols (Pelouze and Fremy)

1 vol H<sub>2</sub>O at t° dissolves vols Cl (not corrected)

t°	Vols. Cl	t°	Vols Cl	t°	Vols. Cl
0	1 75-1 80	12	2 30-2 60	40	1 55-1 60
4	2 70-2 75	14	2 45-2 50	50	1 15-1 20
10	2 70-2 75	30	2 00-2 10	70	0 60-0 65

(Pelouze, A. ch (3) 7 188)

1 vol H<sub>2</sub>O absorbs vols. Cl at t°

t°	Vols Cl	t°	Vols Cl	t°	Vols Cl
0	1 5-1 0	0	2 65-2 70	14	2 6-2 65
3	2 05-2 1	10	2 9-3 0	16	2 35-2 4
8	2 5-2 0	12	2 65-2 75	30	1 8-1 85

(Riegel and Walb, Berz J B 1846. 72)

Solubility in H<sub>2</sub>O :  $\alpha$  = coefficient of solubility.

t°	$\alpha$	t°	$\alpha$	t°	$\alpha$
6.9	2.2931	10.1	2 8741	21 7	2 0422
8 4	2.5469	11 2	2 7267	32 1	1 5766
9 3	2.7135	13 7	2 5079	38.7	1.3802

(Goodwin, B. 15. 3040.)

Goodwin also gives tables for solubility of Cl in HCl and various chlorides, but they do not show evidence of accurate work. (A.M.C.)

Cl<sub>2</sub>+Aq contains at 760 mm. pressure:

1.44%	Cl at 0°
1.07%	" " 6°
0.95%	" " 9°
0.87%	" " 12°

(Roozeboom, R. t. c. 1884, 3. 29.)

See also Cl<sub>2</sub>+8H<sub>2</sub>O.

Solubility of Cl<sub>2</sub> in H<sub>2</sub>O

$\beta^1$  = Vol. of Cl (reduced to 0° and 760 mm.) absorbed by 1 vol. H<sub>2</sub>O under a total pressure of 760 mm

$q$  = g. Cl<sub>2</sub> absorbed by 100 g. H<sub>2</sub>O under a total pressure of 760 mm.

t°	$\beta^1$	q	t°	$\beta^1$	q
10	3 095	0 980	25	1 985	0 630
11	2 996	948	26	1 937	615
12	2 900	918	27	1 891	600
13	2 808	889	28	1 848	587
14	2 720	861	29	1 808	574
15	2 635	835	30	1 769	562
16	2 553	809	35	1 575	501
17	2 474	784	40	1 414	451
18	2 399	760	45	1 300	415
19	2 328	738	50	1 204	386
20	2.260	716	60	1 006	324
21	2 200	698	70	0 848	274
22	2 143	680	80	0 672	219
23	2 087	662	90	0 380	125
24	2.035	646	100	0 000	000

(Winkler, Landolt and Bornstein, Tab. 4th Ed. 1912, 597.)

1 l. HCl+Aq (38% HCl) dissolves 17.3 g. Cl; 1 l. HCl+Aq (33% HCl) dissolves 11 g. Cl; 1 l. HCl+Aq (3% HCl) dissolves 6.5 g. Cl. (Berthelot, C R. 91. 191)

Solubility of Cl<sub>2</sub> in HCl+Aq at 20-21° and 759-761 mm. pressure.

g HCl per l	g Cl <sub>2</sub> per l	Coefficient of absorption	Solubility
0	7 23	2 1157	2 2799
3 134	5 30	1.5496	1 6098
6 248	4 94	1 4483	1 5607
9 402	4.76	1.3942	1 5013
12 540	4 85	1 4200	1 5292
15 670	5 10	1 4933	1 6092
31 340	5 81	1.6736	1 8033
62 680	6 38	1.8682	2 0131
94 020	7.19	2.1044	2 2677
125 360	7.76	2 2711	2 4473
156.700	8 58	2 5095	2 7043
188.040	9 23	2.7020	2.9117
219.380	9 93	2 9243	3 1312
250 720	10 68	3 1272	3 3677
282 060	11.87	3 3278	3 5859
313 401	12.03	3 5492	3 8224

(Mellor, Chem. Soc. 1901, 75. 227.)

Solubility of Cl in NaCl+Aq.  $\alpha$  = coefficient of solubility.  
NaCl=9 97%.

t°	$\alpha$	t°	$\alpha$
7.9	1.8115	18.8	1 2785
11.9	1 5879	22.6	1.0081
15 4	1.3684		

Solubility of Cl in NaCl+ $Aq$ .—*Continued*

NaCl = 16.01%

$t^{\circ}$	$\alpha$	$t^{\circ}$	$\alpha$
6	1 5806	21 4	0 8732
11 6	1 2227	26 9	0 7017
16 4	1 0121		

NaCl = 19.66%.

$t^{\circ}$	$\alpha$	$t^{\circ}$	$\alpha$
0	1 0978	15 4	0 9511
9.2	1 2145	20 4	0 7758
9 3	1 2068	21 9	0 7385
14 8	0 9740	..	.

(Kumpf, W. Ann. Bebl. 6. 276.)

Solubility of Cl in sat. NaCl+ $Aq$  at  $t^{\circ}$  and 760 mm. pressure.

$t^{\circ}$	Coefficient of absorption at $0^{\circ}$ and 760 mm.	Solubility at $0^{\circ}$ and 760 mm.
14 5	0.3607	0 3898
29 0	0 3125	0 3458
60 0	0.1332	0 1625
82 0	0.0586	0 0763

(Kohn and O'Brien, J. Soc. Chem. Ind., 1898, 17. 1100.)

Sat. KCl+ $Aq$  absorbs  $1/2$  less Cl at  $15^{\circ}$  than pure  $H_2O$ . (Dettmer, A. 38. 35.)1 l. of a solution of  $CaCl_2$  (1 pt. in 15 pts.  $H_2O$ ) dissolves 2.45 g. Cl at  $12^{\circ}$ .1 l. of a solution of  $MgCl_2$  (1 pt. in 15 pts.  $H_2O$ ) dissolves 2.33 g. Cl at  $12^{\circ}$ .1 l. of a solution of  $MnCl_2$  (1 pt. in 15 pts.  $H_2O$ ) dissolves 2.00 g. Cl at  $12^{\circ}$ .Sl. sol. in KOH+ $Aq$ . (Fremy.)  
Somewhat sol. in liquid  $NO_2$ . (Frankland, Chem. Soc. 1901, 79. 1361.) $CCl_4$  absorbs 10% of  $Cl_2$  at  $13^{\circ}$ . (Perkins, Chem. Soc. 1894, 65. 20.)1 mol.  $CrOCl_2$  dissolves at  $0^{\circ}$ , 0.70 atom Cl; at  $-14^{\circ}$ , 1.24 atoms; at  $-21^{\circ}$ , 2.31 atoms; and at  $-24^{\circ}$ , 3.00 atoms Cl. (Rooseboom, R. t. c. 4. 379.)Sulphuryl chloride absorbs 71 vols. Cl or 0.136 pt. Cl by weight at  $6^{\circ}$ . (Schulze, J. pr. (2) 27. 168.)

Insol. in benzene. (Moride.)

Sl. sol. in chloral and iodal. (Dumas.)

Sol. in perchlorethylene. (Faraday.)

Sol. in a very large quantity of ether with decomp

Coefficient of solubility of  $Cl_2$  in organic liquids at  $15^{\circ}$ .

Substances	Coefficient of Solubility
Carbon tetrachloride	51 7
Acetic anhydride	39 6
Acetic acid (99.84%)	36 7
" (90 vol. %)	25 3
" (75 vol. %)	16 43
" (65 vol. %)	13 43

(Jones, Chem. Soc. 1911, 99. 392.)

+8 $H_2O$  Critical temp. of decomposition in open vessel =  $9.6^{\circ}$ ; in closed vessel =  $28.7^{\circ}$ .Solubility in  $H_2O$ .%  $Cl_2$  = % of  $Cl_2$  in  $Cl_2$ + $Aq$  sat. at  $t^{\circ}$  and 760 mm. in presence of  $Cl_2$ +8 $H_2O$ 

$t^{\circ}$	% $Cl_2$	$t^{\circ}$	% $Cl_2$
0	0 505	12 5	1.10
3	0 64	20	1.82
6	0 709	28 5	3.50
9	0 900		

(Rooseboom, R. t. c. 1884, 3. 57.)

Chlorine monoxide,  $Cl_2O$ Sol. in  $H_2O$ . At  $0^{\circ}$ ,  $H_2O$  absorbs at least 200 times its volume of  $Cl_2O$  gasChlorine dioxide,  $Cl_2O_2$ Decomp. on air at  $57^{\circ}$  with explosion. $H_2O$  absorbs 5-6 vols.  $Cl_2O_2$ . (Millon, A. ch. (3) 7. 298.) $H_2O$  absorbs at  $8.5^{\circ}$  and 753 mm. press. 8.591 vols  $Cl_2O_2$ . (Brandan.)100 g  $H_2O$  dissolve at: $8.5^{\circ}$  and 752 9 mm press + 7655 g.  $Cl_2O_2$ .

14° " 756 3 " " 5.0117 "

21° " 754 " " 5.4447 "

93° " 760 " " 5.6508 "

(Brandan, A. 151. 340.)

Does not exist, and above data are for mixture of  $ClO_2$  and Cl (Garzaroli-Thurnlakch, A. 209. 184.)Chlorine tetroxide,  $ClO_2$  $H_2O$  at  $4^{\circ}$  absorbs about 20 vols.  $ClO_2$  with formation of  $HClO_2$  and  $HClO$ . $H_2SO_4$  at  $-18^{\circ}$  absorbs about 20 vols.  $ClO_2$ . (Millon, A. ch. (3) 7. 285.)Solubility of  $ClO_2$  in  $H_2O$ .

$t^{\circ}$	g $ClO_2$ per l
1	>108 6
10 7	116 7
14 0	>107 9

(J. Z. phys. Ch. 1906, 54. 569.)

+8H<sub>2</sub>O (=1H<sub>2</sub>O).

Solubility in H<sub>2</sub>O.

t°	g ClO <sub>2</sub> per l	t°	g ClO <sub>2</sub> per l
0 79*	26 98	10	60 06
0	27 59	15 3	60 06
1	29 48	18 2	107 9
5 7	42 10		

\*Eutectic.

(Bray)

Chlorine oxide, Cl<sub>2</sub>O<sub>17</sub>

Very easily decomp. (Millon, A 46. 281.)  
Probably a mixture of ClO<sub>2</sub> and O

Chlorine heptoxide, Cl<sub>2</sub>O<sub>7</sub>

Explosive, decomp. by H<sub>2</sub>O, sol. in well cooled benzene with sl. decomp. (Michael, Am. Ch. J 1909, 23. 447.)

Chloriridiamine chloride,



Sl. sol. in cold, easily in hot H<sub>2</sub>O. (Skoblikoff, A 84. 275.)

— nitrate, Cl<sub>2</sub>Ir(N<sub>2</sub>H<sub>5</sub>NO<sub>2</sub>)<sub>2</sub>.  
Sol. in H<sub>2</sub>O.

— sulphate, Cl<sub>2</sub>Ir(N<sub>2</sub>H<sub>5</sub>)SO<sub>4</sub>.

Sl. sol. in cold, much more easily in hot H<sub>2</sub>O

Chloriridic acid.

Chloriridates.

Most of the chloriridates are very difficultly sol. in H<sub>2</sub>O, but a little more sol. than the corresponding chloroplatinates. Insol. or nearly so in alcohol, but not so difficultly sol. as the chloroplatinates. (Rose.)

Ammonium chloriridate, (NH<sub>4</sub>)<sub>2</sub>IrCl<sub>6</sub>.

Sol. in 20 pts. cold H<sub>2</sub>O (Vanquelin); sl. sol. in cold, much more in hot H<sub>2</sub>O (Claus); sol. in HCl+aq. (Soblewsky); insol. in cold NH<sub>4</sub>Cl+aq. (Claus); insol. in alcohol (Berzelius).

100 pts H<sub>2</sub>O dissolve at.

14.4° 26.8° 39.4°

0.699 0.905 1.226 pts. (NH<sub>4</sub>)<sub>2</sub>IrCl<sub>6</sub>,

52.2° 61.2° 69.3°

1.608 2.130 2.824 pts. (NH<sub>4</sub>)<sub>2</sub>IrCl<sub>6</sub>

(Rimbach and Kortzen, Z. anorg. 1907, 52. 407.)

Cæsium chloriridate, Cs<sub>2</sub>IrCl<sub>6</sub>.

Only sl. sol. in H<sub>2</sub>O. (Delépine, C. R. 1908, 146. 1268.)

Lithium chloriridate, Li<sub>2</sub>IrCl<sub>6</sub>.

Somewhat deliquescent; very sol. in H<sub>2</sub>O. (Antony, Gazz. ch. it 23, 1. 190.)

Potassium chloriridate, K<sub>2</sub>IrCl<sub>6</sub>

Sl. sol. in cold H<sub>2</sub>O, sol. in 15 pts. boiling H<sub>2</sub>O; less sol. in H<sub>2</sub>O containing HCl; insol. in alcohol or sat. KCl, and CaCl<sub>2</sub>+Aq.

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 829.)

Rubidium chloriridate, Rb<sub>2</sub>IrCl<sub>6</sub>.

Very sl. sol. in H<sub>2</sub>O. (Rumbach, Z. anorg. 1907, 52. 408.)

Sodium chloriridate, Na<sub>2</sub>IrCl<sub>6</sub>+6H<sub>2</sub>O

Easily sol. in H<sub>2</sub>O; sol. in alcohol of 0.837 sp gr.

Thallium chloriridate, Tl<sub>2</sub>IrCl<sub>6</sub>.

Decomp. by hot HCl forming Tl<sub>2</sub>IrCl<sub>6</sub>. (Delépine, C. R. 1909, 149. 1073.)

Chloriridium pentamine comps.

See Iridopentamine chloro comps.

Chloriridosulphurous acid.

Potassium chloriridosulphite, K<sub>4</sub>Ir<sub>2</sub>Cl<sub>2</sub>(SO<sub>3</sub>)<sub>4</sub>, 4KCl+12H<sub>2</sub>O

Insol. in cold, decomp. by hot H<sub>2</sub>O.

K<sub>4</sub>Ir<sub>2</sub>Cl<sub>2</sub>(SO<sub>3</sub>)<sub>4</sub>, 2K<sub>2</sub>SO<sub>3</sub>. Decomp. by H<sub>2</sub>O  
Cl<sub>2</sub>Ir<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>, 8KCl+4H<sub>2</sub>O. Sol. in H<sub>2</sub>O;  
insol. in alcohol. (Claus, J. pr. 42. 354.)

Chloriridous acid.

Ammonium chloriridite, (NH<sub>4</sub>)<sub>2</sub>IrCl<sub>5</sub>.

Decomp. by H<sub>2</sub>O. (Delépine, C. R. 1908, 146. 1268.)

+1½H<sub>2</sub>O Sol. in H<sub>2</sub>O. (Claus.)

IrCl<sub>5</sub>(H<sub>2</sub>O)(NH<sub>4</sub>)<sub>2</sub>. (Delépine)

Cæsium chloriridite, IrCl<sub>5</sub>(H<sub>2</sub>O)Cs<sub>2</sub>.

(Delépine.)

Lithium chloriridite, Li<sub>2</sub>IrCl<sub>5</sub>+12H<sub>2</sub>O

Deliquescent; sol. in H<sub>2</sub>O and alcohol. (Delépine, C. R. 1914, 158. 1277.)

Lithium sodium chloriridite, Li<sub>2</sub>NaIrCl<sub>5</sub>+12H<sub>2</sub>O.

Stable in aq. solution in the presence of excess of lithium salt. (Delépine, C. R. 1914, 158. 1278.)

LiNa<sub>2</sub>IrCl<sub>5</sub>+12H<sub>2</sub>O Stable in aq. solution in the presence of excess of sodium salt (Delépine, C. R. 1914, 158. 1278.)

Potassium chloriridite, K<sub>2</sub>IrCl<sub>5</sub>.

Decomp. by H<sub>2</sub>O. (Delépine.)

+3H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O; insol. in alcohol; insol. in sat. KCl+aq. (Berzelius.)  
IrCl<sub>5</sub>(H<sub>2</sub>O)K<sub>2</sub>. (Delépine)

Rubidium chloriridite,  $\text{IrCl}_3(\text{H}_2\text{O})\text{Rb}_2$ .  
(Delépine.)

Silver chloriridite,  $\text{Ag}_3\text{IrCl}_6$ .

Insol. in  $\text{H}_2\text{O}$  or acids; sl. sol. in  $\text{NH}_4\text{OH}$  +

Aq. Ppt. (Delépine, Bull. Soc. 1910, (4), 7.55.)

Sodium chloriridite,  $\text{Na}_3\text{IrCl}_6 \cdot 12\text{H}_2\text{O}$ .

Efflorescent, sol. in  $\frac{1}{2}$  pt.  $\text{H}_2\text{O}$ . Insol. in alcohol. Melts in crystal  $\text{H}_2\text{O}$  at  $50^\circ$ .

Thallium chloriridite,  $\text{Tl}_3\text{IrCl}_6$ .

Sol. in hot  $\text{HCl}$ ; pptd. on cooling. (Delépine, C. R. 1909, 149. 1073.)

Chlorotetramine chromium comps.

See Chlorotetramine chromium comps.

Chloro-azoisimide,  $\text{N}_3\text{Cl}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Raschig, B. 1908, 41. 4194.)

Chlorobromo comps:

See Bromochloro comps.

Chlorocarbonic acid.

See Carbonyl chloride.

Chlorochromic acid,  $\text{CrO}_2\text{OH}$   
 $\text{Cl}$

Known only in its salts.

$\text{CrO}_2\text{Cl}_2$ . See Chromyl chloride.

Ammonium chlorochromate,  $\text{NH}_4\text{CrO}_2\text{Cl} =$   
 $\text{CrO}_2\text{ONH}_4$

More sol. in  $\text{H}_2\text{O}$  than the K salt. (Pelgot, A. ch. 52. 283.)

Barium chlorochromate chloride,

$\text{Ba}(\text{CrO}_2\text{Cl})_2, \text{BaCl}_2$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Pratorius, A. 201. 1.)

+  $\text{H}_2\text{O}$ . Not deliquescent.

Calcium chlorochromate,  $\text{Ca}(\text{CrO}_2\text{Cl})_2$ .

Deliquescent. (Pelgot.)

+  $5\text{H}_2\text{O}$ . Very deliquescent. (Pratorius.)

Chromous chlorochromate.

See Trichromyl chloride.

Cobalt chlorochromate,  $\text{Co}(\text{CrO}_2\text{Cl})_2 \cdot 9\text{H}_2\text{O}$ .

Deliquescent; melts at  $40^\circ$  in crystal  $\text{H}_2\text{O}$  (Pratorius.)

Lithium chlorochromate,  $\text{LiCrO}_2\text{Cl}$

Sol. in  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$  without decomp (Löwenthal, Z. anorg. 1894, 6. 357.)

Magnesium chlorochromate,  $\text{Mg}(\text{CrO}_2\text{Cl})_2$

Deliquescent. (Pelgot.)

+  $9\text{H}_2\text{O}$ . Less deliquescent than the other chlorochromates (Pratorius, A. 201. 1.)

Very hygroscopic; sol. in  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$  without decomp (Löwenthal, Z. anorg. 1894, 6. 359.)

Nickel chlorochromate,  $\text{Ni}(\text{CrO}_2\text{Cl})_2 \cdot 9\text{H}_2\text{O}$ .

Deliquescent; melts in its crystal  $\text{H}_2\text{O}$  at  $46-48^\circ$  (Pratorius.)

Potassium chlorochromate,  $\text{KCrO}_2\text{Cl} =$

$\cdot \text{CrO}_2(\text{Cl})\text{OK}$

Sol. in  $\text{H}_2\text{O}$  with decomp. Cryst. from  $\text{H}_2\text{O}$  containing  $\text{HCl}$  without decomp. (Pelgot.)

Sol. in acetone (Naumann, B. 1904, 37. 4328.)

Sodium chlorochromate,  $\text{NaCrO}_2\text{Cl}$ .

Deliquescent (Pelgot.)

+  $2\text{H}_2\text{O}$ . Deliquescent (Pratorius.)

Strontium chlorochromate,  $\text{Sr}(\text{CrO}_2\text{Cl})_2 +$   
 $4\text{H}_2\text{O}$ .

Deliquescent; melts in crystal  $\text{H}_2\text{O}$  at  $72^\circ$ . (Pratorius.)

Thallous chlorochromate,  $\text{TlCrO}_2\text{Cl}$ .

Decomp. by  $\text{H}_2\text{O}$  (Lachaud and Lepierre, C. R. 103. 198.)

Zinc chlorochromate,  $\text{Zn}(\text{CrO}_2\text{Cl})_2 \cdot 9\text{H}_2\text{O}$

Deliquescent; melts at  $37.5^\circ$  in crystal  $\text{H}_2\text{O}$ . (Pratorius.)

Very hygroscopic, very sol. in  $\text{H}_2\text{O}$  and acids. (Löwenthal, Z. anorg. 1894, 6. 360.)

Dichlorochromium bromide,

$[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Br}$ .

Very deliquescent. Sol. in fuming  $\text{HBr}$ , in a mixture of equal volumes ether and fuming  $\text{HBr}$ , in alcohol and in acetone. (Bjerrum, B. 1907, 40. 2019.)

Chlorochromotetrammonium comps.

See Chlorotetramine chromium comps.

Chlorocolumbium bromide,  $(\text{Cb}_2\text{Cl}_{12})\text{Br}_2 +$   
 $7\text{H}_2\text{O}$ .

Sol. in a small quantity of cold  $\text{H}_2\text{O}$ . (Harned, J. Am. Chem. Soc. 1913, 35. 1083.)

Chlorocolumbium chloride,  $(\text{Cb}_2\text{Cl}_{12})\text{Cl}_2 +$   
 $7\text{H}_2\text{O}$ .

Insol. in cold, sol. in boiling  $\text{H}_2\text{O}$ .

Not easily decomp. by boiling with  $\text{NH}_4\text{OH}$ . Conc.  $\text{HNO}_3$  decomp. a boiling solution of this comp. Completely sol. in conc. alkalis (Harned, J. Am. Chem. Soc. 1913, 35. 1080.)

**Chlorocolumbium hydroxide**,  $(\text{Cb}_2\text{Cl}_{12})(\text{OH})_2 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids and alkalis (Harned, J. Am. Chem. Soc. 1913, **35**, 1082.)

**Chloroctamine cobaltic carbonate**,



Very sol. in  $\text{H}_2\text{O}$  (Vortmann and Blasberg, B. **22**, 2051.)

$\text{Cl}_2\text{Co}_2(\text{NH}_3)_8(\text{CO}_3)_2 + \text{H}_2\text{O}$  (Vortmann and Blasberg.)

**Chloroferrous acid**.

Calcium chloroferrite,  $\text{CaO}$ ,  $\text{CaCl}_2$ ,  $\text{Fe}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Le Chatelier, C. R. **99**, 276.)

**Dichlorofulminoplatinum**,



Insol. in  $\text{H}_2\text{O}$  (v. Meyer, J. pr. (2) **18**, 305.)

**Trichlorofulminoplatinum**,



Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (v. Meyer.)

**Tetrachlorofulminoplatinum**,



Insol. in  $\text{H}_2\text{O}$ . (v. Meyer.)

**Chlorohydroxylonitratoplatinumdiamine nitrite**,  $(\text{OH})\text{ClNO}_2\text{Pt}(\text{NH}_3)_2\text{NO}_2$

Easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Chlorohydroxylplatindiamine bromide**,



Sl. sol. in  $\text{H}_2\text{O}$

— carbonate,  $\text{OH} \cdot \text{Pt}(\text{N}_2\text{H}_5)_2\text{CO}_3$

Insol. in  $\text{H}_2\text{O}$ . (Cleve.)

— chloride,  $\text{OH} \cdot \text{Pt}(\text{N}_2\text{H}_5\text{Cl})_2$

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— chromate,  $\text{OH} \cdot \text{Pt}(\text{N}_2\text{H}_5)_2\text{CrO}_4$

Nearly insol. in  $\text{H}_2\text{O}$

— dichromate,  $\text{OH} \cdot \text{Pt}(\text{N}_2\text{H}_5)_2\text{Cr}_2\text{O}_7$

Ppt (Cleve.)

— nitrate (Raewsky's nitrate),



Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Gerhardt.)

**Chlorohyposulphuric acid**,  $\text{S}_2\text{O}_3\text{Cl}_4$ .

See Sulphur oxytetrachloride.

**Chloromanganic acid**.

See Manganic hydrogen chloride.

**Chloromercurosulphurous acid**.

**Ammonium chloromercurosulphite**,



Sol. in  $\text{H}_2\text{O}$ . (Barth, Z. phys. Ch. **9**, 305.)

**Barium chloromercurosulphite**,



Insol. in  $\text{H}_2\text{O}$  (Barth.)

**Potassium chloromercurosulphite**,  $\text{KSO}_3\text{HgCl}$

Sol. in  $\text{H}_2\text{O}$ . (Barth.)

**Sodium chloromercurosulphite**,  $\text{NaSO}_3\text{HgCl} + \text{H}_2\text{O}$ .

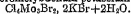
Very sol. in  $\text{H}_2\text{O}$ . (Barth.)

**Chloromolybdenum bromide**,



Insol. in  $\text{H}_2\text{O}$  and dil. acids; sol. in alcohol.  $+6\text{H}_2\text{O}$  At first easily sol. in  $\text{H}_2\text{O}$ , but a precipitate soon forms. Can be crystallized from dil.  $\text{HBr} + \text{Aq}$  Sol. in alcohol and ether. (Blomstrand.)

**Chloromolybdenum potassium bromide**,



Decomp. by  $\text{H}_2\text{O}$ . Can be cryst. from  $\text{HBr} + \text{Aq}$  (Blomstrand.)

**Chloromolybdenum chloride**,  $\text{Cl}_4\text{Mo}_2\text{Cl}_4 = \text{molybdenum dichloride}$ ,  $\text{MoCl}_5$

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; sl. sol. in  $\text{HNO}_3$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{NaOH} + \text{Aq}$ , or  $\text{KOH} + \text{Aq}$ , with separation of precipitate on boiling; sol. in alcohol and ether. (Blomstrand, J. pr. **77**, 96.)

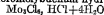
Very sol. in conc.  $\text{HCl}$ . (Rosenheim and Kohn, Z. anorg. **1910**, **66**, 2.)

$+3\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ .

$+4\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Liechta and Kempe, A. **170**, 351.)

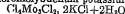
$+6\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Blomstrand.)

**Chloromolybdenum hydrogen chloride**,



Sol. in  $\text{H}_2\text{O}$ , but ppt. forms after a few minutes. (Rosenheim and Kohn, Z. anorg. **1910**, **66**, 5.)

**Chloromolybdenum potassium chloride**,



Decomp. by pure  $\text{H}_2\text{O}$ ; can be recrystallized from  $\text{HCl} + \text{Aq}$  (Blomstrand, J. pr. **77**, 108.)

**Chloromolybdenum hydroxide**,  $\text{Cl}_4\text{Mo}_6(\text{OH})_2 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol. Easily sol. in strong acids if fresh, and washed only with cold  $\text{H}_2\text{O}$ . If washed with warm  $\text{H}_2\text{O}$ , it is less sol. in acids. If precipitated hot, is insol. in acids, even  $\text{H}_2\text{SO}_4$  or fuming  $\text{HNO}_3$ . (Blomstrand, J. pr. 77. 100.)

+  $8\text{H}_2\text{O}$ .

**Chloromolybdenum iodide**,  $\text{Cl}_4\text{Mo}_6\text{I}_2 + 3\text{H}_2\text{O}$

Precipitate

+  $6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and alcohol

**Chloromolybdenum potassium iodide**,  $\text{Cl}_4\text{Mo}_6\text{I}_2, 2\text{KI} + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Recryst. from  $\text{HI} + \text{Aq}$ . (Blomstrand.)

**Chloromolybdenum oxybromide**,  $\text{Cl}_4\text{Mo}_6 \begin{smallmatrix} \text{OH} \\ \text{Br} \end{smallmatrix} + 2\text{H}_2\text{O}$ .

Insol. in alcohol. (Blomstrand, J. pr. 77. 116.)

**Chloromolybdic acid**,  $\text{MoOCl}_2(\text{OH}) + 7\text{H}_2\text{O}$ .

Very hygroscopic. (Weinland, B. 1904, 37. 572.)

**Diammonium tetrachloromolybdate**,  $\text{MoCl}_4(\text{ONH}_2)_2 + 2\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalies, and ammonia. (Weinland, Z. anorg. 1905, 44. 83.)

**Cæsium chlorotrimolybdate, acid**,

$\text{Mo}_6\text{O}_{11}\text{Cl}_{14}(\text{Cs}_2\text{O}) + 22\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalies, and ammonia. (Weinland, l.c.)

**Monocæsium trichloromolybdate**,

$\text{MoOCl}_4(\text{OCs}) + \text{H}_2\text{O}$

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalies, and ammonia. (Weinland.)

**Dicæsium tetrachloromolybdate**,

$\text{MoCl}_4(\text{OCs})_2$

Hygroscopic. Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in dilute acids, alkalies, and ammonia. (Weinland, Z. anorg. 1905, 44. 83.)

**Monopotassium trichloromolybdate**,

$\text{MoOCl}_4(\text{OK}) + \text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalies, and ammonia. (Weinland.)

**Dipotassium tetrachloromolybdate**,

$\text{MoCl}_4(\text{OK})_2 + 2\text{H}_2\text{O}$

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalies, and ammonia. (Weinland.)

**Potassium hydrogen chlorotrimolybdate**,  $\text{Mo}_6\text{O}_{11}\text{Cl}_{14}, \text{K}_2\text{O} + 6\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalies, and ammonia. (Weinland.)

**Monorubidium trichloromolybdate**,

$\text{MoOCl}_4(\text{ORb}) + \text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalies, and ammonia. (Weinland.)

**Darubidium tetrachloromolybdate**,

$\text{MoCl}_4(\text{ORb})_2$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acid, alkalies, and ammonia. (Weinland.)

**Chloronitratoplatinamine nitrite**,

$\begin{smallmatrix} \text{Cl} \\ \text{NO}_2 \end{smallmatrix} \text{Pt}(\text{NH}_2\text{NO}_2)_2$ .

Easily sol. in  $\text{H}_2\text{O}$ .

**Chloronitratoplatin diamine nitrate**,

$\begin{smallmatrix} \text{Cl} \\ \text{NO}_2 \end{smallmatrix} \text{Pt}(\text{N}_2\text{H}_4\text{NO}_2)_2$

Decomp. by  $\text{H}_2\text{O}$  with formation of  $\begin{smallmatrix} \text{Cl} \\ \text{OH} \end{smallmatrix} \text{Pt}(\text{NH}_3)_2\text{NO}_2)_2$ .

— sulphate,  $\begin{smallmatrix} \text{Cl} \\ \text{NO}_2 \end{smallmatrix} \text{Pt}(\text{N}_2\text{H}_4)_2\text{SO}_4 + \text{H}_2\text{O}$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

**Chloronitritotetramine cobaltic chloride**,

$\text{Cl}(\text{NO}_2)\text{Co}(\text{NH}_2)_4\text{Cl}$ .

Not very sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. 5. 195.)

**Chloronitritoplatin semidiamine chloride**,

$\text{Cl}_2(\text{NO}_2)\text{Pt}(\text{NH}_2)_2\text{Cl}$ .

100 pts. solution in  $\text{H}_2\text{O}$  sat. at  $18^\circ$  contain 1.8 pts. salt; sat. at  $100^\circ$ , 6 pts.

Insol. in abs. alcohol or ether. Not decomp. by conc.  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ , and by  $\text{H}_2\text{SO}_4$  only at a high heat.

Formula given was  $\text{PtN}_4\text{H}_{12}\text{Cl}_6\text{O}_4$ . (Peylone, J. B. 1855. 421.)

— nitrite,  $\text{Cl}_2(\text{NO}_2)\text{Pt}(\text{NH}_2)_2\text{NO}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Blomstrand.)

**Chlorophosphatoplatin diamine phosphate**,

$\begin{smallmatrix} \text{ClPt}(\text{N}_2\text{H}_4)_2 \\ \text{PO}_4 \end{smallmatrix} + 2\text{H}_2\text{O}$ .

Nearly insol. in cold, and only very sl. sol. in hot  $\text{H}_2\text{O}$ . (Raewsky.)

**Chloronitrous acid**.

**Iridium potassium chloronitrite**,  $\text{Ir}_2\text{Cl}_6(\text{NO}_2)_4, 6\text{KCl}$ .

Ppt., decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$ . (Leidic, C. R. 1902, 134. 1583.)

$\text{Ir}_2\text{K}_{12}\text{Cl}_{16}(\text{NO}_2)_8 + 4\text{H}_2\text{O}$ . Ppt. (Quennessen, C. R. 1905, 141. 258.)

### Chloropalladic acid.

#### Chloropalladates.

The chloropalladates are generally very sol. in  $\text{H}_2\text{O}$ , and sol in alcohol (v. Bonsdorff, Pogg. 17. 264.)

#### Ammonium chloropalladate, $(\text{NH}_4)_2\text{PdCl}_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius)

#### Barium chloropalladate.

Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)

#### Cadmium chloropalladate.

As above.

#### Cæsium chloropalladate, $\text{Cs}_2\text{PdCl}_6$ .

Nearly insol. in cold  $\text{H}_2\text{O}$  Decomp. by boiling with  $\text{H}_2\text{O}$  or by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, B. 1905, 38. 2386.)

#### Calcium chloropalladate.

Deliquescent, sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff, 1829.)

#### Glucinum chloropalladate, $\text{GlPdCl}_6 + 8\text{H}_2\text{O}$ .

Very hygroscopic, and sol. in  $\text{H}_2\text{O}$ .

#### Magnesium chloropalladate, $\text{MgPdCl}_6 + 6\text{H}_2\text{O}$ .

Deliquescent; sol. in  $\text{H}_2\text{O}$ .

#### Nickel chloropalladate, $\text{NiPdCl}_6 + 6\text{H}_2\text{O}$ .

Extremely deliquescent.

#### Potassium chloropalladate, $\text{K}_2\text{PdCl}_6$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by long boiling with  $\text{H}_2\text{O}$ . Sl. sol. in dil.  $\text{HCl} + \text{Aq}$  without decomp. Insol. in  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$ , or  $\text{NaCl} + \text{Aq}$ . Insol. in alcohol. (Berzelius.)

#### Rubidium chloropalladate, $\text{Rb}_2\text{PdCl}_6$ .

Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$  or by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, B. 1905, 38. 2387.)

#### Zinc chloropalladate, $\text{ZnPdCl}_6 + 6\text{H}_2\text{O}$ .

Very deliquescent. (v. Bonsdorff.)

### Chloropalladous acid

#### Aluminum chloropalladate, $\text{Al}_2\text{Pd}_2\text{Cl}_{12} + 20\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Wolkow, B. 7. 804.)

#### Ammonium chloropalladate, $(\text{NH}_4)_2\text{PdCl}_6 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Claus.)

Easily sol. in  $\text{H}_2\text{O}$ . (Gutbier, B. 1905, 38. 2386.)

#### Barium chloropalladate.

Easily sol. in  $\text{H}_2\text{O}$  or alcohol.

#### Cadmium chloropalladate.

Not deliquescent

#### Cæsium chloropalladate, $\text{Cs}_2\text{PdCl}_6$ .

Can be cryst. from hot  $\text{H}_2\text{O}$  (Gutbier, B. 1905, 38. 2386)

#### Calcium chloropalladate.

Deliquescent Sol. in  $\text{H}_2\text{O}$  or alcohol

#### Glucinum chloropalladate, $\text{GlPdCl}_6 + 6\text{H}_2\text{O}$ .

Very hygroscopic, very sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Wolkow.)

#### Magnesium chloropalladate.

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)

#### Manganese chloropalladate.

Sol. in  $\text{H}_2\text{O}$  and alcohol.

#### Nickel chloropalladate.

Sol. in  $\text{H}_2\text{O}$ .

#### Potassium chloropalladate, $\text{K}_2\text{PdCl}_6$ .

Much more sol. in hot than cold  $\text{H}_2\text{O}$ . (Joannis, C. R. 95. 295.) Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Berzelius.) Sol. in cold sat.  $\text{KCl} + \text{Aq}$ . (Gibbs, Sill. Am. J. (2) 31. 70.) Insol. in alcohol. (Wollaston) Somewhat sol. in alcohol of 0.84 sp. gr, but insol. in absolute alcohol; decomp. on boiling (Berzelius.)

#### Rubidium chloropalladate, $\text{Rb}_2\text{PdCl}_6$ .

Can be cryst from hot  $\text{H}_2\text{O}$  (Gutbier, B. 1905, 38. 2387.)

#### Sodium chloropalladate.

Deliquescent Sol. in  $\text{H}_2\text{O}$  and alcohol.

#### Zinc chloropalladate.

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff)

#### Chlorophosphoarseniodic acid, $2\text{IrCl}_3 \cdot 3\text{H}_2\text{PO}_3 \cdot 5\text{H}_2\text{AsO}_4(?)$ .

Very sol. in  $\text{H}_2\text{O}$ . (Geisenheimer.)

#### Lead chlorophosphoarseniodate, $4\text{IrCl}_3 \cdot 3\text{Pb}_2\text{H}_2(\text{PO}_3)_2 \cdot 3\text{Pb}_2(\text{PO}_4)_2 \cdot 5\text{Pb}_2\text{H}_2(\text{AsO}_4)_2$ .

Insol. in  $\text{H}_2\text{O}$ .

#### Chlorophosphoridic acid, $2\text{IrCl}_3 \cdot 3\text{H}_2\text{PO}_4 \cdot 3\text{H}_2\text{PO}_3$ .

Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Geisenheimer, A. ch. (6) 23. 254.)  $2\text{IrCl}_3 \cdot 3\text{H}_2\text{PO}_4$ . Sol. in  $\text{H}_2\text{O}$  and alcohol.

Ammonium chlorophosphoride,  $2\text{IrCl}_2$ ,  
 $3(\text{NH}_4)_3\text{PO}_4$ ,  $3(\text{NH}_4)_2\text{HPO}_4$ .

Very deliquescent. Very sol in  $\text{H}_2\text{O}$ .  
 (Geisenheimer)

Lead chlorophosphoride,  $4\text{IrCl}_2$ ,  
 $3\text{Pb}_2(\text{PO}_4)_3$ ,  $3\text{PbH}_2(\text{PO}_4)_2$ .

Insol. in  $\text{H}_2\text{O}$  or acetic acid; very sol in dil.  
 $\text{HNO}_3 + \text{Aq}$  (Geisenheimer.)

Silver chlorophosphoride,  $2\text{IrCl}_2$ ,  
 $3\text{AgH}_2\text{PO}_4$ ,  $3\text{AgH}_3\text{PO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ , and  
 $\text{NH}_4\text{OH} + \text{Aq}$ . (Geisenheimer.)

Chlorophosphoplatinic acid.

See Chloroplatinophosphoric acid.

Chlorophosphoric acid.

Thorium chlorophosphate,  $3\text{ThO}_2$ ,  $\text{ThCl}_4$ ,  
 $2\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$  and acids; decomp. by boiling  
 with  $\text{H}_2\text{SO}_4$  and fusing with alkali carbonates.  
 (Colani, C R 1909, 149. 208)

Chloroplatinamine chloride,  $\text{Cl}_2\text{Pt} \begin{smallmatrix} \text{NH}_4\text{Cl} \\ \text{NH}_3\text{Cl} \end{smallmatrix}$

Sol in about 700 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , and 33–34  
 pts. at  $100^\circ$ . Not attacked by boiling conc.  
 $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Sol. in boiling  $\text{KOH} + \text{Aq}$   
 with decomp. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Cleve,  
 Sv. V. A. H 10, § 30.)

— nitrite,  $\text{Cl}_2\text{Pt}(\text{NH}_3\text{NO}_2)_2$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ .

— nitrite silver nitrite,  $\text{Cl}_2\text{Pt}(\text{NH}_3\text{NO}_2)_2$ ,  
 $\text{AgNO}_2$ .

Easily sol. in hot, sl. sol. in cold  $\text{H}_2\text{O}$ .  
 (Cleve.)

— nitritochloride,  $\text{Cl}_2\text{Pt} \begin{smallmatrix} \text{NH}_3\text{NO}_2 \\ \text{NH}_4\text{Cl} \end{smallmatrix}$

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

Chloroplatinidiamine bromide,

$\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5\text{Br})_2$ .

Sl. sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

— chloride (Gros' chloride),

$\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5\text{Cl})_2$ .

Nearly insol in cold, and only sl. sol. in hot  
 $\text{H}_2\text{O}$ . Sol. in hot conc.  $\text{KOH} + \text{Aq}$ , with decomp.  
 (Grunn)

Sol. in cold  $\text{KOH} + \text{Aq}$  without decomp.  
 Nearly insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Buckton.)  
 $+ \text{H}_2\text{O}$ . (Raewsky.)

— chloroplatinate,  $\text{NCl}_2\text{Pt}(\text{N}_2\text{H}_5\text{Cl})_2$ ,  $\text{PtCl}_4$ .

Easily sol. in hot  $\text{H}_2\text{O}$ .

— chloroplatinite,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5\text{Cl})_2$ ,  $\text{PtCl}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

Chloroplatinidiamine chromate,

$\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{CrO}_4$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Cleve)

— chromate,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{Cr}_2\text{O}_7$ .

Sl. sol in cold, more sol. in hot  $\text{H}_2\text{O}$ .  
 (Cleve.)

— nitrate (Gros' nitrate),  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5\text{NO}_2)_2$

Much more easily sol. in hot than in cold  
 $\text{H}_2\text{O}$ . Sol. in hot  $\text{KOH} + \text{Aq}$  with decomp.  
 Nearly insol. in conc.  $\text{HNO}_3 + \text{Aq}$ .

— nitritochloride,  $\text{Cl}_2\text{Pt} \begin{smallmatrix} \text{N}_2\text{H}_5\text{NO}_2 \\ \text{N}_2\text{H}_5\text{Cl} \end{smallmatrix}$

Ppt (Jorgensen.)

— phosphate.

See Chlorophosphatoplatinidiamine phosphate.

— sulphate,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{SO}_4$ .

Sl. sol. in both cold or hot  $\text{H}_2\text{O}$  (Cleve.)  
 $+ 2\text{H}_2\text{O}$ . Sl. sol in cold, easily in hot  
 $\text{H}_2\text{O}$ . (Grunn)

— sulphocyanide,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5)_2(\text{CNS})_2$   
 $+ \text{H}_2\text{O}$ .

Ppt. (Cleve.)

Chloroplatinononodiamine chloride,

$\text{Cl}_2\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{Cl} \\ \text{NH}_3\text{Cl} \end{smallmatrix}$

Quite easily sol in  $\text{H}_2\text{O}$ . (Cleve)

Chloroplatinsemidiamine carbonate chloride,  
 $2\text{Pt}(\text{NH}_3)_2\text{Cl}_2$ ,  $\text{Pt}_2(\text{NH}_3)_4\text{Cl}_2(\text{CO}_3)_2$

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol and ether.  
 Decomp. by cold  $\text{HCl} + \text{Aq}$ . (Schon, Z. anorg  
 1897, 13. 37)

Chloroplatinsemidiamine chloride,

$\text{Cl}_2\text{Pt}(\text{NH}_3)_2\text{Cl}$ .

Sol. in 300 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , and 65 pts. at  
 $100^\circ$ . Not decomp. by conc.  $\text{H}_2\text{SO}_4$ . Sol. in  
 $\text{KOH} + \text{Aq}$  without decomp. (Cleve.)

Chloroplatinic acid,  $\text{H}_2\text{PtCl}_6 + 6\text{H}_2\text{O}$ .

Deliquescent Sol in  $\text{H}_2\text{O}$ , alcohol, or ether.  
 $+ 4\text{H}_2\text{O}$ . Deliquescent (Pigeon, C R.  
 112. 1218)

$\text{PtCl}_4$ ,  $\text{HCl} + 2\text{H}_2\text{O}$  (Pigeon.)

Aluminum chloroplatinate,  $\text{AlCl}_3$ ,  $\text{PtCl}_4 +$   
 $16\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$  and alcohol (Welkow, B.  
 7. 304)

Insol. in ether.

Ammonium chloroplatinate,  $(\text{NH}_4)_2\text{PtCl}_6$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$   
 (Fresenius)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.666 pt. at ord  
 temp. and 12.5 pts at  $100^\circ$ . (Crookes, C. N.  
 9. 37.)

Insol. in cold HCl + Aq. Separates out on cooling from solution in hot HCl, HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>. (Fischer.)

Very sl. sol. in cold, easily in hot NH<sub>4</sub>OH + Aq. (Fresenius.)

Conc. NH<sub>4</sub>Cl + Aq. ppts. it almost completely from aqueous solution (Böttger.)

Sol. in NH<sub>4</sub> succinate + Aq. (Dopping.)

Less sol. in H<sub>2</sub>PtCl<sub>6</sub> + Aq. than in H<sub>2</sub>O. (Rogojski, A. ch. (3) 41. 452.)

Sol. in SnCl<sub>4</sub> + Aq. (Fischer.)

Very sol. with decomp. in KCN + Aq. (Claus.)

At 15–20°, sol. in 26,535 pts. 97.5% alcohol, in 1470 pts. 76% alcohol, and in 665 pts. 55% alcohol. If free HCl is present, it is sol. in 672 pts. 76% alcohol. (Fresenius, A. 69. 118.)

Insol. in absolute alcohol or ether.

**Barium chloroplatinate**, BaPtCl<sub>6</sub> + 6H<sub>2</sub>O

Permanent, sol. in H<sub>2</sub>O; decomp. by alcohol (v. Bonsdorff, Pogg. 17. 250.)

**Barium monochloroplatinate**, PtCl(OH)<sub>2</sub>Ba + H<sub>2</sub>O.

Insol. in H<sub>2</sub>O and in org. solvents. (Bellucci, C. C. 1903, I 131.)

**Barium pentachloroplatinate**, OH.PtCl<sub>5</sub>Ba + H<sub>2</sub>O.

(Miolati, Chem. Soc. 1900, 78. (2) 732.)

**Cadmium chloroplatinate**, CdPtCl<sub>6</sub> + 6H<sub>2</sub>O

Deliquescent, and easily sol. in H<sub>2</sub>O. (v. Bonsdorff.)

**Cæsium chloroplatinate**, Cs<sub>2</sub>PtCl<sub>6</sub>.

100 pts. H<sub>2</sub>O dissolve at:

0°	10°	20°	30°
0.024	0.050	0.079	0.110
40°	50°	60°	70°
0.142	0.177	0.213	0.251

pts. Cs<sub>2</sub>PtCl<sub>6</sub>.

(Bunsen, Pogg. 113. 337.)

Sol. in 1308 pts. H<sub>2</sub>O at 15°, and 261 pts. at 100°. (Crookes, C. N. 9. 205.)

**Calcium chloroplatinate**, CaPtCl<sub>6</sub> + 8H<sub>2</sub>O

Deliquescent; easily sol. in H<sub>2</sub>O. (v. Bonsdorff.)

**Calcium monochloroplatinate**, PtCl(OH)<sub>2</sub>Ca + H<sub>2</sub>O.

Insol. in H<sub>2</sub>O and in org. solvents. (Bellucci, C. C. 1903, I 131.)

**Cerium chloroplatinate**, CeCl<sub>3</sub>, PtCl<sub>4</sub> + 13H<sub>2</sub>O.

Deliquescent; very sol. in H<sub>2</sub>O or alcohol; insol. in ether. (Maignac.)

4CeCl<sub>3</sub>, 3PtCl<sub>4</sub> + 8H<sub>2</sub>O. Deliquescent; easily sol. in H<sub>2</sub>O or alcohol, insol. in ether. (Holzmann, J. pr. 84. 80.)

**Chromium chloroplatinate**, CrCl<sub>3</sub>, PtCl<sub>4</sub> + 10½H<sub>2</sub>O.

Deliquescent. (Nilson, B. 9. 1056.)

+ 10H<sub>2</sub>O. Very sol. in H<sub>2</sub>O and alcohol. Nearly insol. in acetone. (Higley, J. Am. Chem. Soc. 1904, 26.617.)

**Cobalt chloroplatinate**, CoPtCl<sub>6</sub> + 6H<sub>2</sub>O.

Very deliquescent. (Jørgensen.)

**Copper chloroplatinate**, CuPtCl<sub>6</sub> + 6H<sub>2</sub>O.

Deliquescent in moist air. (v. Bonsdorff.)

**Didymium chloroplatinate**, D<sub>2</sub>Cl<sub>3</sub>, PtCl<sub>4</sub> + 13½H<sub>2</sub>O.

Less deliquescent than the cerium salt. (Maignac.)

+ 10½H<sub>2</sub>O. Deliquescent. (Cleve, Bull. Soc. (2) 43. 361.)

**Erbium chloroplatinate**, ErCl<sub>3</sub>, PtCl<sub>4</sub> + 11H<sub>2</sub>O.

Very deliquescent. (Cleve.)

**Gadolinium chloroplatinate**, GdCl<sub>3</sub>, PtCl<sub>4</sub> + 10H<sub>2</sub>O.

Ppt. (Benedicko, Z. anorg. 1900, 22. 204.)

**Glucinum chloroplatinate**, GlPtCl<sub>6</sub> + 8H<sub>2</sub>O.

Deliquescent in moist air. Very sol. in H<sub>2</sub>O, moderately in alcohol. Insol. in ether. (Welkow, B. 6. 1288.)

**Indium chloroplatinate**, 2InCl<sub>3</sub>, 5PtCl<sub>4</sub> + 36H<sub>2</sub>O.

Deliquescent. (Nilson.)

**Iron (ferrous) chloroplatinate**, FePtCl<sub>6</sub> + 6H<sub>2</sub>O.

Deliquescent. (Topsoe.)

**Iron (ferric) chloroplatinate**, FeCl<sub>3</sub>, PtCl<sub>4</sub> + 10½H<sub>2</sub>O.

Deliquescent. (Nilson.)

**Lanthanum chloroplatinate**, LaCl<sub>3</sub>, PtCl<sub>4</sub> + 13H<sub>2</sub>O.

Deliquescent; extremely sol. in H<sub>2</sub>O (Cleve.)

**Lead chloroplatinate**, PbPtCl<sub>6</sub> + 3H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O and alcohol (Topsoe), with decomp. (Birnbbaum, Zeit. Ch. 1867. 520.)

**Lead monochloroplatinate**, [PtCl(OH)<sub>2</sub>]<sub>2</sub>Pb, Pb(OH)<sub>2</sub>.

Ppt. (Bellucci, Chem. Soc. 1902, 82, II. 155.)

**Lead pentachloroplatinate**, basic, PtCl<sub>4</sub>(OH)Pb, Pb(OH)<sub>2</sub>.

(Miolati, Chem. Soc. 1900, 78. (2) 732.)

**Lithium chloroplatinate**, Li<sub>2</sub>PtCl<sub>6</sub> + 6H<sub>2</sub>O.

Extremely deliquescent (Jørgensen); efflorescent. Easily sol. in H<sub>2</sub>O, alcohol, or ether-alcohol; insol. in ether. (Scheibler.)

**Lithium pentachloroplatinate**, OH PtCl<sub>5</sub>Li<sub>2</sub>.

Very hygroscopic (Miolati, Chem. Soc. 1900, 78 (2) 732.)

**Magnesium chloroplatinate,  $MgPtCl_6 \cdot 6H_2O$ .**

Sol in  $H_2O$  and abs alcohol  
+  $12H_2O$ . Sol. in  $H_2O$ .

**Manganese chloroplatinate,  $MnPtCl_6 \cdot 6H_2O$**

Not deliquescent, sol. in  $H_2O$ .  
+  $12H_2O$  Sl efflorescent.

**Nickel chloroplatinate,  $NiPtCl_6 \cdot 6H_2O$ .**

Sol. in  $H_2O$ .

**Potassium chloroplatinate,  $K_2PtCl_6$ .**

100 pts.  $H_2O$  dissolve at:

0° 10° 20° 30° 40° 50°  
0.74 0.90 1.12 1.41 1.76 2.17 pts  $K_2PtCl_6$ ,  
60° 70° 80° 90° 100°  
2.64 3.19 3.79 4.45 5.18 pts.  $K_2PtCl_6$ .

(Bunsen, Pogg. 113. 337.)

100 pts.  $H_2O$  dissolve 0.926 pt at 15°, and  
5.26 pts. at 100°. (Crookes, C. N. 9. 205.)

100 g  $H_2O$  dissolve at:

2° 16° 25° 35° 48°  
0.4812 0.6718 0.8641 1.132 1.745 g  $K_2PtCl_6$ ,  
59° 68° 78° 92°  
2.396 2.913 3.589 4.484 g.  $K_2PtCl_6$ .

(Archibald, J. Am. Chem. Soc. 1908, 30. 752.)

Not attacked by cold conc.  $H_2SO_4$ . (Lassaigne.)

Sl. sol. in cold, more easily in hot dil. acids.  
Less sol in  $KCl$ +Aq than in  $H_2O$ , and nearly  
insol. in sat  $KCl$ +Aq. (Schrötter, W. A. B.  
50, 2. 268.)

**Solubility in  $KCl$ +Aq at 20°.**

G mol $KCl$ per l of $KCl$ +Aq	G $K_2PtCl_6$ in 100 g of solution.
0.00	0.7742
0.20	0.0236
0.25	0.0207
0.50	0.0109
1.00	0.0046
2.00	0.0045
3.00	0.0043
4.00	0.0042
sat.	0.0034

(Archibald, J. Am. Chem. Soc. 1908, 30. 757.)

**Solubility in  $NaCl$ +Aq at 16°.**

G. mol. $NaCl$ per litre of $NaCl$ +Aq	G $K_2PtCl_6$ in 100 g of solution
0.00	0.672
0.05	0.700
0.10	0.729
0.25	0.758
0.50	0.775
0.75	0.791
1.00	0.805
2.00	0.834

(Archibald, J. Am. Chem. Soc. 1908, 30. 757.)

Sol. in  $KOH$ +Aq. Insol. in cold or hot  
alkali carbonates or bicarbonates+ $Aq$ . (Rose.)  
Easily sol. in warm  $Na_2S_2O_3$ + $Aq$ . (Himly.)  
Sol. in  $NH_4Cl$ + $Aq$ . (Biett.)

Sol. in  $NH_4$  succinate+ $Aq$ . (Dopping.)  
At 15-20°, sol in 12,083 pts. absolute alcohol,  
alcohol, in 3775 pts. 76% absolute alcohol, and  
in 1053 pts. 55% absolute alcohol. (Fresenius.)

Sol. in 1835 pts. 70% alcohol containing  
 $HCl$  at 15-20°. (Fresenius.)

Nearly absolutely insol. in alcohol con-  
taining ether.

Sol in 42,600 pts absolute alcohol (Precht,  
Z anal. 18. 509.)

1 l. methyl alcohol dissolves 0.072 g. at 20°.  
(Peligot, Mont. Sci. 1892, (4) 6. I, 873.)

**Solubility in methyl alcohol+Aq at 20°**

% alcohol by wt	G $K_2PtCl_6$ in 100 g of solution
0	0.7742
5	0.5350
10	0.4120
20	0.2642
30	0.1831
40	0.1165
50	0.0625
60	0.0325
70	0.0182
80	0.0124
90	0.0038
100	0.0027

(Archibald, J. Am. Chem. Soc. 1908, 30. 755.)

**Solubility in ethyl alcohol+Aq at 20°.**

% alcohol by wt	G $K_2PtCl_6$ in 100 g of solution
0	0.7742
5	0.4910
10	0.3720
20	0.2180
30	0.1340
40	0.0760
50	0.0491
60	0.0265
70	0.0128
80	0.0085
90	0.0025
100	0.0009

(Archibald, J. Am. Chem. Soc. 1908, 30. 755.)

**Solubility in isobutyl alcohol+Aq at 20°.**

% alcohol	g. $K_2PtCl_6$ in 100 g of solution
0	0.7742
8.20	0.6250
sat.	0.3180

(Archibald, J. Am. Chem. Soc. 1908, 30. 755.)

**Potassium pentachlorohydroplatinate**,  $K_2(PtCl_5OH)$   
Easily sol. in  $H_2O$ . (Ruff, B 1913, 46, 925.)

**Praseodymium chloroplatinate**,  $PtCl_3$ ,  $PtCl_4 + 12H_2O$

Very sol. in  $H_2O$  Sol. in conc HCl. (von Schiele, Z anorg 1898, 18, 353.)

**Rubidium chloroplatinate**,  $Rb_2PtCl_6$

100 pts.  $H_2O$  dissolve at:

0°	10°	20°
0.184	0.154	0.141 pts. $Rb_2PtCl_6$ ,
30°	40°	50°
0.145	0.106	0.203 pts. $Rb_2PtCl_6$ ,
60°	70°	80°
0.258	0.329	0.417 pts. $Rb_2PtCl_6$ ,
90°	100°	
0.521	0.634	pts. $Rb_2PtCl_6$ .

(Bunsen, Pogg 113, 337.)

Sol. in 740 pts.  $H_2O$  at 15°, and 157 pts. at 100°. (Crookes, C. N. 9, 205.)  
Insol. in alcohol.

**Samarium chloroplatinate**,  $SmCl_3$ ,  $PtCl_4 + 10\frac{1}{2}H_2O$ .

Deliquescent Very sol. in  $H_2O$ . (Cleve, Bull. Soc. (2) 43, 165.)

**Silver chloroplatinate**,  $Ag_2PtCl_6$ .

Ppt. Gradually decomp. by  $H_2O$  into  $AgCl$  and  $PtCl_4$  (Jørgensen, J. pr (2) 16, 345.)  
 $Ag_2PtCl_4(OH)_2$ . Ppt.

**Silver monochloroplatinate**,  $[PtCl(OH)_3]Ag_2$

Ppt. (Bellucci, Chem. Soc 1902, 82, (2), 155.)

**Silver pentachloroplatinate**,  $(OH)PtCl_5Ag_3$

Ppt.; stable in boiling  $H_2O$  (Miolati, Chem. Soc. 1900, 78 (2), 732.)

**Silver chloroplatinate ammonia**,  $Ag_3PtCl_6 \cdot 2NH_3$ .

Insol. in  $H_2O$ . (Birnbbaum.)

**Sodium chloroplatinate**,  $Na_2PtCl_6 \cdot 6H_2O$ .

Easily sol. in  $H_2O$  Sat solution at 15° contains 39.77 g  $Na_2PtCl_6$  and has sp gr. of 1.368. Sol. in  $NaCl + Aq$  More sol. in absolute alcohol than in 95% alcohol Sat solution in abs. alcohol contains 11.90%; 95% alcohol, 6.34%. Mixture of equal parts of alcohol and ether dissolve 2.43% Insol in ether. (Precht, Z. anal 18, 502.)

**Sodium pentachloroplatinate**,  $(OH)PtCl_5Na_2$ .

Exists only in solution. (Miolati, l.c.)

**Strontium chloroplatinate**,  $SrPtCl_6 \cdot 8H_2O$ .

Very sol. in  $H_2O$ .

**Strontium monochloroplatinate**,  $PtCl(OH)_2Sr + H_2O$

Insol. in  $H_2O$  and org solvents (Bellucci, C C 1903, I, 131)

**Thallium chloroplatinate**,  $Tl_2PtCl_6$

Very sl. sol. in  $H_2O$  Sol. in 15,585 pts.  $H_2O$  at 15°, and 1948 pts at 100° (Crookes.)

**Thallium monochloroplatinate**,  $[PtCl(OH)_3]Tl$ .

Ppt (Bellucci, Chem. Soc. 1902, 82, (2), 155.)

**Thallium pentachloroplatinate**,  $(OH)PtCl_5Tl_2$ .

(Miolati, Chem Soc. 1900, 78 (2) 732)

**Thorium chloroplatinate**,  $ThCl_4$ ,  $PtCl_4 + 12H_2O$ .

Very deliquescent. (Cleve, Bull Soc (2), 21, 118)

**Tin (stannic) chloroplatinate**,  $SnCl_4$ ,  $PtCl_4 + 12H_2O$ .

(Nilson, B. 9, 1142.)

**Ytterbium chloroplatinate**,  $2YbCl_3$ ,  $PtCl_4 + 22H_2O$ , and  $+35H_2O$ .

Ppt. (Cleve, Z. anorg. 1902, 32, 137)

**Vanadyl chloroplatinate**,  $(VO)PtCl_4 + 10\frac{1}{2}H_2O$ .

Sol in  $H_2O$ ; cryst from  $PtCl_4 + Aq$  (Brauner, M. 3, 58.)

**Yttrium chloroplatinate**,  $4YCl_3$ ,  $5PtCl_4 + 52H_2O$ .

Very deliquescent. (Cleve)  
 $2YCl_3$ ,  $3PtCl_4 + 30H_2O$ . (Nilson, B. 9, 1059.)

$2YCl_3$ ,  $PtCl_4 + 21H_2O$ . (Nilson)

**Zinc chloroplatinate**,  $ZnPtCl_6 \cdot 6H_2O$

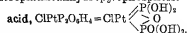
Deliquescent; sol. in  $H_2O$  and alcohol.

**Zinc tetrachloroplatinate**,  $ZnPt(OH)_2Cl_4 + 5H_2O$

Extremely sol in  $H_2O$  and alcohol (Miolati, Z. anorg. 1900, 22, 458.)

**Zirconyl chloroplatinate**,  $(ZrO)PtCl_6 \cdot 12H_2O$ . (Nilson.)

**Chloroplatinooanhydriphosphoric**



Not deliquescent. Sol. in  $H_2O$  (Schutzenberger, Bull. Soc. (2) 18, 154.)

**Chloroplatinocyanhydric acid**,  $H_2Pt(CN)_4Cl_2$

See Perchloroplatinocyanhydric acid.

**Potassium chloroplatinoeyanide**,  $5K_2Pt(CN)_4 \cdot K_2Pt(CN)_4Cl_2 + 21H_2O$ .

Sol. in  $H_2O$ ; insol. in alcohol.

**Silver chloroplatinoeyanide**,

$Ag_2(PtCl_2(CN)_4)_2$ .

Ppt. (Miolata, C. C. 1901, I, 500.)

**Chloroplatinophosphoric acid**,  
 $Cl_2PtP(OH)_2$ .

Very deliquescent, and sol. in  $H_2O$  (Schützenberger, Bull. Soc. (2) 17. 493.)

**Lead chloroplatinophosphate**,  $Pb_2(Cl_2PtPO_4)_2 + 8H_2O$ .

Ppt.

$Pb_2(Cl_2PtPO_4)_2 \cdot 2PbO + 4H_2O$  Ppt (Schützenberger, Bull. Soc. (2) 17. 494.)

**Silver chloroplatinophosphate**,  $Ag_2HPO_4 \cdot PtCl_2$ .

Ppt. (Schützenberger, Bull. Soc. (2) 17. 494.)

**Chloroplatinodiphosphoric acid**,  $PtCl_2 \cdot P_2(OH)_6$ .

Very deliquescent, and easily sol. in  $H_2O$ . (Schützenberger, Bull. Soc. (2) 18. 153.)

**Chloroplatinomorphosphoric acid**,



Less deliquescent than chloroplatinodiphosphoric acid.

**Chloroplatinous acid**,  $H_2PtCl_4$ .

Known only in solution

**Aluminum chloroplatinite**,  $AlPtCl_4 \cdot 10\frac{1}{2}H_2O$ .

Very deliquescent, sol. in  $H_2O$ . (Nilson, J. pr. (2) 16. 260.)

**Ammonium chloroplatinite**,  $(NH_4)_2PtCl_4$ .

Sl. sol. in cold, easily in hot  $H_2O$ . Insol. in alcohol. (Peyrone, A. 55. 206.)

**Barium chloroplatinite**,  $BaPtCl_4 \cdot 3H_2O$ .

Not deliquescent, sol. in  $H_2O$ . Very sl. sol. in 93% alcohol.

**Cadmium chloroplatinite ammonia**,  $CdPtCl_4 \cdot 4NH_3$ .

Insol. in  $H_2O$  or  $NH_4OH + Aq$ . Sol. in  $HCl + Aq$  (Thomsen, B. 2. 668.)

**Cæsium chloroplatinite**,  $Cs_2PtCl_4$ .

Sl. sol. in cold, easily in hot  $H_2O$ .

100 pts.  $H_2O$  dissolve 3.4 pts. salt at 20°

" " 6.73 " " 40°

" " 8.68 " " 60°

" " 10.92 " " 80°

" " 12.10 " " 100°

(Godeffroy, A. 181. 176.)

$Cs_2PtCl_4$  Ppt. Very sensitive to sunlight. Decomp. by  $H_2O$  into the higher and lower chlorides. (Wohler, B. 1909, 42. 4104.)

**Calcium chloroplatinite**,  $CaPtCl_4 \cdot 8H_2O$ .

Deliquescent; sol. in  $H_2O$ .

**Cerium chloroplatinite**,  $CeCl_3 \cdot 2PtCl_2 + 10\frac{1}{2}H_2O$ .

Deliquescent, easily sol. in  $H_2O$  (Nilson, B. 9. 1847.)

**Chromium chloroplatinite**,  $Cr_2Pt_2Cl_{12} + 18H_2O$ .

Deliquescent.

**Cobalt chloroplatinite**,  $CoPtCl_4 \cdot 6H_2O$ .

Sl. deliquescent in moist, efflorescent in dry air.

**Copper chloroplatinite**,  $CuPtCl_4 \cdot 6H_2O$ .

Extremely deliquescent (Topsøe.)

**Copper chloroplatinite ammonia** (cuprammonium chloroplatinite),  
 $Cu(NH_3)_4PtCl_4$ .

Insol. in  $H_2O$  or  $NH_4OH + Aq$ ; easily sol. in  $H_2SO_4 + Aq$  (Milon and Commaile, C. R. 57. 822.)

**Dydium chloroplatinite**,  $DiCl_3 \cdot 2PtCl_2 + 10H_2O$ .

Deliquescent; very sol. in  $H_2O$ . (Nilson.)  
 $2DiCl_3 \cdot 3PtCl_2 + 18H_2O$ . As above. (Nilson.)

**Erbium chloroplatinite**,  $ErPtCl_4 \cdot 13\frac{1}{2}H_2O$ .

Deliquescent  
 $Er_2Pt_2Cl_{12} + 24H_2O$  Deliquescent in moist air

**Glucinum chloroplatinite**,  $GHPtCl_4 \cdot 5H_2O$ .

Deliquescent in moist air. Sol. in  $H_2O$  in all proportions

**Iron (ferrous) chloroplatinite**,  $FePtCl_4 \cdot 7H_2O$ .

Deliquescent. Rather sl. sol. in cold, very sol. in hot  $H_2O$  (Nilson.)

**Lanthanum chloroplatinite**,  $La_3Pt_3Cl_{12} + 18$ ,  
and  $37H_2O$ .

Deliquescent.

**Lead chloroplatinite**,  $PbPtCl_4$ .

Insol. in cold  $H_2O$ .

**Lithium chloroplatinite**,  $Li_2PtCl_4 \cdot 6H_2O$ .

Sol. in  $H_2O$

**Magnesium chloroplatinite**,  $MgPtCl_4 \cdot 6H_2O$ .

Not very deliquescent; very sol. in  $H_2O$ .

**Manganese chloroplatinite**,  $\text{MnPtCl}_4 \cdot 6\text{H}_2\text{O}$   
As the Mg salt.

**Mercurous chloroplatinite**.  
Ppt.

**Nickel chloroplatinite**,  $\text{NiPtCl}_4 \cdot 6\text{H}_2\text{O}$ .  
As the Co salt

**Potassium chloroplatinite**,  $\text{K}_2\text{PtCl}_4$ .  
Moderately sol. in  $\text{H}_2\text{O}$ , insol. in alcohol

**Rubidium chloroplatinite**,  $\text{Rb}_2\text{PtCl}_4$   
Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ .

**Silver chloroplatinite**,  $\text{Ag}_2\text{PtCl}_4$   
Insol. in  $\text{H}_2\text{O}$   $\text{NH}_4\text{OH} + \text{Aq}$  dissolves out  $\text{AgCl}$ . (Lang)  
 $\text{AgCl}$ ,  $\text{PtCl}_2$ (?) As above (Commaille, Bull. Soc. (2) 6, 262.)

**Silver chloroplatinite ammonia**,  $\text{Ag}_2\text{PtCl}_4 \cdot 4\text{NH}_3$   
(Thomsen.)

**Sodium chloroplatinite**,  $\text{Na}_2\text{PtCl}_4 \cdot 4\text{H}_2\text{O}$ .  
Deliquescent; very sol. in  $\text{H}_2\text{O}$

**Strontium chloroplatinite**,  $\text{SrPtCl}_4 \cdot 6\text{H}_2\text{O}$ .  
Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .

**Thallium chloroplatinite**,  $\text{Tl}_2\text{PtCl}_4$   
Very sl. sol. even in boiling  $\text{H}_2\text{O}$ .

**Thorium chloroplatinite**,  $\text{Th}_2\text{Pt}_2\text{Cl}_{14} \cdot 24\text{H}_2\text{O}$ .  
Very deliquescent.

**Yttrium chloroplatinite**,  $\text{Y}_2\text{Pt}_2\text{Cl}_{12} \cdot 24\text{H}_2\text{O}$ .  
Deliquescent.

**Zinc chloroplatinite**,  $\text{ZnPtCl}_4 \cdot 6\text{H}_2\text{O}$   
Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ ; insol. in alcohol.

**Zinc chloroplatinite ammonia**,  $\text{ZnPtCl}_4 \cdot 4\text{NH}_3$   
Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ , insol. in alcohol (Thomsen, J. B. 1868, 278.)

**Zirconyl chloroplatinite**,  $(\text{ZrO})\text{PtCl}_4 \cdot 8\text{H}_2\text{O}$ .  
(Nilson)

**Trichloroplatinous acid**,  $\text{H}_2\text{Pt}(\text{OH})\text{Cl}_3$ .  
Sol. in  $\text{H}_2\text{O}$ . (Miolati, Z. anorg. 1902, 33, 265.)  
 $+ \text{H}_2\text{O}$ . (Nilson, J. pr. (2) 15, 260)

**Lead trichloroplatinite**,  $\text{PbPt}(\text{OH})\text{Cl}_3$ .  
Ppt (Miolati.)

**Silver trichloroplatinite**,  $\text{Ag}_3\text{Pt}(\text{OH})\text{Cl}_3$ .  
Ppt (Miolati.)

### Chloroplatosulphurous acid.

**Ammonium chloroplatosulphite, acid**,  
 $\text{NH}_4\text{PtClSO}_3 \cdot \text{H}_2\text{SO}_3 + 4\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$  (Birnbbaum, A. 152, 149.)

**Ammonium chloroplatosulphite chloride sulphite**,  $\text{NH}_4\text{PtClSO}_3 \cdot (\text{NH}_4)_2\text{SO}_3 \cdot \text{NH}_4\text{Cl}$   
Very deliquescent (Birnbbaum)

**Ammonium chloroplatosulphite sulphite**,  
 $\text{NH}_4\text{PtClSO}_3 \cdot (\text{NH}_4)_2\text{SO}_3 + 3\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Birnbbaum.)

**Barium chloroplatosulphite chloride ammonium chloride**,  $\text{Ba}(\text{ClPtSO}_3)_2 \cdot \text{Ba}(\text{PtClSO}_3)\text{Cl} \cdot 6\text{NH}_4\text{Cl} + 3\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Birnbbaum.)

**Potassium chloroplatosulphite ammonium chloride**,  $\text{KPtClSO}_3 \cdot 2\text{NH}_4\text{Cl}$ .  
Very deliquescent (Birnbbaum, A. 152, 142.)

**Potassium chloroplatosulphite chloride**,  
 $\text{KPtClSO}_3 \cdot 2\text{KCl}$ .  
Deliquescent; sol. in  $\text{H}_2\text{O}$ . (Birnbbaum, A. 152, 145)

**Potassium chloroplatosulphite ammonium potassium sulphite**,  $\text{KPtClSO}_3 \cdot (\text{NH}_4)\text{KSO}_3 + 3\text{H}_2\text{O}$ .  
Very deliquescent. (Birnbbaum, A. 150, 120.)

**Sodium chloroplatosulphite ammonium chloride**,  $\text{NaPtClSO}_3 \cdot 2\text{NH}_4\text{Cl}$ .  
Very deliquescent. (Birnbbaum, A. 150, 117.)

**Chloroplumbic acid**,  $\text{H}_2\text{PbCl}_2$   
Decomp. in solution on standing. (Guthier, J. pr. 1914, (2) 90, 497.)

**Ammonium chloroplumbate**,  $(\text{NH}_4)_2\text{PbCl}_4$ .  
Ppt. Difficultly sol. in a small amount of  $\text{H}_2\text{O}$  Solution decomp. slowly when cold, more rapidly when warmed.  
Decomp. by a large amount of  $\text{H}_2\text{O}$ . Sol. without decomp. in 20%  $\text{HCl}$ . Decomp. by dil acids and alkalis. (Elbs, Z. Elektrochem. 1903, 9, 778.)  
Difficultly sol. in small amount of  $\text{H}_2\text{O}$  and solution decomp. slowly in the cold, more rapidly when warmed. Decomp. by a large amount of  $\text{H}_2\text{O}$ . (Guthier, J. pr. 1914, (2) 90, 498.)  
Sol. in cold  $\text{HNO}_3$  without decomp. (Friedrich, M. 1893, 14, 511.)  
Insol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$  (Nikoljukin, B. 18, 370 R)  
 $5\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2$ . Not hygroscopic. Decomp. by  $\text{H}_2\text{O}$  with pptn. of  $\text{PbO}_2$ . Sol. in  $\text{HCl} + \text{Aq}$  and in cold  $\text{HNO}_3 + \text{Aq}$  without

decomp. (Classen and Zahorski, Z anorg. 4. 100.)

Composition is  $2\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_4$ . (Friedrich, W. A. B. 102, 2b. 527.)

Cesium chloroplumbate,  $\text{Cs}_2\text{PbCl}_6$ .

Nearly absolutely insol. in conc.  $\text{CsCl} + \text{Aq}$  in presence of  $\text{Cl}_2$  (Wells, Z anorg. 4. 335.)

1 ccm. conc  $\text{HCl} + \text{Aq}$  containing  $\text{PbCl}_4$  dissolves 0.000049 g  $\text{Cs}_2\text{PbCl}_6$ . (Wells, Z anorg. 4. 341.)

Reacts with  $\text{H}_2\text{O}$  as the corresponding ammonium salt (Gutbier, J pr 1914, (2) 90. 500.)

Potassium chloroplumbate,  $\text{K}_2\text{PbCl}_6$ .

Decomp. by  $\text{H}_2\text{O}$ , sol. in  $\text{KCl} + \text{Aq}$ . (Wells, Z anorg. 4. 335.)

Readily decomp in the air (Gutbier, J. pr. 1914, (2) 90. 499.)

Rubidium chloroplumbate,  $\text{Rb}_2\text{PbCl}_6$ .

Decomp. by  $\text{H}_2\text{O}$ , sl sol. in conc.  $\text{RbCl} + \text{Aq}$  (Wells, Z anorg. 4. 335.)

1 ccm. conc  $\text{HCl} + \text{Aq}$  containing  $\text{PbCl}_4$  dissolves 0.003 g  $\text{Rb}_2\text{PbCl}_6$  (Wells, Z anorg. 4. 341.)

Reacts with  $\text{H}_2\text{O}$  as the corresponding ammonium salt (Gutbier, J. pr. 1914, (2) 90. 499.)

Decomp. by conc  $\text{H}_2\text{SO}_4$ . Insol. in 90% alcohol. (Erdmann, A. 1896, 294 76.)

**Chloropurpureochromium bromide,**

$\text{CrCl}(\text{NH}_3)_5\text{Br}_2$ .

Somewhat more easily sol. in  $\text{H}_2\text{O}$  than the chloride. (Jørgensen, J pr (2) 20. 105.)

— **chloride**,  $\text{CrCl}(\text{NH}_3)_5\text{Cl}_2$ .

Difficultly sol in cold, and decomp. by hot  $\text{H}_2\text{O}$ .

1 pt. dissolves in 154 pts  $\text{H}_2\text{O}$  at  $16^\circ$  insol. in conc  $\text{HCl} + \text{Aq}$ . More sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp (Jørgensen, J. pr. (2) 20. 105.)

— **mercuric chloride**,  $\text{CrCl}(\text{NH}_3)_5\text{Cl}_2$ ,  $3\text{HgCl}_2$ .

Very difficultly sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

— **chloroplatinate**,  $\text{CrCl}(\text{NH}_3)_5(\text{PtCl}_6)$ .

Extremely difficultly sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

— **chromate**,  $\text{CrCl}(\text{NH}_3)_5(\text{CrO}_4)$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; sl more sol. than chloropurpureocobalt chromate. (Jørgensen.)

— **dithionate**,  $\text{CrCl}(\text{NH}_3)_5(\text{S}_2\text{O}_8)$ .

Very sl. sol. in cold, but much more easily in hot  $\text{H}_2\text{O}$ . (Jørgensen.)

**Chloropurpureochromium ferrocyanide,**  
 $[\text{CrCl}(\text{NH}_3)_5]_2\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O}$

Very difficultly sol. in cold  $\text{H}_2\text{O}$  (Jørgensen.)

— **fluosilicate**,  $\text{CrCl}(\text{NH}_3)_5(\text{SiF}_6)$ .

Very difficultly sol in  $\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{SiF}_6 + \text{Aq}$  (Jørgensen, J. pr. (2) 20. 105.)

— **mercuric iodide**,  $\text{CrCl}(\text{NH}_3)_5\text{I}_2$ ,  $2\text{HgI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ ; sol in alcohol and warm  $\text{KCN} + \text{Aq}$ .

$\text{CrCl}(\text{NH}_3)_5\text{I}_2$ ,  $\text{HgI}_2$ . Very difficultly sol in cold  $\text{H}_2\text{O}$ ; easily sol in  $\text{KCN} + \text{Aq}$ . (Jørgensen, l.c.)

— **nitrate**,  $\text{CrCl}(\text{NH}_3)_5(\text{NO}_3)_2$ .

Sol. in 71 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  Insol. in  $\text{HNO}_3 + \text{Aq}$ . (Jørgensen.)

— **oxalate**,  $\text{CrCl}(\text{NH}_3)_5\text{C}_2\text{O}_4$ .

Very sl sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen, l.c.)

— **sulphate**,  $\text{CrCl}(\text{NH}_3)_5\text{SO}_4 + 2\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ ; precipitated by alcohol (Jørgensen.)

— **sulphate, acid**,  $[\text{CrCl}(\text{NH}_3)_5]\text{SO}_4(\text{HSO}_4)$ .

Quite sol. in  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 20. 185.)

— **pentasulphide**,  $\text{CrCl}(\text{NH}_3)_5\text{S}_5$ .

Very sl sol. in cold, easily sol. in warm  $\text{H}_2\text{O}$ . Decomp. by dil  $\text{HCl} + \text{Aq}$ . Insol. in alcohol. (Jørgensen.)

**Chloropurpureocobaltic bromide,**

$\text{CoCl}(\text{NH}_3)_5\text{Br}_2$ .

Properties resemble the chloride very closely. Sol. in 214 pts.  $\text{H}_2\text{O}$  at  $14.3^\circ$  (Jørgensen, J. pr. (2) 18. 205.)

— **mercuric bromide**,

$4\text{CoCl}(\text{NH}_3)_5\text{Br}_2$ ,  $6\text{HgBr}_2$

Ppt (J.)

— **bromoplatinate**,  $\text{CoCl}(\text{NH}_3)_5\text{Br}_2$ ,  $\text{PtBr}_4$ .

Very sl sol in  $\text{H}_2\text{O}$ . (J.)

— **carbonate**,  $\text{CoCl}(\text{NH}_3)_5\text{CO}_3 + 4\frac{1}{2}\text{H}_2\text{O}$ .

Efflorescent; very easily sol. in  $\text{H}_2\text{O}$ . (J.)

— **chloride**,  $\text{CoCl}(\text{NH}_3)_5\text{Cl}_2$ .

Very sl sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Sol. in 244 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$ . (Claudet, Phil Mag J. (4) 2. 253.) In 287 pts.  $\text{H}_2\text{O}$  at  $10.2^\circ$  and 255 pts. at  $11.5^\circ$ . (Rose, Pogg. 20. 152.) 100 pts.  $\text{H}_2\text{O}$  dissolve 0.232 pt  $\text{CoCl}_2$ ,  $5\text{NH}_3$ , at  $0^\circ$ , and 1.031 pts. at  $46.6^\circ$ . (Kurnakoff, J. Russ. Soc. 24. 629.)

Sl. decomp. by cold, completely by boiling  $\text{H}_2\text{O}$ ; decomp. prevented by a little  $\text{HCl}$ . Pptd. from aqueous solution by alcohol,  $\text{HCl}$ ,

or sat. KCl or NaCl + Aq. not decomp. by boiling HCl + Aq. (Chaudet, *loc.*) Nearly insol in cold, but sol in hot  $H_2O$ , to which a few drops of HCl have been added. Less sol. in dil HCl + Aq than luteocobaltic chloride (Ropojak, A. ch. (3) 41. 447.)

Insol in alcohol (Gibbs and Genth.)

**Chloropurplecobaltic antimony chloride,**  
 $2CoCl(NH_3)_2Cl_3, SbCl_3$ .

Ppt. Decomp by  $H_2O$ . (Gibbs.)

— **bismuth chloride.**

Insol. in conc. HCl. Easily decomp by  $H_2O$ . (Gibbs.)

— **mercuric chloride,  $CoCl(NH_3)_2Cl_2, 3HgCl_2$ .**

Insol in cold, less sol. in hot  $H_2O$  than chloropurplecobaltic chloride. Insol in cold fuming HCl + Aq. sl. sol in hot HCl + Aq. separating on cooling; sl sol in hot aqua regia, moderately sol. in hot  $HNO_3$  + Aq; partly sol in cold conc.  $H_2SO_4$ , wholly on warming. Easily sol. in warm  $H_2C_2O_4$  + Aq. Insol in  $HgCl_2$  + Aq.

Moderately sol. in  $NH_4OH$  + Aq or  $(NH_4)_2CO_3$  + Aq. (Carstangen.)

$CoCl(NH_3)_2Cl_3, 2HgCl_2$ . Sl. sol in cold, but much more easily in hot  $H_2O$  (Gibbs, Proc Am Acad. 10. 33.)

— **chloropalladite,  $CoCl(NH_3)_2Cl_3, PdCl_2$**

Sl. sol in cold, moderately sol in hot  $H_2O$ . (Carstangen.)

— **chloroplatinate,  $CoCl(NH_3)_2Cl_3, PtCl_4$**

Nearly insol in cold. Very sl. sol in hot  $H_2O$ . (Gibbs and Genth, Silf. Am. J (2) 23. 319.)

— **chromate,  $CoCl(NH_3)_2CrO_4$ .**

Very sl sol in  $H_2O$  (J)

— **dichromate,  $CoCl(NH_3)_2Cr_2O_7$ .**

Much more easily sol. in  $H_2O$  than the neutral salt. (J.)

— **dithionate,  $CoCl(NH_3)_2S_2O_4$**

Very sl sol in cold, more easily in hot  $H_2O$  (J)

— **manganic fluoride**

Ppt. Sl. sol. in dil HF + Aq. (Christensen, J. pr (2) 35. 161)

— **fluosilicate,  $CoCl(NH_3)_2SiF_6$**

Very sl. sol. in HF + Aq.

— **iodide,  $CoCl(NH_3)_2I_3$**

Much more sol. in  $H_2O$  than bromide or chloride. Sol in 54.5 pts.  $H_2O$  at 15.6°, and 50 pts at 19.3°. (J.)

**Chloropurplecobaltic mercuric iodide,**  
 $CoCl(NH_3)_2I_3, 2HgI_2$ .

Sl. sol in  $H_2O$  (J.)

$CoCl(NH_3)_2I_3, HgI_2$ . Very sl sol in cold  $H_2O$  (J)

— **nitrate,  $CoCl(NH_3)_2(NO_3)_3$ .**

Sol. in 80 pts  $H_2O$  at 15°. Rather easily sol. in hot  $H_2O$  (Jorgensen, J pr (2) 18. 209)

— **oxalate,  $CoCl(NH_3)_2C_2O_4$ .**

Sl sol in  $H_2O$ . (J)

— **pyrophosphate,  $CoCl(NH_3)_2(H_2P_2O_7)$**

Sl and very slowly sol. in cold, much more easily in warm  $H_2O$ . (J)

$[CoCl(NH_3)_2]_3P_2O_7 + 2H_2O$ . Quite easily sol. in  $H_2O$

— **diphosphopentamolybdate,**

$[CoCl(NH_3)_2]_2(5MoO_3, 2HPO_4)$ .

Ppt. Nearly insol in pure  $H_2O$ ; more sol. in dil  $H_2SO_4$  + Aq without decomp. (J.)

$[CoCl(NH_3)_2]_2(5MoO_3, 2NH_4PO_4)$ . Ppt. As above

— **sulphate,  $CoCl(NH_3)_2SO_4$ .**

*Anhydrous*. Slowly sol in 128–131.9 pts  $H_2O$  at 16°

+  $2H_2O$ . Sol in 133.4 pts.  $H_2O$  at 17.3°  
Rather easily sol in hot  $H_2O$ , and much more rapidly than the anhydrous salt (J)

$[CoCl(NH_3)_2]_2SO_4(SO_4H)_6$ . Decomp. by  $H_2O$  into neutral sulphate. Sol in  $H_2SO_4$

— **tartrate,  $CoCl(NH_3)_2(C_4H_4O_6)_2 + 2\frac{1}{2}H_2O$ .**

Moderately sol. in  $H_2O$ ; insol in alcohol

— **thiosulphate,  $CoCl(NH_3)_2S_2O_3$ .**

Nearly insol. in cold  $H_2O$ , very sl. sol. in boiling  $H_2O$  with partial decomp. (J)

**Chloropurpleoiridium comps.**

See *Iridopentamine* comps.

**Chloropurpleorhodium carbonate,**

$ClRh(NH_3)_2CO_3 + H_2O$ .

Easily sol. in  $H_2O$ . (Jorgensen)

— **chloride,  $ClRh(NH_3)_2Cl_3$**

Sol in 179 pts.  $H_2O$  at 17°, and more easily in hot  $H_2O$ . Sol in conc.  $H_2SO_4$  or boiling NaOH + Aq without decomp. Very sl. sol. in cold dil HCl + Aq (1 : 1). Sl. sol in hot HCl + Aq. Insol. in alcohol. (Jorgensen, J. pr. (2) 27. 433; 34. 394)

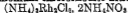
— **rhodium chloride,**

$3ClRh(NH_3)_2Cl_3, 2RhCl_3$ .

Ppt (Jorgensen, Z anorg 5. 75.)

**Chloropurpleorhodium chloroplatinate,**Insol. in cold  $\text{H}_2\text{O}$ . (J.)**— fluosilicate,  $\text{ClRh}(\text{NH}_3)_5\text{SiF}_6$ .**Very sl. sol. in cold  $\text{H}_2\text{O}$ . Sol. in  $\text{NaOH}$  + Aq as roseo salt. (J.)**— hydroxide,  $\text{ClRh}(\text{NH}_3)_5(\text{OH})_2$ .**

Known only in solution. (J.)

**— nitrate,  $\text{ClRh}(\text{NH}_3)_5(\text{NO}_3)_2$ .**Sl. sol. in cold  $\text{H}_2\text{O}$ , but more easily than the chloride. Sol. in boiling  $\text{NaOH}$  + Aq as roseo salt. (J.)**— sulphate,  $\text{ClRh}(\text{NH}_3)_5\text{SO}_4 + 2\text{H}_2\text{O}$ .**Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (J.)  
 $4\text{ClRh}(\text{NH}_3)_5\text{SO}_4 \cdot 3\text{H}_2\text{SO}_4$ . Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (J.)**Chlororhodos acid.****Ammonium chlororhodite,  $(\text{NH}_4)_2\text{RhCl}_5 + \text{H}_2\text{O}$ .**(Gutbier, B. 1908, 41. 213.)  
Sol. in  $\text{H}_2\text{O}$ , insol. in alcohol. (Wollaston)  
Not obtainable. (Léidé, A. ch. (6) 17. 275.)  
 $(\text{NH}_4)_2\text{RhCl}_5 + 1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , but less easily than Na salt, insol. in alcohol. Sol. in dil.  $\text{NH}_4\text{Cl}$  + Aq. (Claus, J. B. 1856. 423.) (Gutbier, l. c.)**Ammonium chlororhodite nitrate,**Very sol. in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3$  + Aq. (Léidé, C. R. 107. 234.)**Barium chlororhodite,  $\text{Ba}_2(\text{RhCl}_5)_2$ .**

Resembles the Na salt. (Bunsen, A. 146. 276.)

**Cæsium chlororhodite,  $\text{Cs}_2\text{RhCl}_5 + \text{H}_2\text{O}$ .**Difficulty sol. in  $\text{H}_2\text{O}$ . (Gutbier, B. 1908, 41. 214.)**Lead chlororhodite,  $\text{Pb}_2(\text{RhCl}_5)_2$ .**Ppt. Insol. in  $\text{H}_2\text{O}$ . (Claus.) Not obtainable. (Léidé.)**Mercurous chlororhodite,  $\text{Hg}_2\text{RhCl}_5$ .**Ppt. Insol. in  $\text{H}_2\text{O}$ . (Claus.) Not obtainable. (Léidé.)**Potassium chlororhodite,  $\text{K}_2\text{RhCl}_5 + \text{H}_2\text{O}$ .**Not efflorescent. Sl. sol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{KCl}$  + Aq., (Gibbs.) Insol. or sl. sol. in alcohol. (Berzelius.)

Salt is anhydrous. (Léidé.)

Contains  $1\text{H}_2\text{O}$ . (Seubert and Kobbé, B. 23. 2556.)Can be cryst. from  $\text{H}_2\text{O}$  containing a little  $\text{HCl}$ . (Gutbier, B. 1908, 41. 212.)  
 $\text{K}_2\text{RhCl}_5 + 3\text{H}_2\text{O}$ . Efflorescent. Sl. sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. to above on standing. (Claus.)

Not obtainable. (Léidé.)

Also obtained by Seubert and Kobbé (B. 23. 2556.)

 $+1\frac{1}{2}\text{H}_2\text{O}$ . (Léidé, C. R. 111. 100.)**Rubidium chlororhodite,  $\text{Rb}_2\text{RhCl}_5 + \text{H}_2\text{O}$ .**Difficulty sol. in  $\text{H}_2\text{O}$ . (Gutbier, B. 1908, 41. 214.)**Silver chlororhodite,  $\text{Ag}_2\text{RhCl}_5$ .**Ppt. Insol. in  $\text{H}_2\text{O}$ . (Claus.)

Not obtainable. (Léidé.)

**Sodium chlororhodite,  $\text{Na}_6\text{Rh}_2\text{Cl}_{12} + 18\text{H}_2\text{O}$ .** $\text{Na}_2\text{RhCl}_5 + 9\text{H}_2\text{O}$   
Efflorescent. Sol. in 15 pts.  $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at  $50^\circ$ . Insol. in alcohol. (Claus.) $+12\text{H}_2\text{O}$ . (Gutbier, B. 1908, 41. 213.)**Chlororuthenic acid.****Ammonium chlororuthenate,  $(\text{NH}_4)_2\text{RuCl}_6$ .**Easily sol. in  $\text{H}_2\text{O}$ . (Claus.)  
Formula is  $(\text{NH}_4)_2\text{Ru}(\text{NO})\text{Cl}_5$ . (Joly, C. R. 107. 994.)  
Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in  $\text{HCl}$ . (Howe, J. Am. Chem. Soc. 1904, 26. 549.)**Ammonium aquochlororuthenate,**

Ppt. (Howe, J. Am. Chem. Soc. 1904, 26. 548.)

**Cæsium chlororuthenate,  $\text{Cs}_2\text{RuCl}_6$ .**Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in hot dil.  $\text{HCl}$  + Aq. (Howe, J. Am. Chem. Soc. 1901, 23. 784.)**Potassium chlororuthenate,  $\text{K}_2\text{RuCl}_6$ .**Very sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in conc.  $\text{NH}_4\text{Cl}$  + Aq. Insol. in 70% alcohol. (Claus.)  
Formula is  $\text{K}_2\text{Ru}(\text{NO})\text{Cl}_5$ . (Joly.)  
Very sl. sol. in cold  $\text{H}_2\text{O}$ . Insol. in presence of  $\text{KCl}$ .

Partially decomp. in hot aqueous solution. (Antony, Gazz. ch. it. 1899, 29. (2), 82.)

Easily sol. in  $\text{H}_2\text{O}$  with rapid decomp. Sol. in  $\text{HCl}$ . (Howe, J. Am. Chem. Soc. 1904, 26. 542.)**Potassium aquochlororuthenate,**Sol. in  $\text{H}_2\text{O}$ . (Howe, J. Am. Chem. Soc. 1904, 26. 547.)**Rubidium chlororuthenate,  $\text{Rb}_2\text{RuCl}_6$ .**Sl. sol. in  $\text{H}_2\text{O}$ , sol. in hot dil.  $\text{HCl}$  + Aq. (Howe, J. Am. Chem. Soc. 1901, 23. 784.)

**Chlororuthenious acid.**

**Ammonium chlororuthenite**,  $(\text{NH}_4)_4\text{Ru}_2\text{Cl}_8$ .  
Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  or alcohol. (Claus, J. pr. 80. 282.)

**Cæsium chlororuthenite**,  $\text{Cs}_2\text{RuCl}_6 + \text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (Howe, J. Am. Chem. Soc. 1901, 23. 785.)

**Potassium chlororuthenite**,  $\text{K}_4\text{Ru}_2\text{Cl}_{12}$ .  
Moderately sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Decomp. easily by heating. Insol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$ . Insol. in 80% alcohol.

**Rubidium chlororuthenite**,  $\text{Rb}_2\text{RuCl}_6 + \text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (Howe, J. Am. Chem. Soc. 1901, 23. 786.)

**Sodium chlororuthenite**,  $\text{Na}_4\text{Ru}_2\text{Cl}_{12}$ .  
Deliquescent. Sol. in  $\text{H}_2\text{O}$  or alcohol.

**Trichlorosilicomercaptane.**  
*See* Silicon chlorohydrosulphide.

**Chlorosmic acid.**

**Ammonium chlorosmate**,  $(\text{NH}_4)_2\text{OsCl}_6$ .  
Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and  $\text{H}_2\text{O}$  containing  $\text{HCl}$ .

**Potassium chlorosmate**,  $\text{K}_2\text{OsCl}_6$ .  
Properties as the  $\text{NH}_4$  salt.

**Potassium amino chlorosmate**,  
 $(\text{NH}_4)_2\text{OsCl}_5 \cdot 2\text{KCl}$ .  
Ppt. (Brizard, A. ch. 1900, (7) 21. 375.)

**Potassium amino chlorosmate hydrogen chloride**,  $(\text{NH}_4)_2\text{OsCl}_5 \cdot 2\text{KCl} \cdot \text{HCl}$ .  
Ppt. (Brizard, A. ch. 1900, (7) 21. 378.)

**Silver chlorosmate**,  $\text{Ag}_2\text{OsCl}_6$ .  
Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$  (Claus and Jacoby.)

**Silver chlorosmate ammonia**,  $\text{Ag}_2\text{OsCl}_6 \cdot 2\text{NH}_3$ .  
Sol. in much  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{KOH} + \text{Aq}$ . Easily sol. in  $\text{KCN} + \text{Aq}$ . (C. and J.)

**Sodium chlorosmate**,  $\text{Na}_2\text{OsCl}_6 + 2\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$  or alcohol.

**Chlorosmious acid.**

**Ammonium chlorosmite**,  
 $(\text{NH}_4)_4\text{Os}_2\text{Cl}_{10} + 3\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$  and alcohol; insol. in ether. (Claus and Jacoby, J. pr. 90. 65.)

**Potassium chlorosmite**,  $\text{K}_4\text{Os}_2\text{Cl}_{12} + 6\text{H}_2\text{O}$ .  
Very easily sol. in  $\text{H}_2\text{O}$  or alcohol. Insol. in ether. (C. and J.)

**Chlorosmisulphurous acid.**

**Potassium hydrogen chlorosmisulphite**,  
 $\text{OsCl}_5(\text{SO}_2)_2 \cdot \text{K}_4\text{H}_2$ .  
Ppt. (Rosenheim, Z. anorg. 1900, 24. 422.)

**Sodium chlorosmisulphite**,  
 $\text{OsCl}_5(\text{SO}_2)_2 \cdot \text{Na}_6 + 10\text{H}_2\text{O}$ .  
Ppt. (Rosenheim, Z. anorg. 1900, 24. 420.)

**Chloropyroselenious acid.**

**Ammonium chloropyroselenite**,  $\text{NH}_4\text{Cl}$ ,  
 $2\text{SeO}_2 + 2\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Muthmann and Schafer, B. 26. 1008.)

**Potassium chloropyroselenite**,  $\text{KCl}$ ,  $2\text{SeO}_2 + \text{H}_2\text{O}$ .  
As  $\text{NH}_4$  salt (M. and S.)

**Rubidium chloropyroselenite**,  $\text{RbCl}$ ,  
 $2\text{SeO}_2 + 2\text{H}_2\text{O}$ .  
As  $\text{NH}_4$  salt. (M. and S.)

**Chlorostannic acid**,  $\text{SnO}(\text{OH})\text{Cl}$   
(Mallet, Chem. Soc. 35. 524.)  
 $\text{H}_2\text{SnCl}_6 + 6\text{H}_2\text{O}$ . Extremely deliquescent; sol. in  $\text{H}_2\text{O}$ . (Seubert, B. 20. 793.)

**Ammonium chlorostannate**,  $(\text{NH}_4)_2\text{SnCl}_6$   
(pink salt)  
Sol. in 3 pts.  $\text{H}_2\text{O}$  at  $14.5^\circ$ . Solution decomp. on boiling when dilute, but not when conc. (Boley.)

**Barium chlorostannate**,  $\text{BaSnCl}_6 + 5\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Lewy, A. ch. (3) 16. 308.)

**Cæsium chlorostannate**,  $\text{Cs}_2\text{SnCl}_6$ .  
Nearly insol. in conc.  $\text{HCl} + \text{Aq}$ . (Sharples, Sill. Am. J. (2) 47. 178.)

**Calcium chlorostannate**,  $\text{CaSnCl}_6 + 5\text{H}_2\text{O}$ .  
Very deliquescent. (Lewy, A. ch. (3) 16. 308.)

**Cerium chlorostannate**,  $\text{CeSnCl}_6 + 9\text{H}_2\text{O}$ .  
Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 31. 197.)

**Cobalt chlorostannate**,  $\text{CoSnCl}_6 + 6\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Jorgensen.)

**Didymium chlorostannate**,  $\text{DyCl}_3$ ,  $\text{SnCl}_4 + 10\frac{1}{2}\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Glucinum chlorostannate**,  $\text{GlSnCl}_6 + 8\text{H}_2\text{O}$ .  
Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Atterberg, Sv. V. A. Handl. 12. No. 4. 14.)

**Lanthanum chlorostannate**,  $4\text{LaCl}_3 \cdot 58\text{SnCl}_4 + 45\text{H}_2\text{O}$ .

Deliquescent. Sol in  $\text{H}_2\text{O}$ . (Cleve.)

**Lithium chlorostannate**,  $\text{Li}_2\text{SnCl}_6 \cdot 8\text{H}_2\text{O}$ .

Sol. in little  $\text{H}_2\text{O}$  without decomp., but decomp. by dilution (Chassevant, A. ch. (6) 30. 42.)

**Magnesium chlorostannate**,  $\text{MgSnCl}_4 \cdot 6\text{H}_2\text{O}$ .

Very deliquescent. (Lewy)

**Manganous chlorostannate**,  $\text{MnSnCl}_4 \cdot 6\text{H}_2\text{O}$ .

Deliquescent in moist, efflorescent in dry air. (Jorgensen)

**Nickel chlorostannate**,  $\text{NiSnCl}_4 \cdot 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ . (Jorgensen.)

**Potassium chlorostannate**,  $\text{K}_2\text{SnCl}_6$ .

Sol. in  $\text{H}_2\text{O}$

**Sodium chlorostannate**,  $\text{Na}_2\text{SnCl}_6 \cdot 6\text{H}_2\text{O}$ .

Easily sol in  $\text{H}_2\text{O}$ . (Topsoe, Gm K. Handb 6<sup>te</sup> auf III 149)

**Strontium chlorostannate**,  $\text{SrSnCl}_4 \cdot 8\text{H}_2\text{O}$ .

Sl. deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . (Topsoe.)

**Yttrium chlorostannate**,  $\text{YCl}_3 \cdot \text{SnCl}_4 \cdot 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Cleve, Bull. Soc. (2) 31.197.)

**Zinc chlorostannate**,  $\text{ZnSnCl}_4 \cdot 6\text{H}_2\text{O}$ .

(Biron, C. C. 1904, II. 410.)

**Chlorosulphobismuthous acid**.

**Cuprous chlorosulphobismuthite**,

$2\text{Cu}_2\text{S} \cdot \text{Bi}_2\text{S}_3 \cdot 2\text{Bi}_2\text{S}_3\text{Cl}$ .

Stable in air and insol. in  $\text{H}_2\text{O}$  at ord. temp.

Decomp. by boiling  $\text{H}_2\text{O}$ .

Decomp. by mineral acids with evolution of  $\text{H}_2\text{S}$ . (Ducatte, C. R. 1902, 134. 1212.)

**Lead chlorosulphobismuthite**,  $\text{PbS} \cdot \text{Bi}_2\text{S}_3 \cdot 2\text{Bi}_2\text{S}_3\text{Cl}$ .

Stable in the air. Insol. in  $\text{H}_2\text{O}$ ; decomp. by boiling  $\text{H}_2\text{O}$ , sol. in dil. acids with decomp. and evolution of  $\text{H}_2\text{S}$ . (Ducatte.)

**Chlorosulphonic acid**,  $\text{HClSO}_3$ .

See Sulphuryl hydroxyl chloride.

**Chloropyrosulphonic acid**.

**Ammonium chloropyrosulphonate**,

$\text{ClS}_2\text{O}_6\text{NH}_4$ .

Fumes in the air.

Decomp. by  $\text{H}_2\text{O}$  and alcohol. (Traube, B. 1913, 46. 2519)

**Sodium chloropyrosulphonate**,  $\text{ClS}_2\text{O}_6\text{Na}$ .

Fumes in the air.

Decomp. by  $\text{H}_2\text{O}$  and alcohol (Traube.)

**Chlorosulphuric acid**,  $\text{HSO}_3\text{Cl}$ .

See Sulphuryl hydroxyl chloride.

$\text{SO}_2\text{Cl}_2$ . See Sulphuryl chloride.

**Aluminium chlorosulphate**,  $\text{Al}(\text{SO}_4)\text{Cl} \cdot 6\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Nearly insol. in abs. alcohol. (Recoura, Bull. Soc. 1902, (3) 27. 1155.)

**Chromium chlorosulphate**,  $\text{CrClSO}_4 \cdot 5\text{H}_2\text{O}$ .

Green (Weinland, Z. anorg. 1905, 48. 253.) (Recoura, C. R. 1902, 135. 164.)

Violet. (Weinland, Z. anorg. 1905, 48. 254.)

Very sol. in  $\text{H}_2\text{O}$  Insol. in a mixture of alcohol and acetone (Recoura, C. R. 1902, 135. 164.)

+  $8\text{H}_2\text{O}$ . Two isomeric modifications:

(a) *Green needles*. Easily sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1906, 48. 251.)

(b) *Violet plates*. Easily sol. in  $\text{H}_2\text{O}$ . (Weinland.)

**Chlorosulphurous acid**.

**Ammonium palladious trichlorosulphate**,

$(\text{NH}_4)_2\text{PdCl}_3\text{SO}_3 \cdot \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  (Rosenheim, Z. anorg. 1900, 23. 30.)

**Chlorotelluric acid**.

**Ammonium chlorotellurate**,  $(\text{NH}_4)_2\text{TeCl}_6$ .

Sol without decomp. in a small amt. of  $\text{H}_2\text{O}$ , but decomp. by much  $\text{H}_2\text{O}$  or alcohol.

**Cesium chlorotellurate**,  $\text{Cs}_2\text{TeCl}_6$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{Aq}$ .

100 pts  $\text{HCl} + \text{Aq}$  (sp. gr. 1.2) dissolve 0.05 pt. at  $22^\circ$ .

100 pts.  $\text{HCl} + \text{Aq}$  (sp. gr. 1.05) dissolve 0.78 pt. at  $22^\circ$ .

Insol. in alcohol (Wheeler, Sill. Am. J. 145. 267)

**Potassium chlorotellurate**,  $\text{K}_2\text{TeCl}_6$ .

Deliquescent; decomp. by  $\text{H}_2\text{O}$  and absolute alcohol (Berzelius.)

The most sol. in  $\text{H}_2\text{O}$  of the chloro- or bromo-tellurates. Easily sol in dil  $\text{HCl} + \text{Aq}$ ; conc.  $\text{HCl} + \text{Aq}$  ppts.  $\text{KCl}$  (Wheeler, Sill. Am. J. 145. 267.)

**Rubidium chlorotellurate**,  $\text{Rb}_2\text{TeCl}_6$ .

Decomp. by  $\text{H}_2\text{O}$ . Much more sol. in dil.  $\text{HCl} + \text{Aq}$  than  $\text{Cs}_2\text{TeCl}_6$ .

100 pts.  $\text{HCl} + \text{Aq}$  (sp. gr. 1.2) dissolve 0.34 pt. at  $22^\circ$ .

100 pts.  $\text{HCl} + \text{Aq}$  (sp. gr. 1.05) dissolve, 13.99 pts. at  $22^\circ$ .

Sl. sol. in alcohol. (Wheeler.)

**Chlorotetramine chromium bromide,**

Very easily sol in  $\text{H}_2\text{O}$  (Cleve, 1861; Jørgensen, J. pr. (2) 42. 210.)

—chloride,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})_2\text{Cl}_2$

Sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. Sol. in  $\text{HCl} + \text{Aq.}$ , and this solution may be boiled without decomp. (Cleve)

Sol. in 15.7 pts  $\text{H}_2\text{O}$  at 15°. (Jørgensen, J. pr. 42. 208.)

—chromate,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})_2\text{CrO}_4$ .

Preprecipitate. (Cleve)

—fluosilicate,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})_2\text{SiF}_6$

Sl. sol. in  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 42. 218.)

—hydroxide,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})_2$ .

Known only in solution. (Cleve)

—iodide,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})_2\text{I}_2$

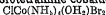
Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

—nitrate,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})_2(\text{NO}_3)_2$ .

Very easily sol. in  $\text{H}_2\text{O}$  (Cleve), (Jørgensen, J. pr. (2) 42. 209.)

—sulphate,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})_2\text{SO}_4$ .

Very difficulty sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Chlorotetramine cobaltic bromide,**

More sol. in  $\text{H}_2\text{O}$  than chloride. Nearly insol. in  $\text{HBr} + \text{Aq}$  (1.1). (Jørgensen, J. pr. (2) 42. 215.)

—chloride,  $\text{ClCo}(\text{NH}_3)_4(\text{OH})_2\text{Cl}_2$

Sol. in about 40 pts.  $\text{H}_2\text{O}$ , and is identical with octamine cobaltic purpureochloride of Vortmann (Jørgensen, J. pr. (2) 42. 211.)

—chloroplatinate,  $\text{ClCo}(\text{NH}_3)_4(\text{OH})_2\text{PtCl}_6 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

—chromate,  $\text{ClCo}(\text{NH}_3)_4(\text{OH})_2\text{CrO}_4$ .

Easily sol. in cold  $\text{H}_2\text{O}$  (Jørgensen, J. pr. (2) 42. 216.)

—fluosilicate,  $\text{ClCo}(\text{NH}_3)_4(\text{OH})_2\text{SiF}_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{SiF}_6 + \text{Aq.}$  (Jørgensen, J. pr. (2) 42. 219.)

—sulphate,  $\text{ClCo}(\text{NH}_3)_4(\text{OH})_2\text{SO}_4$

Sol. in  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 42. 214.)

**Chlorotitanic acid,  $\text{TiCl}_4 \cdot 2\text{HCl} = \text{H}_2\text{TiCl}_6$ .**

Known only in solution (Kowalewsky, Z. anorg. 1900, 25. 192.)

**Chlorous acid,  $\text{HClO}_2$** 

Known only in aqueous solution. 100 g  $\text{H}_2\text{O}$  at 8.5° and 753 mm pressure dissolve 4.7 g  $\text{ClO}_2$ . Hydrate with 50.07–67.43%  $\text{H}_2\text{O}$ , perhaps  $\text{HClO}_2 \cdot \text{H}_2\text{O}$ , separates out at 0°. (Brandan, A. 151. 340.)

Pure  $\text{HClO}_2$  is not known even in solution. (Garzaroni-Thurnlakh, A. 209. 184.)

**Chlorites.**

All chlorites are easily sol. in  $\text{H}_2\text{O}$  and alcohol, with gradual decomp.

**Ammonium chlorite.**

Known only in aqueous solution, which decomposes on evaporation or long standing.

**Barium chlorite,  $\text{Ba}(\text{ClO}_2)_2$** 

Deliquescent; easily sol. in  $\text{H}_2\text{O}$ . Solution decomp. on evaporation. Easily sol. in alcohol. (Millon, A. ch. (3) 7. 298.)

**Lead chlorite,  $\text{Pb}(\text{ClO}_2)_2$** 

Nearly insol. in cold  $\text{H}_2\text{O}$ , and only sl. sol. in hot  $\text{H}_2\text{O}$ . Sol. in  $\text{KOH} + \text{Aq.}$  (Garzaroni and Hayn, A. 209. 203.)

**Lead chlorite chloride,  $6\text{Pb}(\text{ClO}_2)_2 \cdot 4\text{PbCl}_2$ ,  $\text{PbO}$ .**

Rather difficulty sol. in  $\text{H}_2\text{O}$ . (Schmel, A. 109. 317.)

**Potassium chlorite,  $\text{KClO}_2$** 

Very deliquescent and sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol of 38°. (Millon, A. ch. (3) 7. 323.) Sol. in  $\text{HClO}_2 + \text{Aq.}$

**Silver chlorite,  $\text{AgClO}_2$ .**

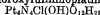
Sol. in hot, less in cold  $\text{H}_2\text{O}$ . Easily decomp. by heating above 100°. Decomp. by weakest acids. (Millon, A. ch. (3) 7. 329.)

**Sodium chlorite,  $\text{NaClO}_2$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

**Strontium chlorite,  $\text{Sr}(\text{ClO}_2)_2$** 

Deliquescent and sol. in  $\text{H}_2\text{O}$ . Decomp. by slow evaporation. (Millon, A. ch. (3) 7. 327.)

**Chloroxyfulminoplatinum,**

Insol. in  $\text{H}_2\text{O}$ , sol. in  $\text{HCl} + \text{Aq.}$  (v. Meyer, J. pr. (2) 18. 305.)

**Chloruronic acid,  $\text{H}_2\text{UO}_2\text{Cl} + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol (Myhus, B. 1901, 34. 2776.)

**Chromacichloride,  $\text{CrO}_2\text{Cl}_2$ .**

See Chromyl chloride.

**Chromatiodic acid.**

See Chromoiodic acid.

**Chromic acid,  $H_2CrO_4$** 

Very sol in  $H_2O$ . (Moissan, C. R. 98, 1851.)

Does not exist except in solution. (Field, Chem. Soc. 61, 405.)

The composition of the hydrates formed by  $H_2CrO_4$  at different dilutions is calculated from determinations of the lowering of the fr-pt produced by  $H_2CrO_4$  and of the conductivity and sp. gr. of  $H_2CrO_4 + Aq$  (Jones, Am. Ch. J. 1905, 34, 333.)

See also **Chromium trioxide**.

**Chromates.**

Chromates of the alkali metals and of  $Cu$ ,  $Mg$ , and  $Sr$  are sol. in  $H_2O$ ; the others are generally insol. or sl. sol in  $H_2O$ , but sol in  $HNO_3 + Aq$ .

**Aluminum chromate, basic,  $Al_2O_3, CrO_3 + 7H_2O$ .**

Easily sol. in  $NH_4OH + Aq$ , alum, or acetic acid +  $Aq$ . Insol. in  $NH_4Cl + Aq$ . (Farne, Chem. Soc. 4, 300.)

Insol. as such as  $H_2O$ , but easily decomp. into  $H_2CrO_4$  and a basic insol. comp. Sol. in alkaline solutions and acids. Decomp. by many salts. (Eliot and Storer, Proc. Am. Acad. 5, 214.)

**Aluminum sodium chromate silicate,  $4Al_2O_3, 5Na_2O, CrO_3, 7SiO_2$ .**

(Weyberg, C. B. Minn., 1904, 727.)

**Ammonium chromate, basic,  $5(NH_4)_2O, 4CrO_3(?)$** 

Easily sol. in cold  $H_2O$  (Pohl, W. A. B. 6, 592.)

**Ammonium chromate,  $(NH_4)_2CrO_4$ .**

Very sol. in  $H_2O$ , pptd. from aqueous solution by alcohol. (Malaguti and Sarzeau.)

100 g.  $H_2O$  dissolve 40.46 g. at  $30^\circ$ . (Schreinemakers, Chem. Weekbl. 1905, 1, 395.)

Sol. in  $H_2O$  without decomp. (Schreinemakers, C. C. 1905, II 1087.)

Sp. gr. of  $(NH_4)_2CrO_4 + Aq$  at  $t^\circ/4^\circ$ .

$t^\circ$	13°	13 7°	19.6°
% $(NH_4)_2CrO_4$	10.52	19.75	28.04
Sp. gr.	1.0633	1.1197	1.1727

(Slotte, W. Ann. 1881, 14, 18.)

Sl. sol. in liquid  $NH_3$  (Franklin, Am. Ch. J. 1898, 20, 826.)

Difficulty sol. in acetone (Naumann, B. 1904, 37, 4328.)

**Ammonium dichromate,  $(NH_4)_2Cr_2O_7$ .**

Less sol. in  $H_2O$  than  $(NH_4)_2CrO_4$  (Mosser.)

100 g.  $H_2O$  dissolve 47.17 g. at  $30^\circ$ .

(Schreinemakers, Chem. Weekbl. 1905, 1, 395.)

Sp. gr. of  $(NH_4)_2Cr_2O_7 + Aq$  at  $t^\circ/4^\circ$ .

$t^\circ$	12°	10 5°	12°
% $(NH_4)_2Cr_2O_7$	6.85	13.00	19.93
Sp. gr.	1.0393	1.0782	1.1258

(Slotte, W. Ann. 1881, 14, 18.)

Sol. in alcohol (Ranitzer, Zeit. angew. ch. 1913, 26, 456.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Insol. in acetone (Naumann, B. 1904, 37, 4328.)

**Ammonium trichromate,  $(NH_4)_3Cr_3O_{10}$** 

Not deliquescent, but very sol. in  $H_2O$  (Siewert.)

Decomp. by  $H_2O$  into chromic acid and dichromate (Jäger and Kruss, B. 22, 2036.)

Sol. in acetone (Naumann, B. 1904, 37, 4328.)

**Ammonium tetrachromate,  $(NH_4)_4Cr_4O_{18}$** 

Deliquescent. Decomp. by  $H_2O$ . (Jäger and Kruss, B. 22, 2037.)

**Ammonium hexachromate,  $(NH_4)_6Cr_6O_{30} + 10H_2O(?)$** 

Very efflorescent. (Rammelsberg, Pogg. 94, 516.)

**Ammonium barium chromate,**

$BaCrO_4, (NH_4)_2CrO_4$ .

Ppt. Decomp. by  $H_2O$ . (Gröger, Z. anorg. 1908, 58, 414.)

**Ammonium cadmium chromate,  $(NH_4)_2O, 4CdO, 4CrO_3 + 3H_2O$** 

Ppt. Decomp. by boiling  $H_2O$ . (Gröger, M. 1904, 25, 533.)

**Ammonium cadmium chromate ammonia,  $(NH_4)_2CrO_4, CdCrO_4, 1/2 NH_3 + 1/2 H_2O$** 

Decomp. by  $H_2O$ . (Gröger, Z. anorg. 1908, 58, 418.)

$(NH_4)_2Cd(CrO_4)_2, 2NH_3$ . Insol. in cold, decomp. by hot  $H_2O$ .

Sol. in dil. acids or in  $NH_4OH + Aq$ . (Biggs, Chem. Soc. 1903, 83, 395.)

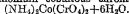
**Ammonium chromous chromate(?),**

$(NH_4)_2CrO_4, CrCrO_4 = (NH_4)_2Cr(CrO_4)_2$ .

Difficultly sol. in  $H_2O$ . Insol. in alcohol, ether, chloroform, or glacial acetic acid. Easily sol. in conc. acids, from which it is separated on dilution. Decomp. by  $NaOH + Aq$ . (Heintze, J. pr. (2) 4, 220.)

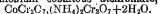
**Ammonium chromyl chromate,  $3(NH_4)_2O, 2CrO_3, 3CrO_3$ .**

Nearly insol. in  $H_2O$ . (Pascal, C. R. 1909, 148, 1465.)

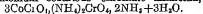
**Ammonium cobaltous chromate.**

Ppt. Easily decomp (Briggs, Z. anorg. 1907, 56, 247.)

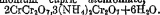
$(\text{NH}_4)_2\text{O}$ ,  $4\text{CoO}$ ,  $4\text{CrO}_3 + 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in cold dil  $\text{H}_2\text{SO}_4$ . (Groger, Z. anorg. 1906, 48, 202.)

**Ammonium cobaltous dichromate,**

Sl. hygroscopic; sol. in  $\text{H}_2\text{O}$ , insol. in alcohol. (Kruss, Z. anorg. 1895, 8, 454.)

**Ammonium cobaltous chromate ammonia,**

Ppt.; decomp by  $\text{H}_2\text{O}$  (Gröger, Z. anorg. 1908, 58, 422.)

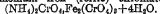
**Ammonium cupric dichromate,**

Sol in  $\text{H}_2\text{O}$  (Kruss, Z. anorg. 1895, 8, 455.)

**Ammonium cupric chromate ammonia,**

Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58, 420.)

Insol in cold, decomp by hot  $\text{H}_2\text{O}$ . Sol in dil. acids or in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Briggs, Chem. Soc. 1903, 83, 394.)

**Ammonium iron (ferric) chromate,**

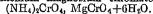
More easily decomp. by  $\text{H}_2\text{O}$  than  $\text{K}_2\text{CrO}_4$ ,  $\text{Fe}_2(\text{CrO}_4)_3 + 4\text{H}_2\text{O}$ . (Hensgen, B. 12, 1300.)  $6\text{CrO}_3$ ,  $5\text{Fe}_2\text{O}_3$ ,  $8(\text{NH}_4)_2\text{O}$ , and  $4\text{CrO}_3$ ,  $\text{Fe}_2\text{O}_3, (\text{NH}_4)_2\text{O} + 4\text{H}_2\text{O}$ . Ppts. (Lepierre, C. R. 1894, 119, 1217.)

**Ammonium lithium chromate,  $\text{NH}_4\text{LiCrO}_4 + 2\text{H}_2\text{O}$ .**

Not deliquescent. (Rammelsberg.)

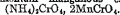
**Ammonium lead chromate,  $(\text{NH}_4)_2\text{CrO}_4$ ,  $\text{PbCrO}_4$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58, 424.)

**Ammonium magnesium chromate,**

Much more sol. in  $\text{H}_2\text{O}$  than the corresponding sulphate. (v. Hauer.)

Sol. in  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58, 416.)

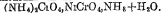
**Ammonium manganous chromate,**

Sol. in  $\text{H}_2\text{O}$ . (Hensgen, R t c. 3, 433.)

**Ammonium nickel chromate,  $(\text{NH}_4)_2\text{CrO}_4$ ,  $\text{NiCrO}_4 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1906, 51, 353.)

Can be cryst from  $\text{H}_2\text{O}$  under  $40^\circ$ . (Briggs, Chem. Soc. 1903, 83, 392.)

**Ammonium nickel chromate ammonia,**

Decomp. by  $\text{H}_2\text{O}$ . (Groger, Z. anorg. 1906, 51, 354.)

$(\text{NH}_4)_2\text{Ni}(\text{CrO}_4)_2, 2\text{NH}_3$ . Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Sol in dil. acids or in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Briggs, Chem. Soc. 1903, 83, 393.)

+  $6\text{H}_2\text{O}$ . (Briggs, Proc. Chem. Soc. 1902, 18, 254.)

**Ammonium potassium chromate,  $\text{NH}_4\text{KCrO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (E. Kopp, C. N. 11, 16.) +  $\text{H}_2\text{O}$ . (Etard, C. R. 85, 443.)

$2(\text{NH}_4)_2\text{CrO}_4, 3\text{K}_2\text{CrO}_4$ . Very sol. in  $\text{H}_2\text{O}$ . (Zehenter, M. 1897, 18, 51.)

**Ammonium silver chromate,  $(\text{NH}_4)_2\text{CrO}_4$ ,  $3\text{Ag}_2\text{CrO}_4$ .**

Decomp by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58, 423.)

**Ammonium sodium chromate,  $\text{NH}_4\text{NaCrO}_4 + 2\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$ . (Zehenter, M. 1897, 18, 54.)

**Ammonium strontium chromate,  $(\text{NH}_4)_2\text{CrO}_4$ ,  $\text{SrCrO}_4$ .**

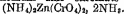
Ppt. Decomp by  $\text{H}_2\text{O}$ . (Groger, Z. anorg. 1908, 58, 415.)

**Ammonium uranyl chromate,  $(\text{NH}_4)_2\text{CrO}_4$ ,  $2(\text{UO}_2)\text{CrO}_4 + 6\text{H}_2\text{O}$ .**

Decomp. by boiling with  $\text{H}_2\text{O}$ . Sol in acidulated  $\text{H}_2\text{O}$ . (Formánek, A. 257, 106.) +  $3\text{H}_2\text{O}$ . (Formánek.)

**Ammonium zinc chromate,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{ZnO}$ ,  $2\text{CrO}_3 + \text{H}_2\text{O}$ .**

Decomp. by hot  $\text{H}_2\text{O}$ . (Groger, M. 1904, 25, 520.)

**Ammonium zinc chromate ammonia,**

Insol. in cold, decomp by hot  $\text{H}_2\text{O}$ . Sol. in dil acids or in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Briggs, Chem. Soc. 1903, 83, 394.)

$4\text{ZnCrO}_4, 2(\text{NH}_4)_2\text{CrO}_4, 3\text{NH}_3 + 3\text{H}_2\text{O}$ . Ppt. Decomp by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58, 416.)

**Ammonium dichromate chloride mercuric chloride,  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7, 2\text{NH}_4\text{Cl}, 4\text{HgCl}_2 + 2\text{H}_2\text{O}$ .**

Ppt. Sol. in cold, more sol. in warm  $\text{H}_2\text{O}$ . (Strömholm, Z. anorg. 1912, 75, 280.)

**Ammonium dichromate chloride mercuric cyanide,  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7, 4\text{NH}_4\text{Cl}$ ,  $6\text{Hg}(\text{CN})_2 + 4\text{H}_2\text{O}$ .**

(Strömholm, Z. anorg. 1913, 80, 157.)

**Ammonium chromate chromyl fluoride,**  
 $(\text{NH}_4)_2\text{CrO}_4 \cdot \text{CrO}_2\text{F}_2$ .

Sol in  $\text{H}_2\text{O}$  (Varenne, C. R. 91. 939.)

**Ammonium chromate iodate.**

See Chromoiodate, ammonium.

**Ammonium dichromate mercuric chloride,**  
 $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \cdot \text{HgCl}_2$ .

Cannot be recryst. from  $\text{H}_2\text{O}$  or  $\text{HgCl}_2 + \text{Aq}$ , but from  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 + \text{Aq}$  (Jäger and Krüss, B. 22. 2044.)

+  $\text{H}_2\text{O}$ . (Richmond and Abel, Chem. Soc. Q. J. 3. 199.)

Cannot be made to crystallize with  $\text{H}_2\text{O}$  (Jäger and Krüss.)

$3(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \cdot \text{HgCl}_2$ . Decomp by  $\text{H}_2\text{O}$ . (J. and K.)

$4(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \cdot \text{HgCl}_2$ . Decomp by  $\text{H}_2\text{O}$ . (J. and K.)

$(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \cdot 3\text{HgCl}_2$ . (J. and K.)

$(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \cdot 4\text{HgCl}_2$ . (J. and K.)

**Ammonium chromate phosphate.**

See Phosphochromate, ammonium.

**Ammonium chromate tellurate.**

See Chromotellurate, ammonium.

**Barium chromate,  $\text{BaCrO}_4$ .**

Extremely sl. sol. in  $\text{H}_2\text{O}$ .

Calculated from electrical conductivity of  $\text{BaCrO}_4 + \text{Aq}$ , 1 l  $\text{H}_2\text{O}$  dissolves 3.8 mg.  $\text{BaCrO}_4$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

When not ignited,  $\text{BaCrO}_4$  is sol. in 86,957 pts.  $\text{H}_2\text{O}$ ; 22,988 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (0.5%  $\text{NH}_4\text{Cl}$ ); 3670 pts.  $\text{HCl} + \text{H}_2\text{O}_2 + \text{Aq}$  (5%  $\text{HCl} + \text{H}_2\text{O}_2$ ); 1986 pts.  $\text{HCl} + \text{H}_2\text{O}_2 + \text{Aq}$  (10%  $\text{HCl} + \text{H}_2\text{O}_2$ ); 1813 pts.  $\text{H}_2\text{CrO}_4 + \text{Aq}$  (10%  $\text{CrO}_3$ ). When ignited, 160,000 pts.  $\text{H}_2\text{O}$  are necessary for solution. (Schweitzer, by Frensius, Z. anal. 29. 414.)

Sol in 23,000 pts. boiling  $\text{H}_2\text{O}$ . (Mescherzski, Z. anal. 21. 399.)

3.5 mg.  $\text{BaCrO}_4$  are dissolved in 1 l. of sat. solution at  $18^\circ$  (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Easily sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , or chromic acid +  $\text{Aq}$ , from which it is precipitated by  $\text{NH}_4\text{OH}$ , or by dilution with  $\text{H}_2\text{O}$ . (Bahr.)

Insol. in  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{Aq}$ . (Schweitzer.)

Sol. in 49,381 pts.  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  (0.75% salt) at  $15^\circ$ ; in 23,355 pts.  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  (1.5% salt) at  $15^\circ$ ; in 45,162 pts.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (0.5% salt) at  $15^\circ$ . (Frensius, Z. anal. 29. 418.)

Easily sol. in alkali tartrates, or citrates +  $\text{Aq}$ . (Fleischer, J. pr. (2) 5. 326.)

$0.22 \times 10^{-4}$  g equiv.  $\text{BaCrO}_4$  are dissolved in 1 l of 45% alcohol at ord. temp (Guerzini, Dissert. 1912.)

Insol. in acetic acid and in  $\text{M}_2\text{Cr}_2\text{O}_7 + \text{Aq}$ .

Partly sol in a mixture of the two, except

in presence of  $\text{MC}_2\text{H}_3\text{O}_2$ . (Caron and Raquet, Bull. Soc. 1906, (3) 35. 1064.)

Not completely insol in acetic acid. (Baubigny, Bull. Soc. 1907, (4) 1. 53.)

Insol. in acetone (Naumann, B. 1904, 37. 4329.)

Insol in methyl acetate (Naumann, B. 1909, 42. 3790.)

**Barium dichromate,  $\text{BaCr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$**

Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{BaCrO}_4$ . Sol in  $\text{H}_2\text{CrO}_4 + \text{Aq}$  (Bahr, J. B. 1853. 358.)

Sol in cold  $\text{H}_2\text{O}$  with formation of  $\text{BaCrO}_4$  and  $\text{CrO}_3$ .

Insol in glacial acetic acid. (Mayer, B. 1903, 36. 1742.)

**Barium calcium chromate,  $\text{BaCa}(\text{CrO}_4)_2$**

(Bougeois Bull. Soc. Min. 1879, 2. 124.)

**Barium potassium chromate,  $\text{BaK}_2(\text{CrO}_4)_2$**

Decomp. by  $\text{H}_2\text{O}$ . (Göger, Z. anorg. 1907, 64. 186.)

Decomp. by  $\text{H}_2\text{O}$  Stable in  $\text{K}_2\text{CrO}_4 + \text{Aq}$ , containing.

2.181	pts.	$\text{K}_2\text{CrO}_4$	per 100 pts.	$\text{H}_2\text{O}$	at	$11.5^\circ$
3.395	"	"	"	"	"	$27.5^\circ$
5.120	"	"	"	"	"	$50.0^\circ$
7.119	"	"	"	"	"	$78.0^\circ$
9.036	"	"	"	"	"	$100.0^\circ$

(Barre, C. R. 1914, 158. 497.)

**Barium potassium trichromate,**

$\text{Ba}_2\text{K}_2(\text{Cr}_2\text{O}_7)_3 \cdot 3\text{H}_2\text{O}$ .

Extremely deliquescent. (Bahr.)

**Bismuth chromates, basic.**

These comps. are insol in  $\text{H}_2\text{O}$  even in presence of  $\text{H}_2\text{CrO}_4$ ; sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  (Löwe, J. pr. 67. 288.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.00008 pt "bismuth chromate"; 100 pts. acetic acid dissolve 0.00021 pt "bismuth chromate"; 100 pts.  $\text{HNO}_3 + \text{Aq}$  (sp. gr. = 1.038) dissolve 0.00024 pt "bismuth chromate"; 100 pts.  $\text{KOH} + \text{Aq}$  (sp. gr. = 1.33) dissolve 0.00016 pt. "bismuth chromate." (Pearson, Phil. Mag. (4) 11. 206.)

Not insol in dil.  $\text{HNO}_3 + \text{Aq}$  unless  $\text{K}_2\text{CrO}_4$  is present. Less sol. in hot  $\text{NaOH} + \text{Aq}$  than  $\text{PhCrO}_4$ . (Storer.)

"Bismuth chromate" is insol in acetone. (Naumann, B. 1904, 37. 4329.)

$3\text{Bi}_2\text{O}_3 \cdot 2\text{CrO}_3 = 2(\text{BiO})_2\text{CrO}_4 \cdot \text{Bi}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ .

$\text{Bi}_2\text{O}_3 \cdot \text{CrO}_3 = (\text{BiO})_2\text{CrO}_4$ . Insol. in  $\text{H}_2\text{O}$ , easily sol. in dil.  $\text{HCl} + \text{Aq}$ , less in dil.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Murr.)

$\text{Bi}_2\text{O}_3 \cdot 2\text{CrO}_3 = (\text{BiO})_2\text{Cr}_2\text{O}_7$ . Insol. in  $\text{H}_2\text{O}$ .

+  $\text{H}_2\text{O}$ .

$5\text{Bi}_2\text{O}_3 \cdot 11\text{CrO}_3 + 6\text{H}_2\text{O}$ . (Murr, Chem. Soc. 31. 24.)

$3\text{Bi}_2\text{O}_3, 7\text{Cr}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol in mineral acids, especially  $\text{HCl} + \text{Aq}$  Partly sol. in  $\text{KOH} + \text{Aq}$

**Bismuth chromate, acid,  $\text{Bi}_2\text{O}_3, 4\text{Cr}_2\text{O}_3 + \text{H}_2\text{O}$**

Insol. in hot or cold  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  (Murr, Chem Soc 30. 17)

**Bismuth potassium chromate,  $\text{Bi}_2(\text{CrO}_4)_3, \text{K}_2\text{CrO}_4$**

Insol. in  $\text{H}_2\text{O}$ . Decomp. with hot  $\text{H}_2\text{O}$   $\text{Bi}_2\text{O}_3, \text{K}_2\text{O}, 6\text{CrO}_3 + \text{H}_2\text{O}$  (Preis and Raymann, J. B 1880. 336.)

**Bromomolybdenum chromate.**

(Atterberg)

**Cadmium chromate, basic,  $2\text{CdO}, \text{Cr}_2\text{O}_3 + \text{H}_2\text{O}$**

Very sl sol in  $\text{H}_2\text{O}$ , very slowly sol in  $\text{NH}_4\text{OH} + \text{Aq}$  with combination. (Malaguti and Sarzeau, A. ch. (3) 9. 431)

Composition as above. (Freese, B 2. 478)

**Cadmium chromate,  $\text{CdCrO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ , sol in acids, decomp. by heating with  $\text{H}_2\text{O}$  (Schulz, Z. anorg 1895, 10. 153.)

Sol in hot conc  $\text{CdSO}_4 + \text{Aq}$  (Briggs, Z. anorg 1907, 56. 253)

+  $2\text{H}_2\text{O}$  Decomp. by boiling  $\text{H}_2\text{O}$  (Schulz, Z. anorg. 1895, 10. 153)

**Cadmium dichromate,  $\text{CdO}, 2\text{CrO}_3 + \text{H}_2\text{O}$**

Easily sol in  $\text{H}_2\text{O}$  without decomp; hygroscopic (Schulz, Z. anorg. 1895, 10. 152.)

Easily sol in  $\text{H}_2\text{O}$  but decomp. on evaporation (Gröger, Z. anorg. 1910, 66. 11)

**Cadmium trichromate,  $\text{CdCr}_2\text{O}_7 + \text{H}_2\text{O}$ .**

Deliquescent. (Gröger, Z. anorg 1910, 66. 12.)

**Cadmium chromate ammonia,  $\text{CdCrO}_4, 4\text{NH}_3 + 3\text{H}_2\text{O}$**

Efflorescent. Decomp. by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , insol in alcohol and ether (Malaguti and Sarzeau)

**Cadmium potassium chromate,  $\text{CdK}_2(\text{CrO}_4)_2 + 2\text{H}_2\text{O}$**

Ppt. Decomp. by  $\text{H}_2\text{O}$  (Gröger, Z. anorg 1907, 54. 189.)

$3\text{CdO}, \text{K}_2\text{O}, 3\text{CrO}_3 + 3\text{H}_2\text{O}$  Ppt. (Preis and Raymann, Sitzungsber. böhm. Gesell 1880.)

$4\text{CdO}, \text{K}_2\text{O}, 4\text{CrO}_3 + 3\text{H}_2\text{O}$  Ppt. Slowly decomp. by  $\text{H}_2\text{O}$  (Grosjean, M 1904, 25. 533)

**Cadmium potassium dichromate,**

$\text{CdCr}_2\text{O}_7, \text{K}_2\text{Cr}_2\text{O}_7 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; sl. hygroscopic (Kruss, Z. anorg. 1895, 8. 454.)

**Cadmium dichromate mercuric cyanide,**  
 $\text{CdCr}_2\text{O}_7, 2\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  without decomp (Kruss, Z. anorg 1895, 8. 460)

**Cæsium chromate,  $\text{Cs}_2\text{CrO}_4$**

(Chabré, C. R 1901, 132. 680)

Aq solution sat. at  $30^\circ$  contains 47%. (Schrenemakers, C. C. 1909, I 11)

**Cæsium dichromate,  $\text{Cs}_2\text{Cr}_2\text{O}_7$ .**

(Chabré, C. R 1901, 132. 680)

Much more sol in hot  $\text{H}_2\text{O}$ , than in cold. (Fraprie, Am J. Sci 1906, (4) 21. 309.)

Aq solution sat. at  $30^\circ$  contains 5.2%. (Schrenemakers, C. C. 1909, I 11)

**Cæsium trichromate,  $\text{Cs}_2\text{Cr}_3\text{O}_{16}$ .**

Decomp. by  $\text{H}_2\text{O}$  (Schrenemakers, Chem. Weekbl. 1908, 5. 811.)

Sol in  $\text{H}_2\text{O}$ . (Fraprie, Am J. Sci. 1906, (4) 21. 315)

**Cæsium tetrachromate,  $\text{Cs}_2\text{Cr}_4\text{O}_{13}$ .**

Sol in  $\text{H}_2\text{O}$  with decomp. (Schrenemakers, Chem Weekbl 1908, 5. 811.)

**Cæsium cobaltous chromate,**

$\text{Cs}_2\text{Co}(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$ .

(Briggs, Z. anorg. 1907, 56. 248)

**Cæsium magnesium chromate,**

$\text{Cs}_2\text{Mg}(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$ .

(Briggs, Chem. Soc. 1904, 85. 680.)

**Cæsium nickel chromate,  $\text{Cs}_2\text{Ni}(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$ .**

Sol. in cold  $\text{H}_2\text{O}$  without much change, but decomp. by warm  $\text{H}_2\text{O}$  (Briggs, Chem. Soc. 1904, 85. 679.)

**Calcium chromate basic,  $\text{Ca}_2\text{CrO}_5 + 3\text{H}_2\text{O}$ .**

Sol. in 230 pts  $\text{H}_2\text{O}$  without decomp. (Mylius and Wrochem, Gm. K. 3. I, 1385)

**Calcium chromate,  $\text{CaCrO}_4$**

*Anhydrous* Very sl. sol. in  $\text{H}_2\text{O}$  (Sievert, J. B. 1882. 148)

Aq. solution sat. at  $18^\circ$  contains 2.3%  $\text{CaCrO}_4$ ; sp. gr. = 1.023 (Mylius and Wrochem, B 1900, 33. 3688.)

Insol. in acetone (Naumann, B. 1904, 37. 4329.)

+  $\frac{1}{2}\text{H}_2\text{O}$  Aq. solution sat. at  $18^\circ$  contains 4.4%  $\text{CaCrO}_4$ , sp. gr. = 1.044. (Mylius and Wrochem, B 1900, 33. 3688.)

+  $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	$0^\circ$	$8^\circ$	$13^\circ$	$18^\circ$	$25^\circ$
% $\text{CaCrO}_4$	11.5	10.8	10.3	9.6	9.1

$t^\circ$	$40^\circ$	$60^\circ$	$75^\circ$	$90^\circ$	$100^\circ$
% $\text{CaCrO}_4$	7.8	5.7	4.6	3.6	3.1

(Mylius and Wrochem, Gm.-K 3. I, 1386.)

Sp. gr. of solution containing 9.6% by wt  $\text{CaCrO}_4$  at  $18^\circ = 1.096$ . (Mylius and Wrochem, B 1900, 33, 3688.)  
 $+2\text{H}_2\text{O}$ . Sol in 241.3 pts  $\text{H}_2\text{O}$  at  $14^\circ$  (Siewert.)  
 Sol in 34 pts  $\text{H}_2\text{O}$  (Schwarz, Dtingl. 198. 159.)

Solubility of two modifications in  $\text{H}_2\text{O}$  at  $t^\circ$

$\alpha$  modification

$t^\circ$	$0^\circ$	$20^\circ$	$30^\circ$	$45^\circ$
% $\text{CaCrO}_4$	14.75	14.22	13.89	12.53

$\beta$  modification.

$t^\circ$	$0^\circ$	$14^\circ$	$18^\circ$	$19.5^\circ$	$30^\circ$	$40^\circ$
% $\text{CaCrO}_4$	9.8	10	10.3	10.4	10.4	10.4

(Mylius and Wrochem, Gm.-K. 3. I, 1387.)

$\alpha$  modification Sp. gr. of the solution containing 14.3% by wt  $\text{CaCrO}_4$  at  $18^\circ = 1.149$  (Mylius and Wrochem, B 1900, 33, 3688.)

$\beta$  modification Sp. gr. of the solution containing 10.3% by wt.  $\text{CaCrO}_4$  at  $18^\circ = 1.105$  (Mylius and Wrochem, B 1900, 33, 3688.)

Easily sol in  $\text{H}_2\text{O}$  containing  $\text{CrO}_3$

Insol. in absolute alcohol.

50 cc. of alcohol (29%) dissolve 0.608 g  $\text{CaCrO}_4$ , 50 cc. of alcohol (53%) dissolve 0.44 g  $\text{CaCrO}_4$ . (Fresenius, Z. anal. 30. 672.)

Sol. in acids and in dilute alcohol (Caron and Raquet, Bull. Soc. 1906, (3) 35. 1064.)

Calcium dichromate,  $\text{CaCr}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$

Very deliquescent (Bahr, J. pr. 60. 60.)

In sat. solution at  $18^\circ$ , 61%  $\text{CaCr}_2\text{O}_7$  is present. (Mylius and Wrochem, Gm.-K. 3. I, 1387.)

Sol in acetone (Naumann, B. 1904, 37. 4328.)

Calcium potassium chromate,  $\text{CaCrO}_4$ ,

$\text{K}_2\text{CrO}_4$ ,

(Barre, C. R. 1914, 158. 495.)

$+ \text{H}_2\text{O}$  Easily sol. in  $\text{H}_2\text{O}$  (Duncan.)

Insol in  $\text{H}_2\text{O}$  when ignited

$+ 2\text{H}_2\text{O}$  Easily sol. in  $\text{H}_2\text{O}$ , even after ignition. Insol in alcohol (Duncan, J. B. 1860. 313.)

Formed below  $45^\circ$ . (Bancroft, C. R. 1914, 158. 495.)

Sol. in cold  $\text{H}_2\text{O}$ . Sl. sol in sat.  $\text{K}_2\text{CrO}_4 + \text{Aq.}$  (Grögen, Z. anorg. 1907, 54. 187.)

Two modifications Solubility of a modification is somewhat less than that of the  $\beta$  modification (Wyrouboff, Bull. Soc. Min. 1891, 14. 255.)

Solubility of two modifications in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	$0^\circ$	$15^\circ$
Solubility of $\alpha$	23.06	25.06
" $\beta$	23.01	24.45

(Rakowski, C. C. 1909, I 133.)

$4\text{CaCrO}_4$ ,  $\text{K}_2\text{CrO}_4$ .

$5\text{CaCrO}_4$ ,  $\text{K}_2\text{CrO}_4$ . Sol in much  $\text{H}_2\text{O}$  (Bahr.)

Calcium chromate potassium sulphate,

$\text{CaCrO}_4$ ,  $\text{K}_2\text{SO}_4 + \text{H}_2\text{O}$ .

Decomp by  $\text{H}_2\text{O}$  (Hannay, Chem. Soc. 32. 399.)

$\text{CaCrO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{K}_2\text{CrO}_4$  As above (H.)

Cerous chromate.

Insol. in  $\text{H}_2\text{O}$ .

Calcium strontium chromate,  $\text{CaSr}(\text{CrO}_4)_2$ .

(Bourgeois, Bull. Soc. Min. 1879, 2. 123.)

Ceric dichromate,  $\text{CeO}_2$ ,  $2\text{CrO}_3 + 2\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ ; sol. in acids; decomp. completely by boiling  $\text{H}_2\text{O}$ . (Bancroft, C. R. 1894. 116. 145.)

Chromic chromate,  $\text{Cr}_2\text{O}_3 = \text{Cr}_2\text{O}_3$ ,  $\text{CrO}_3$ .

Insol. as such in  $\text{H}_2\text{O}$ , but decomp. thereby into  $\text{CrO}_3$  and  $\text{Cr}_2\text{O}_3$ ; decomp. by alkalis and many saline solutions. Easily sol. in dil. acids if recently pptd., but with difficulty if dried at a high temp. (Ehret and Stoier, Proc. Am. Acad. 5. 207.)

$\text{Cr}_2\text{O}_3 = \text{Cr}_2\text{O}_3$ ,  $3\text{CrO}_3$ . Sol. in  $\text{HCl} + \text{Aq.}$  Very slowly sol. in  $\text{HNO}_3 + \text{Aq.}$  Slowly decomp. by  $\text{H}_2\text{SO}_4$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  Easily decomp. by  $\text{KOH} + \text{Aq.}$

Does not exist (Ehret and Storer, l.c.)  
 $\text{Cr}_2\text{O}_3 = 3\text{Cr}_2\text{O}_3$ ,  $2\text{CrO}_3$ . Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$  difficultly sol. in acetic acid. Easily sol. in  $\text{KOH} + \text{Aq.}$  (Traube, A. 66. 108.)

Existence doubtful.

$\text{Cr}_2\text{O}_3 = 2\text{Cr}_2\text{O}_3$ ,  $\text{CrO}_3$ . Insol. in all acids, even aqua regia; slowly attacked by a boiling conc. solution of alkali hydroxides. (Geuther and Merz, A. 118. 62.)  $\text{Cr}_2\text{O}_3$  according to Wohler

Chromic cupric chromate,  $\text{CuCr}_2\text{O}_6$ ,  $\text{Cr}_2\text{O}_3 + 12\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ . Sol in  $\text{HCl}$  and  $\text{HNO}_3$ . (Rosenfeld, B. 1879, 12. 957.)

$6\text{CuO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $\text{CrO}_3 + 9\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$ . Sol in acids (Rosenfeld, B. 1879, 12. 958.)

Chromic potassium chromate,  $\text{Cr}_2\text{H}_2(\text{CrO}_4)_2$ ,  $\text{K}_2\text{CrO}_4(?)$ .

Insol. in  $\text{H}_2\text{O}$ , alcohol, or acetic acid. Not attacked by cold  $\text{HNO}_3 + \text{Aq.}$ ; sl. oxidized when hot. Insol in cold, easily sol. in hot  $\text{H}_2\text{SO}_4$ . Sl. sol. in  $\text{SO}_2 + \text{Aq.}$ . Sol. in conc.  $\text{HCl} + \text{Aq.}$  (Tommasi, Bull. Soc. (2) 17. 396.)

Chromous potassium chromate,

$\text{K}_2\text{CrO}_4(\text{CrO}_4)_2 = \text{K}_2\text{Cr}(\text{CrO}_4)_2(?)$ .

Sat. cold solution in  $\text{H}_2\text{O}$  contains 9% of the salt. Insol in alcohol and ether (Heintze, J. pr. (2) 4. 212.)

**Cobaltous chromate, basic,  $3\text{CoO}$ ,  $\text{CrO}_3 + 4\text{H}_2\text{O}$**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Malaguti and Sarzeau, A. ch. (3) 9. 431.)

True formula is  $2\text{CoO}$ ,  $\text{CrO}_3 + 2\text{H}_2\text{O}$  (Froese, Pogg. 140. 252.)

$4\text{CoO}$ ,  $3\text{CrO}_3 + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  (Groger, Z. anorg. 1906, 49. 203.)

**Cobaltous chromate,  $\text{CoCrO}_4$**

Much more sol. in  $\text{H}_2\text{O}$  than  $\text{NiCrO}_4$ . Easily sol. in hot dil.  $\text{HNO}_3 + \text{Aq.}$  (Briggs, Z. anorg. 1909, 63. 327.)

+  $2\text{H}_2\text{O}$ . Ppt. (Briggs, Z. anorg. 1909, 63. 328.)

**Cobaltous dichromate,  $\text{CoCr}_2\text{O}_7 + \text{H}_2\text{O}$**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Briggs, Z. anorg. 1907, 56. 247.)

**Cobaltous potassium chromate, basic.**

$\text{K}_2\text{O}$ ,  $4\text{CoO}$ ,  $4\text{CrO}_3 + 3\text{H}_2\text{O}$ .

Sol. in cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Groger, Z. anorg. 1906, 49. 199.)

**Cobaltous potassium chromate,  $\text{K}_2\text{Co}(\text{CrO}_4)_2 + 2\text{H}_2\text{O}$**

Decomp. by  $\text{H}_2\text{O}$  (Groger, Z. anorg. 1906, 49. 200.)

**Cupric chromate, basic,  $3\text{CuO}$ ,  $\text{CrO}_3 + 2\text{H}_2\text{O}$**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HNO}_3 + \text{Aq.}$  and in  $\text{NH}_4\text{OH} + \text{Aq.}$  Decomp. by  $\text{KOH} + \text{Aq.}$  (Malaguti and Sarzeau, A. ch. (3) 9. 434.)

$7\text{CuO}$ ,  $2\text{CrO}_3 + 5\text{H}_2\text{O}$ . Ppt. (Rosenfeld, B. 13. 1469.)

$7\text{CuO}$ ,  $\text{CrO}_3 + 5\text{H}_2\text{O}$ . Ppt. (R.)

**Cobaltous dichromate mercuric cyanide,  $\text{CoCr}_2\text{O}_7$ ,  $2\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$**

Very stable. Sol. in  $\text{H}_2\text{O}$ . (Kruss, Z. anorg. 1895, 8. 458.)

**Cupric chromate,  $\text{CuCrO}_4$**

Insol. in  $\text{H}_2\text{O}$ ; very sol. in chromic acid and in other acids, decomp. by boiling with  $\text{H}_2\text{O}$ . (Schulz, Z. anorg. 1895, 10. 152.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

**Cupric dichromate, basic,  $\text{CuCr}_2\text{O}_7$ ,  $2\text{CuO}$**   
(Stanley, C. N. 54. 194.)

**Cupric dichromate,  $\text{CuCr}_2\text{O}_7 + 2\text{H}_2\text{O}$**

Deliquescent. Very easily sol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq.}$  and alcohol (Dröge, A. 101. 39.)

Aqueous solution is decomp. by boiling. (Malaguti and Sarzeau, A. ch. (3) 9. 456.)

Very hygroscopic. Very sol. in  $\text{H}_2\text{O}$  without decomp. (Schulz, Z. anorg. 1895, 10. 150.)

**Cupric tetrachromate,  $\text{CuCr}_4\text{O}_{12} + 2\text{H}_2\text{O}$**

Deliquescent. Decomp. when its solution in  $\text{H}_2\text{O}$  is concentrated. (Grüger, Z. anorg. 1910, 66. 15.)

**Cupric lead chromate,  $2(\text{PbCrO}_4, \text{PbO})$ ,  $(2\text{CuCrO}_4, \text{CuO})$**

Min. *Vauquelinite*. Sol. in acids.

**Cupric potassium chromate, basic,**

$\text{KCu}_2(\text{OH})(\text{CrO}_4)_2 + \text{H}_2\text{O}$ .

Ppt. (Grüger, M. 1903, 24. 485.)

$3\text{CuO}$ ,  $\text{K}_2\text{O}$ ,  $3\text{CrO}_3 + 2\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Knop, A. 70. 52.)

Does not exist. (Rosenfeld, B. 13. 1472.)

$4\text{CuO}$ ,  $\text{K}_2\text{O}$ ,  $4\text{CrO}_3 + \text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Gerhardt.)

+  $3\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Groger, Dissert. 1880.)

**Cupric potassium chromate ammonia,**

$\text{K}_2\text{Cu}(\text{CrO}_4)_2, 2\text{NH}_3$ .

Very sol. in dil.  $\text{NH}_3 + \text{Aq.}$ ; decomp. by  $\text{H}_2\text{O}$ . (Briggs, Chem. Soc. 1904, 65. 672.)

**Cupric chromate ammonia,  $\text{CuCrO}_4, 4\text{NH}_3$**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Parravano and Pasta, Gazz. ch. it. 1907, 37. (2). 255.)

$4\text{CuCrO}_4, 8\text{NH}_3 + 5\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  and  $\text{NH}_4\text{OH} + \text{Aq.}$ ; insol. in organic solvents; easily sol. in  $\text{AgNO}_3 + \text{Aq.}$  (Schuyten, C. C. 1900, I. 399.)

$2\text{CuCrO}_4, 7\text{NH}_3 + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Very sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Briggs, Chem. Soc. 1904, 65. 673.)

$3\text{CuO}$ ,  $2\text{CrO}_3$ ,  $10\text{NH}_3 + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ ; sl. sol. or insol. in alcohol, ether, or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Malaguti and Sarzeau.)

Decomp. by hot  $\text{H}_2\text{O}$ ; insol. in alcohol (Böttger.)

**Cupric dichromate ammonia,  $\text{CuCr}_2\text{O}_7, 4\text{NH}_3 + 2\text{H}_2\text{O}$**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Parravano and Pasta, Gazz. ch. it. 1907, 37. (2). 255.)

**Cupric dichromate mercuric cyanide,**

$\text{CuCr}_2\text{O}_7, \text{Hg}(\text{CN})_2 + 5\text{H}_2\text{O}$ .

Not hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Kruss, Z. anorg. 1895, 8. 461.)

**Didymium chromate,  $\text{D}_{12}(\text{CrO}_4)_3$**

Sl. sol. in  $\text{H}_2\text{O}$ , easily in dil. acids (Friedrichs and Smith, A. 191. 353.)

+  $7\text{H}_2\text{O}$ . (Cleve.)

**Didymium potassium chromate,**

$\text{D}_{12}(\text{CrO}_4)_3, \text{K}_2\text{CrO}_4$ .

Precipitate. Decomp. by  $\text{H}_2\text{O}$ . (Cleve.)

Dysprosium chromate,  $Dy_2(CrO_4)_3$   
+  $10H_2O$ .

Very sl sol in  $H_2O$ . 1.0002 pt is sol in 100 pts  $H_2O$  at  $25^\circ$  (Jantsch, B. 1911, 44, 1276.)

Glucinum chromate, basic,  $GhCrO_4 \cdot 13GhO + 23H_2O$

Ppt. Insol. in  $H_2O$ . (Creuzberg, Dingl. 183. 449.)

$GhCrO_4 \cdot 6Gh(OH)_2$ . Ppt. Insol. in  $H_2O$  (Glassmann, B. 1907, 40, 2603)

Glucinum chromate,  $GhCrO_4 \cdot H_2O$ .

Decomp. by  $H_2O$  with separation of the basic chromate. (Glassmann, B. 1907, 40, 2603)

Gold (auric) chromate,  $Au_2(CrO_4)_3 \cdot CrO_3$ .

Ppt. (Orloff, Ch Z 1907, 31, 1182.)

Indium chromate.

Ppt (Meyer)

Indium dichromate.

Very sol in  $H_2O$ . Known only in solution.

Iron (ferric) chromate, basic.

Decomp. by  $H_2O$  (Maus.)

$Fe_2O_3 \cdot CrO_3$ . Insol. in  $H_2O$ , but decomp. thereby, or by saline solutions; easily sol. in acids. Sol. in  $H_2CrO_4 + Aq$ . (Ehott and Storei, Proc. Am. Acad. 5, 216)

Iron (ferric) dichromate.

Sol. in  $H_2O$  and alcohol. (Maus, Pogg 9, 132.)

Iron (ferric) potassium chromate, basic,

$2CrO_3 \cdot 6Fe_2O_3 \cdot 3K_2O$ .

$4CrO_3 \cdot 3Fe_2O_3 \cdot 4K_2O$ .

$10CrO_3 \cdot 8Fe_2O_3 \cdot 7K_2O$ .

$11CrO_3 \cdot 8Fe_2O_3 \cdot 4K_2O + 9H_2O$ .

$9CrO_3 \cdot 2Fe_2O_3 \cdot 6K_2O + 6H_2O$ .

$9CrO_3 \cdot 2Fe_2O_3 \cdot 6K_2O + 10H_2O$ .

$10CrO_3 \cdot 3Fe_2O_3 \cdot 6K_2O + 5H_2O$ .

$7CrO_3 \cdot 2Fe_2O_3 \cdot 2K_2O + 7H_2O$ .

$4CrO_3 \cdot Fe_2O_3 \cdot K_2O + 4H_2O$ .

$6CrO_3 \cdot 2Fe_2O_3 \cdot 3K_2O$ .

$16CrO_3 \cdot 4Fe_2O_3 \cdot 5K_2O + 8H_2O$ .

Above compounds are ppts., insol. in  $H_2O$ , alcohol and ether. (Lepierre, C. R. 1894, 119, 1215-18.)

Iron (ferric) potassium chromate,

$Fe_2(CrO_4)_3 \cdot K_2CrO_4 + 4H_2O$ .

Decomp. by much  $H_2O$ , conc.  $HCl$ , or  $NH_4OH + Aq$ . Not decomp. by alcohol. (Hensgen, B. 12, 1300)

Iron (ferric) sodium chromate, basic,

$5CrO_3 \cdot 7Fe_2O_3 \cdot 4Na_2O$ .

Ppt (Lepierre, C. R. 1894, 119, 1217.)

Lanthanum chromate,  $La_2(CrO_4)_3$ .

Sl sol. in cold, more easily in hot  $H_2O$ ; easily sol. in acids. (Frerichs and Smith, A. 191, 355)

+  $8H_2O$  Ppt (Cleve)

Lanthanum potassium chromate.

(Cleve)

Lead chromate, basic,  $2PbO \cdot CrO_3$  (chromic red)

Insol. in  $H_2O$ , acetic acid dissolves out  $\frac{1}{2}$  the  $PbO$ . Sol. in  $KOH + Aq$  (Badams, Pogg 3, 221)

Insol. in acetone. (Naumann, B 1904, 37, 4329.)

$3PbO \cdot CrO_3$ . (Hermann, Pogg 28, 162.) +  $H_2O$ . Ppt (Strömholm, Z anorg. 1904, 38, 443.)

Min *Melanochroite*, *Phanicrosite* Sol. in acids.

$PbO$ ,  $PbCrO_4$ . Ppt (S)

Lead chromate,  $PbCrO_4$ .

Insol. in  $H_2O$ . Pptd. from  $Pb(NO_3)_2$  in presence of 70,000 pts.  $H_2O$ . (Huang.)

Calculated from electrical conductivity of  $PbCrO_4 + Aq$ , 1 l  $H_2O$  dissolves 0.2 mg.  $PbCrO_4$  at  $18^\circ$  (Kohlrausch and Rose, Z. phys. Ch. 12, 241.)

1 l.  $H_2O$  dissolves  $1.2 \times 10^{-6}$  g  $PbCrO_4$  at  $25^\circ$ . (Hevesy, Z. anorg 1913, 82, 328.)

Sol. in dil.  $H_2SO_4 + Aq$  (Storer), sl sol. in dil.  $HNO_3 + Aq$

Sol. in 500 pts.  $HNO_3 + Aq$  of 1.12 sp. gr.; in 150 pts.  $HNO_3 + Aq$  of 1.225 sp. gr.; in 130 pts.  $HNO_3 + Aq$  of 1.265 sp. gr.; in 80 pts  $HNO_3 + Aq$  of 1.395 sp gr (Storei's Dict.)

Solubility of  $PbCrO_4$  in  $HNO_3 + Aq$  at  $18^\circ$ .

(Millimols. per l.)

0.1N	0.2N	0.3N	0.4N
0.506	0.844	1.13	1.44

(Beck and Stegmüller, l. c.)

Easily decomp. by hot  $HCl + Aq$  (Fresenius.)

Solubility of  $PbCrO_4$  in  $HCl + Aq$ .

(Millimols. per l.)

$t^\circ$	0.1N	0.2N	0.3N	0.4N	0.5N	0.6N
18	0.186	0.393	0.654	1.07	1.56	2.25
25	0.239	0.485	0.839	1.32	4.06	2.95
37	0.357	0.744	1.31	2.10	3.28	4.69

(Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, 34, 446.)

Insol. in  $HC_2H_3O_2 + Aq$ .

Easily sol. in  $KOH$ , or  $NaOH + Aq$ . 1 l.  $KOH + Aq$  ( $\frac{1}{2}$  normal) dissolves 11.9 g.  $PbCrO_4$  at  $15^\circ$ ; 16.2 g. at  $60^\circ$ ; 26.1 g. at  $80^\circ$ ;

38.5 g. at 102°. (Lachaud and Lepierre, Bull. Soc. (3) 6, 230.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Brett, 1837.)

Sol. in  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{Aq.}$ ; almost completely insol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$

Not pptd. in presence of  $\text{Na citrate.}$  (Spil-let.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

Min. *Crocoite* Sol. in hot  $\text{HCl} + \text{Aq.}$ ; difficultly sol in  $\text{HNO}_3 + \text{Aq.}$ ; sol in  $\text{KOH} + \text{Aq.}$

**Lead dichromate,  $\text{PbCr}_2\text{O}_7$ .**

Decomp. by  $\text{H}_2\text{O}$

+  $2\text{H}_2\text{O}$  As above (Preis and Raymann, B. 13, 340.)

**Lead lithium chromate,  $\text{PbCrO}_4, \text{Li}_2\text{CrO}_4$**

(Lachaud and Lepierre, C. R. 110, 1035.)

**Lead potassium chromate,  $\text{PbCrO}_4, \text{K}_2\text{CrO}_4$ .**

Insol. in hot or cold  $\text{H}_2\text{O}$  or in alcohol Dil acids dissolve out  $\text{K}_2\text{CrO}_4$ . (Lachaud and Lepierre, C. R. 110, 1035.)

Decomp. by  $\text{H}_2\text{O}$ . Stable in contact with solutions containing.

	$\text{K}_2\text{CrO}_4$ per 100 pts. $\text{H}_2\text{O}$ at	10°
8.950 pts.	" " " "	10°
3.077 " "	" " " "	27.5°
7.629 " "	" " " "	37.5°
7.150 " "	" " " "	50.0°
6.145 " "	" " " "	76.0°
4.940 " "	" " " "	100.0°

(Barre, C. R. 1914, 158, 497)

**Lead sodium chromate,  $\text{PbCrO}_4, \text{NaCrO}_4$ .**

Sol. in  $\text{H}_2\text{O} (?)$ . (Lachaud and Lepierre)  
 $\text{PbCrO}_4, 2\text{PbO}, \text{Na}_2\text{CrO}_4$  (L and L)

**Lithium chromate,  $\text{Li}_2\text{CrO}_4$ .**

100 cc of solution sat. at 18° contain 85 g anhydrous salt (Kohlrausch, B. A. B. 1897, 90.)

99.94 pts. are sol. in 100 pts  $\text{H}_2\text{O}$  at 30° (Schreinemakers, C. C. 1905, II, 1486.)

+  $2\text{H}_2\text{O}$ . Very easily sol. in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 128, 323.)

100 g.  $\text{H}_2\text{O}$  dissolve 111 g. salt at 20°. (Von Weimarn, C. C. 1911, II, 1300.)

Sp. gr. of solution sat. at 18° = 1.574, and contains 52.6%  $\text{LiCrO}_4$  (Mylus and Wrochem, B. 1897, 30, 1718.)

**Lithium dichromate,  $\text{Li}_2\text{Cr}_2\text{O}_7$ .**

130.4 pts. are sol in 100 pts.  $\text{H}_2\text{O}$  at 30° (Schreinemakers, C. C. 1905, II, 1486.)

+  $2\text{H}_2\text{O}$ . Deliquescent Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Lithium potassium chromate,  $\text{K}_2\text{CrO}_4$ ,**

$\text{Li}_2\text{CrO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

Hydroscopic. (Zehenter, M. 1897, 18, 54.)

**Magnesium chromate,  $\text{MgCrO}_4$ .**

Sol in  $\text{H}_2\text{SO}_4$ , and  $\text{HCl}$ , insol. in  $\text{HNO}_3$ . (Dufau, C. R. 1896, 123, 888)

Sp gr of  $\text{MgCrO}_4 + \text{Aq}$  sat at t°/4°

t°	13.6°	14.5°	13.6°
% $\text{MgCrO}_4$	12.31	21.86	27.71
Sp. gr.	1.0886	1.1641	1.2170

(Slotte, W. Ann. 1881, 14, 19.)

Sol. in acetone. (Naumann, B. 1904, 37, 4328)

+  $7\text{H}_2\text{O}$ . Easily sol in  $\text{H}_2\text{O}$  (Vanquehn.)

100 cm. of solution sat. at 18° contain 60 g.  $\text{MgCrO}_4$ . (Kohlrausch, B. A. B. 1897, 90.)

Sp. gr. of solution sat. at 18° = 1.422, and contains 42%  $\text{MgCrO}_4$ . (Mylus and Wrochem, B. 1897, 30, 1718)

+  $5\text{H}_2\text{O}$ . Very sol in  $\text{H}_2\text{O}$ . (Wyrouboff, Bull. Soc. Min. 12, 60)

**Magnesium dichromate,  $\text{Mg}_2\text{Cr}_2\text{O}_7$ .**

Sol. in  $\text{H}_2\text{O}$

Sl. sol in alcohol. (Reintzer, Zeit. angew. 1913, 26, 456.)

**Magnesium potassium chromate,  $\text{MgCrO}_4$ ,  $\text{K}_2\text{CrO}_4 + 2\text{H}_2\text{O}$ .**

100 pts  $\text{H}_2\text{O}$  dissolve 28.2 pts at 20°; 34.3 pts. at 60°. (Schweitzer)

Sol. in  $\text{H}_2\text{O}$ . Sl. sol in sat  $\text{K}_2\text{CrO}_4 + \text{Aq.}$  (Grogger, Z. anorg. 1907, 54, 188)

Insol. in alcohol

+  $6\text{H}_2\text{O}$ . Efflorescent. (Briggs, Chem. Soc. 1904, 85, 679.)

**Magnesium rubidium chromate,**

$\text{MgRb}_2(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$ .

(Briggs, Chem. Soc. 1904, 85, 679.) (Barker, Chem. Soc. 1911, 99, 1327.)

**Magnesium sodium chromate.**

(Stanley, C. N. 54, 194.)

**Manganous chromate,  $2\text{MnO}, \text{CrO}_3 + \text{H}_2\text{O}$ .**

Ppt. Sol. in dil  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq.}$  (Warrington and Reinsch, Schw J. 3, 378.)

**Manganous potassium chromate,  $\text{MnCrO}_4$ ,  $\text{K}_2\text{CrO}_4 + 2\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol in dil.  $\text{H}_2\text{SO}_4$ . (Grogger, Z. anorg. 1905, 44, 459)

$2\text{MnCrO}_4, \text{K}_2\text{CrO}_4 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Hengen, R. t. c. 3, 433.)

**Mercurous chromate, basic,  $4\text{Hg}_2\text{O}, 3\text{CrO}_3$ .**

Very sl. sol in cold, more in boiling  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq.}$  Decomp. by  $\text{HCl} + \text{Aq.}$  Sl. sol in  $\text{NH}_4\text{Cl} + \text{Aq.}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Brett.)

Does not exist. (Richter, B. 15, 1489.)

$3\text{Hg}_2\text{O}, \text{CrO}_3$ . Sol in  $\text{HNO}_3 + \text{Aq.}$  (Richter.)

$3\text{Hg}_2\text{O}$ ,  $2\text{CrO}_3$ . Ppt (Fichter, Z anorg. 1912, 76. 350.)

**Mercurous chromate,  $\text{Hg}_2\text{CrO}_4$ \***

Very sl. sol in cold, more readily in hot  $\text{H}_2\text{O}$ . Sl sol in dil  $\text{HNO}_3 + \text{Aq}$ ; sol in conc  $\text{HNO}_3$ ; sol in  $\text{KCN} + \text{Aq}$ ; insol. in  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$ . (Rose, Pogg 53. 124.)

Less sol in  $\text{K}_2\text{CrO}_4 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Fichter, Z. anorg 1912, 76. 349.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Mercuric chromate, basic,  $2\text{HgO}$ ,  $\text{CrO}_3$ .**

Sol. in  $\text{HCl}$  and in  $\text{HNO}_3 + \text{Aq}$ . (Geuther.)  $3\text{HgO}$ ,  $\text{CrO}_3$ . Sl. sol in  $\text{H}_2\text{O}$  (Millon.)

The only true compound. All others are mixtures of  $\text{HgO}$  or  $\text{HgCrO}_4$  with this compound. (Cox, Z. anorg. 1904, 40. 155.)

$4\text{HgO}$ ,  $\text{CrO}_3$ . Sl sol in  $\text{H}_2\text{O}$ . (Millon, A. ch. (3) 18. 365.)

$7\text{HgO}$ ,  $2\text{CrO}_3$ . Easily sol in warm  $\text{HNO}_3$ , when freshly precipitated. Easily sol in  $\text{HCl} + \text{Aq}$  (Geuther, A. 106. 247.)

Does not exist. (Freese, B. 2. 477.)

$5\text{HgO}$ ,  $\text{CrO}_3$ . Easily sol. in  $\text{HCl} + \text{Aq}$  Very sl. sol. in  $\text{HNO}_3 + \text{Aq}$ . Decomp. by  $\text{H}_2\text{O}$  into—

$6\text{HgO}$ ,  $\text{CrO}_3$ . Insol in  $\text{H}_2\text{O}$  (Jager and Krüss, B. 22. 2049.)

**Mercuric chromate,  $\text{HgCrO}_4$**

Decomp. by  $\text{H}_2\text{O}$  and acids into basic salt. (Geuther.)

Sol. in acids Sol in warm  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  Sol. in  $\text{Hg}(\text{NO}_3)_2$  or  $\text{HgCl}_2 + \text{Aq}$ .

Insol in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol in acetone. (Naumann, B. 1904, 37. 4329.)

**Mercuric dichromate,  $\text{HgCr}_2\text{O}_7$ .**

Ppt. (Gawalowski, C. C 1906. II, 1307.)

**Mercurous potassium chromate,**

$\text{Hg}_2\text{K}_2(\text{CrO}_4)_2$ .

Ppt., decomp. by  $\text{H}_2\text{O}$  (Gröger, Z anorg 1907, 54. 191.)

**Mercuric chromate, basic, ammonia,  $12\text{HgO}$ ,  $3\text{CrO}_3$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$**

(Gröger, Z. anorg. 1908, 58. 420.)

**Mercuric chromate ammonia,  $\text{HgCrO}_4$ ,  $2\text{NH}_3 + \text{H}_2\text{O}$**

(Gröger, Z. anorg 1908, 58. 419.)

**Mercuric chromate sulphide,  $2\text{HgCrO}_4$ ,  $\text{HgS}$ .**

Not attacked by weak acids (Palm, C. C. 1863. 121.)

**Nickel chromate, basic,  $4\text{NiO}$ ,  $\text{CrO}_3 + 6\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Malaguti and Sarzeau, A. ch (3) 9. 451.)

$3\text{NiO}$ ,  $\text{CrO}_3 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Freese, J. B. 1869. 271.)

$2\text{NiO}$ ,  $\text{CrO}_3 + 6\text{H}_2\text{O}$ . As above (Schmidt, A. 156. 19.)

$5\text{NiO}$ ,  $2\text{CrO}_3 + 12\text{H}_2\text{O}$ . As above (Schmidt.)

**Nickel chromate,  $\text{NiCrO}_4$ .**

Not attacked by boiling  $\text{H}_2\text{O}$

Nealy insol. in hot dil  $\text{HNO}_3$ . Slowly sol. in conc.  $\text{HNO}_3$  and aqua regia.

Somewhat sol in  $\text{NH}_3 + \text{Aq}$ . (Briggs, Z. anorg 1909, 63. 326.)

**Nickel dichromate,  $2\text{NiCr}_2\text{O}_7 + 3\text{H}_2\text{O}$ .**

Slowly sol in cold, rapidly sol in hot  $\text{H}_2\text{O}$ . Deliquescent (Briggs, Z. anorg 1907, 56. 246.)

**Nickel potassium chromate,  $\text{NiCrO}_4$ ,  $\text{K}_2\text{CrO}_4 + 2\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  (Grogei, Z anorg. 1906, 51. 353.)

$+ 6\text{H}_2\text{O}$ . Efflorescent (Briggs, Chem. Soc. 1904, 85. 678.)

**Nickel rubidium chromate,  $\text{NiRb}(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$**

Sl. efflorescent at ord. temp. (Briggs, Chem Soc 1904, 85. 678.)

**Nickel chromate ammonia,  $\text{NiCrO}_4$ ,  $6\text{NH}_3 + 4\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Quite easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.96 sp. gr. (Schmidt.) Insol in alcohol or ether.

**Potassium chromate,  $\text{K}_2\text{CrO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ , etc.**

System.  $\text{K}_2\text{O}$ ,  $\text{CrO}_3$ ,  $\text{H}_2\text{O}$  at  $0^\circ$

100 g of the sat solution contains		Solub phase
g $\text{K}_2\text{O}$	g $\text{CrO}_3$	
31.18		
26.06	0.54	$\text{K}_2\text{CrO}_4$
19.31	4.27	"
17.73	5.50	"
17.06	11.77	"
17.18	11.91	"
17.62	18.71	"
17.63	18.72	"
17.61	18.91	$\text{K}_2\text{CrO}_4 + \text{K}_2\text{Cr}_2\text{O}_7$
17.79	19.10	"
17.80	19.10	"
10.90	11.93	$\text{K}_2\text{Cr}_2\text{O}_7$
8.07	8.93	"
1.87	3.13	"
1.41	3.00	"
1.42	3.01	"
0.97	3.94	"
0.78	22.38	"
1.02	38.83	"
1.26	40.10	"
1.36	40.41	"
1.22	41.70	"

System.  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $0^\circ$ —Continued

100 g. of the sat. solution contain		Solid phase
g $K_2O$	g $CrO_3$	
1.28	41.75	$K_2Cr_2O_7$
1.40	42.10	"
1.23	42.11	"
1.33	42.16	"
1.31	42.28	"
1.38	42.48	"
1.40	42.68	"
1.47	42.93	$K_2Cr_2O_7 + K_2Cr_2O_{10}$
1.47	42.95	"
1.47	43.09	"
1.25	44.52	$K_2Cr_2O_{10}$
1.27	44.95	"
1.18	45.84	"
1.17	46.84	"
1.36	47.22	$K_2Cr_2O_{10} + K_2Cr_2O_{13}$
1.36	47.31	"
1.40	47.67	"
1.24	48.23	$K_2Cr_2O_{13}$
1.35	51.06	"
1.10	53.81	"
1.08	55.63	"
1.16	56.93	"
0.96	57.03	"
1.16	59.46	"
0.91	59.87	"
0.81	60.16	"
0.70	61.76	$K_2Cr_2O_{13} + CrO_3$
0.62	61.77	"
0.57	61.78	"
0.67	61.86	"
	61.51	$CrO_3$
	61.52	"
	61.55	"
	61.57	"

(Koppel and Blumenthal, Z. anorg. 1907, 53, 245.)

System.  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $20^\circ$ 

100 g. of the sat. solution contain		Solid phase
g $K_2O$	g $CrO_3$	
2.21	42.92	$K_2Cr_2O_7 + K_2Cr_2O_{10}$
2.20	43.28	"
2.10	44.02	$K_2Cr_2O_{10}$
2.02	45.28	"
2.01	46.24	"
2.00	48.46	$K_2Cr_2O_{10} + K_2Cr_2O_{13}$
1.94	48.62	$K_2Cr_2O_{13}$
1.62	49.01	"
0.62	62.80	$K_2Cr_2O_{13} + CrO_3$

(Koppel and Blumenthal, Z. anorg. 1907, 53, 243.)

System.  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $30^\circ$ 

100 g. of the sat. solution contain		Solid phase
g $K_2O$	g $CrO_3$	
46.8		KOH, $2H_2O$
26.89	0.94	$K_2CrO_4$
22.25	3.06	"
19.52	6.99	"
18.65	13.72	"
18.60	17.00	"
18.70	17.03	"
19.12	20.30	"
19.35	21.00	$K_2CrO_4 + K_2Cr_2O_7$
15.04	16.85	$K_2Cr_2O_7$
14.77	16.51	"
12.28	14.57	"
11.20	13.11	"
4.98	10.48	"
3.07	19.34	"
2.42	28.21	"
2.35	33.77	"
2.30	36.78	"
2.30	40.41	"
2.50	44.50	$K_2Cr_2O_7 + K_2Cr_2O_{10}$
2.25	49.95	$K_2Cr_2O_{10} + K_2Cr_2O_{13}$
1.35	53.39	$K_2Cr_2O_{13}$
0.60	62.81	$K_2Cr_2O_{13} + CrO_3$
	62.52	$CrO_3$

(Koppel and Blumenthal, Z. anorg. 1907, 53, 235.)

System.  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $60^\circ$ 

100 g. of the sat. solution contain		Solid phase
g $K_2O$	g $CrO_3$	
e. 50.0		KOH, $H_2O$
32.98	0.53	$K_2CrO_4$
21.05	9.15	"
20.70	8.90	"
20.25	14.43	"
20.32	16.56	"
20.67	21.94	"
20.72	22.00	"
20.08	23.49	$K_2CrO_4 + K_2Cr_2O_7$
20.55	23.74	$K_2Cr_2O_7$
14.53	20.82	"
13.36	20.93	"
10.01	21.24	"
10.01	21.24	"
8.39	26.95	"
7.65	31.49	"
7.54	32.92	"
6.86	39.64	"
7.06	49.34	$K_2Cr_2O_7 + K_2Cr_2O_{10}$
6.51	50.40	$K_2Cr_2O_{10}$
5.33	52.70	"
5.49	52.79	"
5.06	53.42	"
5.12	53.58	"
5.30	53.70	"

System.  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $60^\circ$ —Continued

100 g. of the sat. solution contain		Solid phase
g. $K_2O$	g. $CrO_3$	
5.01	54.09	$K_2Cr_2O_7 + K_2Cr_4O_{12}$
4.06	54.73	
3.29	54.91	"
2.95	55.43	
3.01	56.41	"
2.50	58.05	
2.31	58.69	"
2.00	60.69	
2.05	61.25	"
1.70	61.27	
1.79	61.29	"
1.57	62.57	
1.27	65.77	$K_2Cr_4O_{12} + CrO_3$
.	65.12	

(Koppel and Blumenthal, Z. anorg. 1907, 53, 240.)

System.  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at the cryohydrate pt.

Cryohydrate pt.	100 g. of the solution contain		Solid phase
	g. $K_2O$	g. $CrO_3$	
-11.5°	17.18	18.11	$K_2Cr_2O_7 + K_2Cr_4O_{12}$
-30.0°	1.18	42.51	
-39.0°	0.79	45.69	$K_2Cr_2O_7 + K_2Cr_4O_{12}$

(Koppel and Blumenthal, Z. anorg. 1907, 53, 263-5.)

B.-pt. of solutions of  $CrO_3 + K_2O + Aq.$ 

B.-pt.	100 g. of the solution contain		Solid phase
	g. $K_2O$	g. $CrO_3$	
109°	30.01	11.92	$K_2Cr_2O_7$
105.8	23.8	25.3	
106.8	24.3	30.5	$K_2Cr_2O_7 + K_2Cr_4O_{12}$
104.8	16.4	35.0	
114.0	16.8	59.2	$K_2Cr_2O_7 + K_2Cr_4O_{12} + CrO_3$
127.0		71.2	

(Koppel and Blumenthal, Z. anorg. 1907, 53, 255.)

Potassium chromate,  $K_2CrO_4$ Easily sol. in  $H_2O$ .

Sol. in 2 pts.  $H_2O$  at  $18.75^\circ$  (Abt.)  
 100 pts.  $H_2O$  at  $15^\circ$  dissolve 43.857 pts.  $K_2CrO_4$ , and solution has sp. gr. of 1.9032 (Michel and Kraft, A. ch. (3) 41, 478.)

1 pt. dissolves in 2.07 pts.  $H_2O$  at  $15.5^\circ$ . (Thomson.)

1 pt. dissolves in 1.75 pts.  $H_2O$  at  $17.5^\circ$ , and in 1.67 pts.  $H_2O$  at  $100^\circ$  (Moser)

100 pts.  $H_2O$  dissolve at—  
 $0^\circ$  10° 20° 30°  
 58.00 60.92 62.94 64.96 pts.  $K_2CrO_4$ ,

$40^\circ$   $50^\circ$   $60^\circ$   $70^\circ$   
 66.98 69.00 71.02 73.04 pts.  $K_2CrO_4$ ,

$80^\circ$   $90^\circ$   $100^\circ$   
 75.06 77.08 79.10 pts.  $K_2CrO_4$ .

(Allumid, C. R. 59, 500.)

100 pts.  $H_2O$  dissolve at—

$0^\circ$   $10^\circ$   $27.37^\circ$   $42.1^\circ$   
 61.5 62.1 66.3 70.3 pts.  $K_2CrO_4$ ,

$63.6^\circ$   $93.6^\circ$   $106.1^\circ$   
 74.9 79.7 81.8 pts.  $K_2CrO_4$ .

(Nondenskjold and Landstrom, Pogg. 136, 314.)

100 pts.  $K_2CrO_4 + Aq$  sat. at  $10-12^\circ$  contain 37.14 pts. salt. (v. Hauser, J. pr. 103, 114.)

100 pts.  $H_2O$  at  $19.5^\circ$  dissolve 62.3 pts.  $K_2CrO_4$ , and solution has sp. gr. of 1.3787. (Schiff, A. 109, 326.)

Sat.  $K_2CrO_4 + Aq$  contains at—

$34^\circ$   $53^\circ$   $79^\circ$   
 39.7 40.3 41.8%  $K_2CrO_4$ .

$96^\circ$   $120^\circ$   $157^\circ$   
 42.6 44.0 45.4%  $K_2CrO_4$

(Étard, A. ch. 1804, (7) 2, 550.)

100 cc. sat.  $K_2CrO_4 + Aq$  contain 53 g.  $K_2CrO_4$  at  $18^\circ$  (Kohlrausch, B. A. B. 1897, 90.)

100 pts.  $H_2O$  dissolve 64.91 pts.  $K_2CrO_4$  at  $30^\circ$ , or 100 g. of solution contain 39.36 g.  $K_2CrO_4$  (Schrenemakers, Chem. Weekbl. 1905, 1, 837.)

100 g.  $H_2O$  dissolve:

54.57 g.  $K_2CrO_4$  at  $-11.37^\circ$  (cryohydric pt.)  
 57.11 g. " "  $0^\circ$   
 65.13 g. " "  $30^\circ$   
 74.60 g. " "  $60^\circ$   
 88.80 g. " "  $105.8^\circ$  (b-pt. of sat. sol.)

(Koppel, Z. anorg. 1907, 53, 262.)

64.62 g.  $K_2CrO_4$  are sol. in 100 g.  $H_2O$  at  $25^\circ$ . (Amadori, Real Att. Linc. 1912, (5) 21, 1, 667.)

Sp. gr. of  $K_2CrO_4 + Aq$  at 19.5°

% $K_2CrO_4$	Sp. gr.	% $K_2CrO_4$	Sp. gr.	% $K_2CrO_4$	Sp. gr.
1	1.0080	15	1.1287	28	1.2592
2	1.0101	16	1.1380	29	1.2700
3	1.0243	17	1.1474	30	1.2808
4	1.0325	18	1.1570	31	1.2921
5	1.0408	19	1.1667	32	1.3035
6	1.0492	20	1.1765	33	1.3151
7	1.0576	21	1.1864	34	1.3268
8	1.0663	22	1.1964	35	1.3386
9	1.0750	23	1.2066	36	1.3505
10	1.0837	24	1.2169	37	1.3625
11	1.0925	25	1.2274	38	1.3746
12	1.1014	26	1.2379	39	1.3868
13	1.1104	27	1.2485	40	1.3991
14	1.1195				

(Krems, and Schuff, calculated by Gerlach, Z. anal. 8. 288.)

$K_2CrO_4$  dissolved in 2 pts.  $H_2O$  has sp. gr. 1.28; 3 pts., 1.21; 4 pts., 1.18; 5 pts., 1.15; 6 pts., 1.12; 7 pts., 1.11; 8 pts., 1.10 (Moser)

Sp. gr. of sat. solution at 8° = 1.368 (Anthon, 1837.)

Sp. gr. of sat.  $K_2CrO_4 + Aq$  containing 24.26%  $K_2CrO_4$  = 1.2335 at 18°/4° (Slotte, W. Ann. 1881, 14. 18.)

Sp. gr. of  $K_2CrO_4 + Aq$  at 25°

Concentration of $K_2CrO_4 + Aq$	Sp. gr.
1-normal	1.0935
$\frac{1}{2}$ -"	1.0475
$\frac{1}{3}$ -"	1.0241
$\frac{1}{4}$ -"	1.0121

(Wagner, Z. phys. Ch. 1890, 5. 36)

Sat.  $K_2CrO_4 + Aq$  boils at 107° (Krems)

Sat.  $K_2CrO_4 + Aq$  boils at 104.2° under 718 mm. pressure. (Alluard.)

Freezing point of sat.  $K_2CrO_4 + Aq$  = -12.5° (Rudorff)

By dissolving  $K_2CrO_4$  in 2 pts.  $H_2O$ , the temp. is lowered 10° (Mosen.)

100 pts. sat. solution of  $K_2CrO_4$  and  $K_2SO_4$  contain 37.14 pts. of the two salts at 10-12° (v. Hauer, J. pr. 103. 114)

Solubility of  $K_2CrO_4 + K_2SO_4$  in  $H_2O$  at 25° (G per 100 g.  $H_2O$ .)

$K_2CrO_4$	$K_2SO_4$	$K_2CrO_4$	$K_2SO_4$
63.09	0.76	20.83	5.75
61.39	1.17	14.65	7.12
58.40	1.84	7.81	8.98
51.81	2.36	4.36	10.25
40.93	3.33	1.94	10.86
27.36	4.82		

(Amadori, Reul. Att. Lanc. 1912, (5) 21, I. 667)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

100 g. sat. solution in glycol at 15.4° contain 1.7 g.  $K_2CrO_4$ . (de Coninck, C. C. 1905, II 183)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790), ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329, Eidmann, C. C. 1899, II, 1014.)

+4 $H_2O$  Easily sol. in  $H_2O$  and in  $NH_4OH + Aq$  (Wesch, Dissert. 1909.)

Potassium dichromate,  $K_2Cr_2O_7$ .

Sol. in  $H_2O$ , with slight absorption of heat. Less sol. in  $H_2O$  than  $K_2CrO_4$ .

Sol. in 9.6 pts.  $H_2O$  at 17.3° (Thompson)  
10 " " " 18.7° (Moser)

100 pts.  $H_2O$  at 15° dissolve 9.126 pts.  $K_2Cr_2O_7$ , and solution has sp. gr. = 1.0618 (Michel and Krafft, A. ch. (3) 41. 478)

100 pts.  $H_2O$  dissolve pts.  $K_2Cr_2O_7$ . A = according to Alluard (C. R. 59. 500); K = according to Krems (Pogg. 92. 497)

t°	A	K	t°	A	K
0	4.6	4.97	60	45.0	50.5
10	7.4	8.5	70	56.7	
20	12.4	13.1	80	68.6	73.0
30	18.4		90	81.1	
40	25.9	29.1	100	94.1	102.00
50	35.0				

Solubility in  $H_2O$  at high temperatures

100 pts.  $H_2O$  dissolve pts.  $K_2Cr_2O_7$  at t°

t°	Pts. $K_2Cr_2O_7$	t°	Pts. $K_2Cr_2O_7$
117	128.3	148	200.6
129	153.8	180	262.7

(Tilden and Shenstone, Phil. Trans. 1884. 23)

Solubility of  $K_2Cr_2O_7$  in  $H_2O$  at t°

t°	% $K_2Cr_2O_7$	t°	% $K_2Cr_2O_7$
-1	4.1	92	42.8
+1	4.3	97	44.0
6	5.6	104	48.0
7	6.1	120	52.0
12	7.2	130	54.4
15	8.5	150	60.8
20	10.4	157	62.8
29	14.2	178	66.6
36	16.6	215	76.9
57	28.2	291	89.7
61	30.2	312	91.8
65	32.0	360	97.4
70	34.4		

(Etard, A. ch. 1894, (7) 2. 550.)

100 g  $H_2O$  dissolve 10.1 g.  $K_2Cr_2O_7$  at  $15.5^\circ$  (Greenish and Smith, *Pharm. J.* 1901, 66, 774.)

100 pts  $H_2O$  at  $30^\circ$  dissolve 18.12 pts  $K_2Cr_2O_7$ . (Schreinemakers, *Chem. Weekbl.* 1905 1, 837.)

100 g  $H_2O$  dissolve

4.50 g.  $K_2Cr_2O_7$  at  $-0.63^\circ$  (cryohydric pt.)

4.64 g. " "  $0^\circ$

18.13 g. " "  $30^\circ$

45.44 g. " "  $60^\circ$

108.2 g. " "  $104.8^\circ$  (b-pt. of sat. sol.)

(Koppel, *Z. anorg.* 1907, 53, 263)

100 c.c. sat. solution contain 11.43 g  $K_2Cr_2O_7$  at  $20^\circ$  (Sherrill and Eaton, *J. Am. Chem. Soc.* 1907, 29, 1643.)

100 g. sat.  $K_2Cr_2O_7$  contain

5.52 g.  $K_2Cr_2O_7$  at  $4.81^\circ$

15.17 " "  $30.10^\circ$

17.77 " "  $35.33^\circ$

(Le Blanc and Schmandt, *Z. phys. Ch.* 1911, 77, 614)

100 g sat.  $K_2Cr_2O_7 + Aq.$  at  $35.03^\circ$  contains 17.72 g  $K_2Cr_2O_7$ . (Le Blanc, *Z. phys. Ch.* 1913, 86, 335.)

$K_2Cr_2O_7 + Aq$  sat at  $5^\circ$  has sp gr 1.063. (Anthon, 1837)

Sp. gr. of  $K_2Cr_2O_7 + Aq$  at  $19.5^\circ$ .

% $K_2Cr_2O_7$	Sp gr	% $K_2Cr_2O_7$	Sp gr
1	1.007	9	1.065
2	1.015	10	1.073
3	1.022	11	1.080
4	1.030	12	1.085
5	1.037	13	1.097
6	1.043	14	1.102
7	1.050	15	1.110
8	1.058		

(Kremers, calculated by Gerlach, *Z. anal.* 8, 288.)

Sp gr of  $K_2Cr_2O_7 + Aq$  containing 4.71%  $K_2Cr_2O_7 = 1.0325$  at  $11^\circ/4^\circ$ ; containing 6.97%  $K_2Cr_2O_7 = 1.0493$  at  $10.6^\circ/4^\circ$  (Slotte, *W. Ann.* 1881, 14, 18)

Sat.  $K_2Cr_2O_7 + Aq$  boils at  $104^\circ$  (Kremers),  $103.4^\circ$ . (Alluard)

Insol. in alcohol.

Sl. sol. in liquid  $NH_3$ . (Franklin, *Am. Ch.* 1898, 20, 829.)

Insol. in alcohol (Reimutze, *Zeit. angew. Ch.* 1913, 26, 456.)

100 g sat. solution in glycol contain 6 g  $K_2Cr_2O_7$ . (de Coninck, *Bull. acad. roy. Belg.* 1906, 257)

Insol. in benzonitrile. (Naumann, *B.* 1914, 47, 1370.)

Insol. in acetone. (Naumann, *B.* 1904, 37, 4329)

Insol. in acetone and in methylal (Eidmann, *C. C.* 1899, II, 1014.)

**Potassium trichromate,  $K_2Cr_2O_{10}$**

Easily sol. in  $H_2O$  and alcohol (Bothe, *J.* pr 46, 184.)

Not deliquescent, decomp. by  $H_2O$  in chromic acid and  $K_2Cr_2O_7$ . (Jager and Kruss, *B.* 22, 2041)

**Potassium tetrachromate,  $K_2Cr_4O_{14}$**

Very deliquescent, and easily sol. in  $H_2O$  (Schwarz, *Dingl.* 186, 31)

Not deliquescent. Decomp. by  $H_2O$  (Jager and Kruss, *B.* 22, 2042)

**Potassium samarium chromate,**

$K_2Sm_2(CrO_4)_4 + 6H_2O$ .

Precipitate (Cleve.)

Insol. in ethyl acetate (Naumann, *B.* 1904, 37, 3601)

**Potassium sodium chromate,  $3K_2CrO_4$ ,  $Na_2CrO_4$**

Sol. in  $H_2O$ . (v. Hauer, *J.* pr. 83, 359.)

64.2 pts. are sol. in 100 pts  $H_2O$  at  $14^\circ$  (Zehenter, *M.* 1897, 18, 49)

**Potassium strontium chromate,  $K_2Sr(CrO_4)_2$**

Ppt. Decomp. by  $H_2O$ . (Günger, *Z. anorg.* 1907, 54, 187)

Decomp. by  $H_2O$  Stable in contact with solutions containing

at  $11.5^\circ$ , 2.914 pts  $K_2CrO_4$  per 100 pts  $H_2O$ .

at  $27.5^\circ$ , 4.123 " " " " " "

at  $50^\circ$ , 5.942 " " " " " "

at  $76^\circ$ , 7.920 " " " " " "

at  $100^\circ$ , 9.784 " " " " " "

(Barre, *C. R.* 1914, 158, 496.)

**Potassium thallium chromate,  $K_2CrO_4$ ,  $Tl_2CrO_4$**

(Lachaud and Lepierre, *Bull. Soc.* (3) 6, 232.)

+  $2H_2O$  Rapidly hydrolyzed by  $H_2O$  unless a large excess of the  $CrO_4$  ion is present.

Readily sol. in dl. mineral acids

Difficultly sol. in  $K_2Cr_2O_7 + Aq.$  (Hawley, *J. Am. Chem. Soc.* 1907, 29, 304.)

**Potassium uranyl chromate,  $K_2CrO_4$ ,  $2(UO_2)CrO_4 + 6H_2O$**

Decomp. by boiling with  $H_2O$  Sol. in acidified  $H_2O$  (Formánek, *A.* 257, 103)

$K_2CrO_4$ ,  $(UO_2)CrO_4 + H_2O$ ;  $2K_2CrO_4$ ,  $3(UO_2)CrO_4 + 7H_2O$ ;  $3K_2CrO_4$ ,  $4(UO_2)CrO_4 + 7H_2O$ ; and  $K_2CrO_4$ ,  $3(UO_2)CrO_4 + 14H_2O$ .

Precipitates (Wiesner, *C. C.* 1882, 777.)

**Potassium ytterbium chromate, basic,**

$2KYb(CrO_4)_3 + Yb(OH)_3 + 15\frac{1}{2}H_2O$ .

Ppt (Cleve, *Z. anorg.* 1902, 32, 151.)

**Potassium yttrium chromate,  $K_2CrO_4$ ,**

Ppt (Cleve)

**Potassium zinc chromate, basic,  $K_2O, 5ZnO,$   
 $4CrO_3 + 6H_2O$ , or  $K_2O, 4ZnO, 3CrO_3$   
 $+ 3H_2O$** Slightly sol. in cold, decomp. by hot  $H_2O$  (Wöhler.) $K_2O, 4ZnO, 3CrO_3 + 3H_2O$ . Insol in cold, decomp. by hot  $H_2O$  (Gröger, M 1904, 25. 520.)**Potassium zinc chromate,  $K_2Zn(CrO_4)_2 + 2H_2O$ .**Ppt. Decomp. by  $H_2O$  (Gröger, Z. anorg. 1907, 54. 189.)**Potassium dichromate chloride mercuric chloride,  $K_2Cr_2O_7, 2KCl, 4HgCl_2 + 2H_2O$ .**Solution in  $H_2O$  sat. at  $20.5^\circ$  contains 6.78% salt. Salt is much more sol in hot  $H_2O$ . (Strömholm, Z anorg 1912, 75. 278.)**Potassium chromate iodate.**

See Chromiodate, potassium.

**Potassium chromate magnesium sulphate,  $K_2CrO_4, MgSO_4 + 9H_2O$ .**Sol in  $H_2O$ . (Étard, C. R. 85. 443.)**Potassium chromate mercuric chloride,  $K_2Cr_2O_7, 2HgCl_2$ .**Easily sol in  $H_2O$ . Sol in dil  $HCl + Aq$ . (Darby)**Potassium dichromate mercuric chloride,  $K_2Cr_2O_7, HgCl_2$ .**Ether or absolute alcohol dissolves out  $HgCl_2$ . (Millon, A. ch. (3) 18. 388.)Can be crystallized from  $H_2O$ . (Jäger and Kruss, B. 22. 2046.)**Potassium chromate mercuric cyanide,  $2K_2CrO_4, 3Hg(CN)_2$ .**Easily sol. in  $H_2O$ . $+ H_2O$ . (Dexter)Formula is  $K_2CrO_4, 2Hg(CN)_2$  (Clarke and Sterne, Am. Ch. J. 3. 352.)**Potassium dichromate mercuric cyanide,  $K_2Cr_2O_7, Hg(CN)_2 + 2H_2O$ .**Sol in  $H_2O$  (Wyrouboff, J. B. 1880. 309)**Potassium chromate phosphate.**

See Phosphochromate, potassium.

**Potassium chromate sulphate,  $K_2CrO_4,$   
 $6K_2SO_4$ .**Easily sol. in  $H_2O$ . (Boutron-Chalard.)**Potassium chromate tellurate.**

See Chromotellurate, potassium.

**Rubidium chromate,  $Rb_2CrO_4$ .**Sol. in  $H_2O$ . (Piccard, J. pr. 86. 455.)**Solubility in  $H_2O$  at  $t^\circ$** 

$t^\circ$	% $Rb_2CrO_4$
— 7	36.65
0	38.27
10.3	40.22
20	42.42
30	44.11
40	46.13
50	47.44
60.4	48.90

(Schreinemakers and Filippo, Chem. Weekbl. 1906, 3. 157.)

**Rubidium dichromate,  $Rb_2Cr_2O_7$** Sol. in  $H_2O$ . (Grandeau, A. ch. (3) 87. 227.)Very sl. sol in  $H_2O$ ; 5% at  $10^\circ$ , 8% at  $26^\circ$ , 35% at  $60^\circ$ . (Wyrouboff, Bull. Soc. Min. 1881, 4. 129.)100 pts.  $H_2O$  dissolve 10.46 pts.  $Rb_2Cr_2O_7$  at  $30^\circ$ . The solution contains 9.47% salt (Schreinemakers and Filippo, Chem. Weekbl. 1906, 3. 157.)Two forms of crystals. Figures denote pts. salt per 100 pts.  $H_2O$ .

$t^\circ$	$14^\circ$	$26^\circ$	$43^\circ$
Monoclinic form	4.45	8.00	16.52
Triclinic form	4.40	7.91	16.57

(Wyrouboff, Bull. Soc. 1908, (4) 3. 7.)

**Solubility of monoclinic and triclinic forms**

Temp	Pts. of salt in 100 pts. $H_2O$		Temp	Pts. of salt in 100 pts. $H_2O$	
	Mono-clinic	Tri-clinic		Mono-clinic	Tri-clinic
$18^\circ$	5.42	4.96	$40^\circ$	13.22	12.90
$24^\circ$	6.94	6.55	$50^\circ$	18.94	18.77
$30^\circ$	9.08	8.70	$60^\circ$	28.1	27.3

(Stortenbeker, C. C. 1907, II 1588)

**Rubidium dichromate chloride mercuric chloride,  $Rb_2Cr_2O_7, 2RbCl, 4HgCl_2 + 2H_2O$ .**Sol. in  $H_2O$ .Solution sat. at  $20.5^\circ$  contains 5.35% salt. (Strömholm, Z. anorg. 1912, 75. 284.)**Silver (argentous) chromate,  $Ag_2CrO_4$ .**

Sol. in dil. acids. (Wöhler and Rautenberg.)

Existence very doubtful.

**Silver chromate,  $Ag_2CrO_4$ .**Absolutely insol. in  $H_2O$ . Sol. in acids, ammonia, and alkali chromates + Aq. (Warrington, A. 27. 12.)Appreciably sol in cold, and still more in hot  $H_2O$ . (Meineke, A. 261. 341.)100 cc.  $H_2O$  dissolve 0.064 grain  $Ag_2CrO_4$  at  $100^\circ$ ; 100 cc.  $H_2O$  containing 50 grains

of the following salts dissolve the given amts. of  $\text{Ag}_2\text{CrO}_4$  at  $100^\circ$ :  $\text{NaNO}_3$ , 0.064 gram;  $\text{KNO}_3$ , 0.192 gram;  $\text{NH}_4\text{NO}_3$ , 0.320 gram;  $\text{Mg}(\text{NO}_3)_2$ , 0.256 grain (Carpenter, J. S. C. I. 5. 280)

According to electrical conductivity of  $\text{Ag}_2\text{CrO}_4 + \text{Aq}$ , 1 l  $\text{H}_2\text{O}$  dissolves 28 mg  $\text{Ag}_2\text{CrO}_4$  at  $18^\circ$  (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

1 l  $\text{H}_2\text{O}$  dissolves 25 mg  $\text{Ag}_2\text{CrO}_4$  at  $18^\circ$  (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

25 mg. are contained in 1 l. of sat. solution at  $18^\circ$ . Solubility increases unusually rapidly with temp. (Kohlrausch, Z. phys. Ch. 1906, 64. 168.)

Sol. in 26,378 pts. cold  $\text{H}_2\text{O}$  and 9116 pts.  $\text{H}_2\text{O}$  at  $100^\circ$  (Koninck and Nihoul, Zett. angew. Ch. 1891, 5. 295.)

1 l  $\text{H}_2\text{O}$  dissolves  $1.2 \times 10^{-4}$  gram atoms of silver at  $25^\circ$  (Abegg and Cox, Z. phys. Ch. 1903, 48. 11.)

1 l  $\text{H}_2\text{O}$  dissolves 0.029 g.  $\text{Ag}_2\text{CrO}_4$  at  $25^\circ$  (Schafer, Z. anorg. 1905, 46. 310.)

1 l  $\text{H}_2\text{O}$  dissolves 0.0256 g.  $\text{Ag}_2\text{CrO}_4$  at  $15^\circ$ ; 0.0341 g. at  $27^\circ$ ; 0.0534 g. at  $50^\circ$ . (Whitby, Z. anorg. 1910, 67. 108.)

Sol. in hot  $\text{NH}_4\text{OH} + \text{Aq}$  of sp. gr. 0.94 (15.63%  $\text{NH}_3$ ); sl. sol. in cold  $\text{NH}_4\text{OH} + \text{Aq}$  of sp. gr. 0.91 (24.99%  $\text{NH}_3$ ). (Margosches, Z. anorg. 1904, 41. 73.)

Solubility of  $\text{Ag}_2\text{CrO}_4$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$

Mols $\text{NH}_4\text{OH}$ per l	Mols $\times 10^3$ $\text{Ag}_2\text{CrO}_4$ per l
0.01	2.004
0.02	4.169
0.04	8.595
0.08	17.58

(Sherrill and Russ, J. Am. Chem. Soc. 1907, 29. 1662.)

Sl. sol. in very conc.  $\text{K}_2\text{CrO}_4 + \text{Aq}$ . Practically insol. in  $\text{AgNO}_3 + \text{Aq}$  (Margosches.)

Solubility of  $\text{Ag}_2\text{CrO}_4$  in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$

Mols. $\text{HNO}_3$ per l	Milliat. per l		Solid Phase
	Cr	Ag	
0.01	3.157	6.315	$\text{Ag}_2\text{CrO}_4$
0.015	3.730	"	"
0.02	4.177	8.356	"
0.025	4.567	"	"
0.03	5.200	"	"
0.04	5.803	11.62	"
0.05	6.380	"	"
0.06	6.833	"	"
0.07	7.333	"	"
0.075	7.477	14.85	$+ \text{Ag}_2\text{Cr}_2\text{O}_7$
0.08	7.260	15.45	"
0.10	5.647	19.01	"
0.13	4.293	23.89	"
0.14	3.948	25.63	"

(Sherrill and Russ, J. Am. Chem. Soc. 1907, 29. 1663.)

Insol. in liquid  $\text{NH}_3$  (Gore, Am. Ch. J. 1898, 20. 829.)

11.65% alcohol dissolves 0.0129 g.  $\text{Ag}_2\text{CrO}_4$  at ord. temp. (Guerini, Dissert. 1912.)

Insol. in  $\text{H}_2\text{O}$  containing acetic acid in presence of large excess of  $\text{AgNO}_3$  (Gooch and Weed, Am. J. Sci. 1908, (4) 26. 85.)

Practically insol. in glacial acetic acid but somewhat sol. in dil. acetic acid. It behaves in a similar manner toward propionic, lactic and other organic acids. The red modification is more sol. than the greenish-black. (Margosches, Z. anorg. 1906, 51. 233.)

Silver dichromate,  $\text{Ag}_2\text{Cr}_2\text{O}_7$

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  (Warrington.)

Decomp. by boiling with  $\text{H}_2\text{O}$  into  $\text{CrO}_3$  and  $\text{Ag}_2\text{CrO}_4$ . (Jäger and Krüss, B. 22. 2050.)

Decomp. by cold  $\text{H}_2\text{O}$ . (Autenrieth, B. 1902, 35. 2061.)

1 pt is sol. in 12,000 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Mayer, B. 1903, 36. 1741.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 7.3 \times 10^{-3}$  atoms  $\text{Ag}$  per l. Decomp. by  $\text{HNO}_3 + \text{Aq}$  (less than 0.06 N) with separation of  $\text{Ag}_2\text{CrO}_4$ . (Sherrill and Russ, J. Am. Chem. Soc. 1907, 29. 1674.)

Solubility of  $\text{Ag}_2\text{Cr}_2\text{O}_7$  in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$

Mols $\text{HNO}_3$ per l	Milliat. per l		Solid Phase
	Cr	Ag	
0	32.20	5.390	$\text{Ag}_2\text{CrO}_4 + \text{Ag}_2\text{Cr}_2\text{O}_7$
0.01	25.06	6.131	"
0.02	20.21	7.148	"
0.04	13.59	9.529	"
0.06	11.10	11.10	$\text{Ag}_2\text{Cr}_2\text{O}_7$
0.08	11.10	11.10	"
0.08 + 0.1 $\text{AgNO}_3$	6.624	"	"

(Sherrill and Russ, J. Am. Chem. Soc. 1907, 29. 1664.)

Silver uranyl chromate,  $2\text{Ag}_2\text{CrO}_4 \cdot \text{UO}_2\text{CrO}_4$

Ppt. (Formánek, A. 257. 110.)

Silver chromate ammonia,  $\text{Ag}_2\text{CrO}_4 \cdot 4\text{NH}_3$

Decomp. by  $\text{H}_2\text{O}$ . Sol. in warm conc.  $\text{NH}_4\text{OH} + \text{Aq}$  (Mitscherlich, Pogg. 12. 141.)

Silver dichromate mercuric cyanide,

$\text{Ag}_2\text{Cr}_2\text{O}_7 \cdot \text{Hg}(\text{CN})_2$

Sol. in cold  $\text{H}_2\text{O}$ ; very sol. in hot  $\text{H}_2\text{O}$  without decomp. (Krüss, Z. anorg. 1895, 8. 456.)

$\text{Ag}_2\text{Cr}_2\text{O}_7 \cdot 2\text{Hg}(\text{CN})_2$  Scarcely sol. in cold, more readily in hot  $\text{H}_2\text{O}$ . Sol. in hot  $\text{HNO}_3 + \text{Aq}$ , separating on cooling. (Darby, Chem. Soc. L. 24.)

Sodium chromate, basic,  $\text{Na}_4\text{Cr}_2\text{O}_7 \cdot 13\text{H}_2\text{O}$

Sol. without decomp. in  $\text{H}_2\text{O}$ .

Sat. solution at  $30^\circ$  contains 41.3%

$\text{Na}_2\text{Cr}_2\text{O}_7$  (Schreinemakers, Z. phys. Ch. 1906, 55. 93.)

Deliquescent.  
Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	0°	10°	20.5°
% $\text{Na}_2\text{Cr}_2\text{O}_7$	33.87	35.58	38.05
$t^\circ$	27.7°	35°	37°
% $\text{Na}_2\text{Cr}_2\text{O}_7$	40.09	44.09	45.13

(Mylius and Funk, Gm.-K. 3. I, 1379.)

$\text{Na}_2\text{Cr}_2\text{O}_7 + \text{Aq}$  sat. at  $18^\circ$  contains 37.50%  $\text{Na}_2\text{Cr}_2\text{O}_7$  and has sp. gr. = 1.446. (Mylius and Funk, B. 1900, 33. 3688.)

Sodium chromate,  $\text{Na}_2\text{CrO}_4$

100 ccm of solution sat. at  $18^\circ$  contain 54 g  $\text{Na}_2\text{CrO}_4$  (Kohlrausch, B. A. B. 1897. 90.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% $\text{Na}_2\text{CrO}_4$
70	55.15
80	55.53
100	55.74

(Mylius and Funk, Gm.-K. 3. I, 1379.)

$\text{Na}_2\text{CrO}_4 + \text{Aq}$  sat. at  $18^\circ$  contains 40.10%  $\text{Na}_2\text{CrO}_4$  and has sp. gr. = 1.432. (Mylius and Funk, B. 1900, 33. 3686.)

See also +4, 6, and  $10\text{H}_2\text{O}$ .

Sp. gr. of  $\text{Na}_2\text{CrO}_4 + \text{Aq}$  at  $t^\circ/4^\circ$ .

$t^\circ$	17.4°	17.1°	20.7°
% $\text{Na}_2\text{CrO}_4$	5.76	10.62	14.81
Sp. gr.	1.0576	1.1125	1.1644

(Slotte, W. Ann. 1881, 14. 18.)

+4 $\text{H}_2\text{O}$ . Sat. solution at  $30^\circ$  contains 46.62%  $\text{Na}_2\text{CrO}_4$ . (Schreinemakers, Z. phys. Ch. 1906, 55. 93.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% $\text{Na}_2\text{CrO}_4$	$t^\circ$	% $\text{Na}_2\text{CrO}_4$
25.6	46.08	49.5	50.93
31.5	47.05	54.5	52.28
36	47.98	59.5	53.39
40	48.97	65	55.23
45	50.20		

(Mylius and Funk, Gm.-K. 3. I, 1379.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{CrO}_4$	Mols $\text{H}_2\text{O}$ to 1 mol anhydrous salt	Mols anhydrous salt to 100 mols. $\text{H}_2\text{O}$
28.9	46.47	10.37	9.64
29.7	46.54	10.34	9.67
31.2	47.08	10.12	9.88

(Salkowski, B. 1901, 34. 1948.)

+6 $\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{Cr}_2\text{O}_7$	Mols $\text{H}_2\text{O}$ to 1 mol anhydrous salt	Mols anhydrous salt to 100 mols $\text{H}_2\text{O}$
17.7	43.65	11.60	8.62
19.2	44.12	11.40	8.77
21.2	44.64	11.16	8.96
23.2	45.27	10.88	9.19
24.7	45.75	10.77	9.37
26.6	46.28	10.45	9.57

(Salkowski, B. 1901, 34. 1948.)

+10 $\text{H}_2\text{O}$ . Deliquescent (Kopp, A. 42. 99.) Easily sol in  $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at  $23^\circ$  (Berthelot.)

Sp. gr. of solution sat. at  $18^\circ$  = 1.409, and contains 38.1%  $\text{Na}_2\text{Cr}_2\text{O}_7$  (Mylius and Funk, B. 1897, 30. 1718.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% $\text{Na}_2\text{Cr}_2\text{O}_7$
0	24.04
10	33.41
18.5	41.65
19.5	44.78
21	47.40

(Mylius and Funk, Gm.-K. 3. I, 1379.)

Sp. gr. of solution at  $18^\circ$  containing 40.1%  $\text{Na}_2\text{Cr}_2\text{O}_7$  = 1.432 (Mylius, B. 1900, 33. 3688.)

Sl. sol in alcohol. (Moser.)

100 g absolute methyl alcohol dissolve 0.345 g  $\text{Na}_2\text{Cr}_2\text{O}_7$  at  $25^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Sodium dichromate,  $\text{Na}_2\text{Cr}_2\text{O}_7$

More sol. in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{CrO}_4$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{Cr}_2\text{O}_7$
93°	81.19
98°	81.25

(Mylius and Funk, Gm.-K. 3. I, 1380.)

Sp. gr. of aqueous solution containing—  
1 5 10 15 20 25%  $\text{Na}_2\text{Cr}_2\text{O}_7$ ,  
1.007 1.035 1.071 1.105 1.141 1.171

30 35 40 45 50 %  $\text{Na}_2\text{Cr}_2\text{O}_7$ ,  
1.208 1.245 1.280 1.313 1.343

(Stanley, C. N. 54. 194.)

Sp. gr. of sat. solution containing 63.92%  $\text{Na}_2\text{Cr}_2\text{O}_7$  at  $18^\circ$  = 1.745 (Mylius and Funk, B. 1900, 33. 3688.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sol. in acetone (Naumann, B. 1904, 37, 4328.)  
+2H<sub>2</sub>O. Deliquescent.

100 pts H<sub>2</sub>O dissolve at—  
0° 15° 30° 80° 100° 139°  
107 2 109.2 116 6 142 8 162 8 209 7 pts. salt  
(Stanley, C N 54. 194)

Solubility in H<sub>2</sub>O at t°

t°	% Na <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>
0	61.98
17	63.82
34 5	67.36
52	71.76
72	76.90
81	79.80

(Mylius and Funk, Gm.-K. 3. I, 1380)

100 g. H<sub>2</sub>O at 30° dissolve 197.6 g Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, or sat. solution at 30° contains 66.4% Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> (Schreinemakers, Z. phys. Ch 1900, 55. 97.)

100 ccm. of a solution of sodium dichromate in alcohol contain 5.133 g Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> + 2H<sub>2</sub>O at 19.4°. The solution decomp. rapidly. (Reimtsma, Zeit. angew. Ch 1913, 26. 456)

The composition of the hydrates formed by Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> at different dilutions is calculated from determinations of the lowering of the fr = pt. produced by Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> and of the conductivity and sp. gr. of Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> + Aq. (Jones, Am. ch. J. 1905, 34. 317)

#### Sodium trichromate, NaCr<sub>2</sub>O<sub>10</sub>

Deliquescent Very sol. in H<sub>2</sub>O (Stanley, C N 54. 194.)  
+H<sub>2</sub>O Sat. solution at 30° contains 80% Na<sub>2</sub>Cr<sub>2</sub>O<sub>10</sub>. (Schreinemakers, Z. phys. Ch 1906, 55. 94.)

Solubility in H<sub>2</sub>O at t°.

t°	0°	15°	55°	99°
% Na <sub>2</sub> Cr <sub>2</sub> O <sub>10</sub>	80.03	80.44	82.68	85.78

(Mylius and Funk, Gm.-K. 3. I, 1380.)

Sp. gr. of sat. solution containing 80.6% Na<sub>2</sub>Cr<sub>2</sub>O<sub>10</sub> at 18° = 2.059 (Mylius and Funk, B. 1900, 33. 3688)

#### Sodium tetrachromate, Na<sub>2</sub>Cr<sub>4</sub>O<sub>13</sub> + 4H<sub>2</sub>O.

Solubility in H<sub>2</sub>O at t°

t°	0°	16°	22°
% Na <sub>2</sub> Cr <sub>4</sub> O <sub>13</sub>	72.19	74.19	76.01

(Mylius and Funk, Gm.-K. 3. I, 1380.)

Deliquescent.

Sat. solution at 18° contains 74.6% Na<sub>2</sub>Cr<sub>4</sub>O<sub>13</sub> and has sp. gr. = 1.926 (Mylius and Funk, B. 1900, 33. 3688)

#### Sodium uranyl chromate, Na<sub>2</sub>CrO<sub>4</sub>.

2(UO<sub>2</sub>)CrO<sub>4</sub> + 10H<sub>2</sub>O  
Easily sol in H<sub>2</sub>O (Fornáček, A 257 108.)

100 pts of the solution in H<sub>2</sub>O contain 52.52 pts of the anhydrous salt at 20° (Rimbach, B. 1901, 37. 482)

#### Sodium chromate silicate, Na<sub>2</sub>O, Cr<sub>2</sub>O<sub>3</sub>, 2SiO<sub>2</sub> + 14H<sub>2</sub>O.

Not decomp. by HCl + Aq (Singer, Dissert 1910.)

2Na<sub>2</sub>O, 3Cr<sub>2</sub>O<sub>3</sub>, 6SiO<sub>2</sub>. Not decomp by boiling conc. acids except HF (Weyberg, C B Miner, 1908. 519.)

5Na<sub>2</sub>O, 2Cr<sub>2</sub>O<sub>3</sub>, 11SiO<sub>2</sub>. (Weyberg)  
3Na<sub>2</sub>O, 2Cr<sub>2</sub>O<sub>3</sub>, 9.5SiO<sub>2</sub>. (Weyberg)

#### Strontium chromate, SrCrO<sub>4</sub>

Somewhat sol. in H<sub>2</sub>O. Sol in 840 pts. H<sub>2</sub>O (Meschevski, Z. anal. 21. 399); sol. in 831.8 pts H<sub>2</sub>O at 15° (Fresenius, Z. anal. 29. 419)

100 cc H<sub>2</sub>O dissolve 0.4651% at 10°, 1% at 20°; 2.417% at 50°, 3% at 100° (Reichard, Ch. Z. 1903, 27. 877)

Easily sol in HCl, HNO<sub>3</sub>, or H<sub>2</sub>CrO<sub>4</sub> + Aq  
Sol. in 512 pts 0.5% NH<sub>4</sub>Cl + Aq at 15°  
Sol. in 637 pts. 1% HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq at 15°  
Sol. in 348.8 pts. solution containing 0.75% NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, 4 drops HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, and 6 drops (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq (Fresenius)

100 ccm NH<sub>4</sub>Cl + Aq sat at bpt. dissolve 1 g SrCrO<sub>4</sub> (Dumesnil, A. ch 1900, (7) 20. 125.)

50 ccm alcohol (29%) dissolve 0.0066 g SrCrO<sub>4</sub>.

50 ccm alcohol (53%) dissolve 0.001 g SrCrO<sub>4</sub>. (Fresenius, Z. anal 30. 672)

#### Strontium dichromate, SrCr<sub>2</sub>O<sub>7</sub>

Easily sol. in H<sub>2</sub>O.

#### Strontium trichromate, SrCr<sub>3</sub>O<sub>10</sub> + 3H<sub>2</sub>O

Very deliquescent, and sol in H<sub>2</sub>O. (Preis and Raymann, B. 13. 340.)

#### Strontium chromate mercuric hydrogen chloride, SrCrO<sub>4</sub> 2HgCl<sub>2</sub>, HCl.

According to Strömholm is SrCl<sub>2</sub>, SrCr<sub>2</sub>O<sub>7</sub>, 4HgCl<sub>2</sub> + H<sub>2</sub>O

Recryst from H<sub>2</sub>O. (Imbert and Belugon, Bull. Soc., 1897, (3) 17. 471)

2SrCrO<sub>4</sub>, 6HgCl<sub>2</sub>, HCl. (Imbert and Belugon.)

#### Thalious chromate, TiCrO<sub>4</sub>

100 pts. H<sub>2</sub>O dissolve 0.03 pt at 60°. (Rupp and Zimmer, Z. anorg. 1902, 33. 157)

Ppt. Insol. in cold moderately conc. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq, or in very dil. HNO<sub>3</sub> + Aq, and very sl. sol on boiling therewith. Dil. NH<sub>4</sub>OH, and Na<sub>2</sub>CO<sub>3</sub> + Aq have the same action. Attacked by very dil. HCl + Aq  
Sol. in hot conc. HCl + Aq. Decomp by dil. H<sub>2</sub>SO<sub>4</sub> + Aq (Carstanjen)

11 KOH + Aq (112 g per l) dissolves about 3.5 g  $\text{Ti}_2\text{CrO}_4$  on boiling, which separates out on cooling

Boiling conc. KOH + Aq (31% KOH) dissolves 18 g.  $\text{Ti}_2\text{CrO}_4$  per litre. (Lepetit and Lachaud, C R 113. 196)

**Thalious dichromate,  $\text{Ti}_2\text{Cr}_2\text{O}_7$**

Insol. in  $\text{H}_2\text{O}$ , etc Has the same properties as  $\text{Ti}_2\text{CrO}_4$

**Thalious trichromate,  $\text{Ti}_2\text{Cr}_3\text{O}_{10}$**

Sol. in 2814 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 438 7 pts. at  $100^\circ$  (Crookes.)

**Thallic chromate.**

Ppt.

**Thorium chromate, basic,  $\text{Th}(\text{OH})_2\text{CrO}_4$**

Ppt., unstable in solution (Palmer, Am Ch. J. 1895, 17. 278.)

**Thorium chromate,  $\text{Th}(\text{CrO}_4)_2 + \text{H}_2\text{O}$**

Ppt. Sol. in HCl and  $\text{NH}_4\text{Cl} + \text{Aq}$ . 1 pt. is sol. in 284 pts.  $\text{H}_2\text{O}$  at  $22^\circ$  (Palmer, Am Ch. J. 1895, 17. 375 and 378)

+  $3\text{H}_2\text{O}$  Ppt (Haber, M. 1897, 18. 689.)

+  $8\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  (Chydenius, Pogg 119. 54)

**Tin (stannous) chromate.**

Ppt Sol. in dil. acids (Berzelius)

**Tin (stannic) chromate.**

Ppt (Leykauf, J. pr 19. 127.)

**Uranyl chromate, basic,  $\text{UO}_3 \cdot 2(\text{UO}_3)_2\text{CrO}_4 + 8\text{H}_2\text{O}$**

Ppt (Orloff, Ch. Z 1907, 31. 375)

$\text{UO}_3 \cdot (\text{UO}_3)_2\text{CrO}_4 + 6\text{H}_2\text{O}$  (Orloff.)

**Uranyl chromate,  $(\text{UO}_2)_2\text{CrO}_4 + 3\text{H}_2\text{O}$**

1 pt. is sol in 13 3 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ ; slowly sol. in alcohol to give a solution which is decomp on boiling (Orloff, Ch. Z. 1907, 31. 375.)

+  $11\text{H}_2\text{O}$  Very sol. in  $\text{H}_2\text{O}$  (Formánek, A. 257. 108)

**Yttrium chromate.**

Deliquescent Easily sol. in  $\text{H}_2\text{O}$  (Berlin.)

**Zinc chromate, basic,  $4\text{ZnO} \cdot \text{CrO}_3 + 3\text{H}_2\text{O}$**

(Gröger, Z. anorg 1911, 70. 135)

+  $5\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ ; sol. in hot  $\text{H}_2\text{CrO}_4 + \text{Aq}$ , slowly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Malaguti and Sarzeau, A. ch. (3) 9. 431.)

$3\text{ZnO} \cdot \text{CrO}_3 + 2\text{H}_2\text{O}$  (Gröger)

$2\text{ZnO} \cdot \text{CrO}_3 + \text{H}_2\text{O}$ . (Briggs, Z. anorg. 1907, 56. 254.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . Ppt. Insol. in  $\text{H}_2\text{O}$  Sol. in hot  $\text{H}_2\text{CrO}_4 + \text{Aq}$ . (Prussen and Philippon, A 149. 92.)

+  $2\text{H}_2\text{O}$ . Ppt. Not wholly insol. in  $\text{H}_2\text{O}$ . (Prussen and Philippon.)

$3\text{ZnO} \cdot 2\text{CrO}_3 + \text{H}_2\text{O}$  (Gröger)

**Zinc chromate,  $\text{ZnCrO}_4$**

Insol in  $\text{H}_2\text{O}$ ; very sol. in acids; decomp. by boiling with  $\text{H}_2\text{O}$ . (Schulze, Z anorg. 1895, 10. 154.)

Insol in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J 1898, 20. 830.)

Insol. in acetone. (Naumann, B 1904, 27. 4329.)

+  $\text{H}_2\text{O}$  (Gröger, Z. anorg 1911, 70. 135.)

**Zinc dichromate,  $\text{ZnCr}_2\text{O}_7 + 3\text{H}_2\text{O}$**

Hygroscopic.

Very sol. in  $\text{H}_2\text{O}$  and sl. decomp. by boiling. (Schulze, Z anorg. 1895, 10. 153)

**Zinc trichromate,  $\text{ZnCr}_3\text{O}_{10} + 3\text{H}_2\text{O}$**

Deliquescent, very sol. in  $\text{H}_2\text{O}$ . (Gröger, Z. anorg 1910, 66. 10.)

**Zinc chromate ammonia,  $\text{ZnCrO}_4 \cdot \text{NH}_3 + \text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$ . (Gröger, Z anorg. 1908, 58. 417.)

$\text{ZnCrO}_4 \cdot 4\text{NH}_3 + 5\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in alcohol and ether (Malaguti and Sarzeau, A ch (3) 9. 431.)

+  $3\text{H}_2\text{O}$ . Efflorescent. Decomp by  $\text{H}_2\text{O}$ . Easily sol in dil. acids and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Bieler, A 151. 223)

$2\text{ZnO} \cdot 3\text{CrO}_3 \cdot 10\text{NH}_3 + 10\text{H}_2\text{O}$  Ppt. (Malaguti and Sarzeau.)

**Zinc dichromate mercuric cyanide,  $\text{ZnCr}_2\text{O}_7 \cdot 2\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$**

Very sol. in  $\text{H}_2\text{O}$ . Stable in aqueous solution at  $100^\circ$ . (Krus, Z. anorg 1895, 8. 460.)

**Perchromic acid**

See Perchromic acid.

**Chromicomolybdic acid,  $\text{Cr}_2\text{O}_3 \cdot 12\text{MoO}_3 + 28\text{H}_2\text{O}$**

Slowly sol in  $\text{H}_2\text{O}$  (Hall, J. Am. Chem. Soc 1907, 29. 708.)

**Ammonium chromicomolybdate,  $3(\text{NH}_4)_2\text{O} \cdot \text{Cr}_2\text{O}_3 \cdot 12\text{MoO}_3 + 20\text{H}_2\text{O}$**

Sol. in  $\text{H}_2\text{O}$ . (Struve, J. pr 61. 457; Hall, J. Am. Chem. Soc. 1907, 29. 695.)

+  $26\text{H}_2\text{O}$ . (Marckwald, Dissert, 1895.)

**Ammonium barium chromicomolybdate,  $(\text{NH}_4)_2\text{O} \cdot 22\text{BaO} \cdot \text{Cr}_2\text{O}_3 \cdot 12\text{MoO}_3 + 20\text{H}_2\text{O}$**

(Hall, J. Am Chem. Soc 1907, 29. 707.)

**Barium chromicomolybdate**,  $4\text{BaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 15\text{H}_2\text{O}$ ,  $4\text{BaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 18\text{H}_2\text{O}$ ;  $5\text{BaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 16\text{H}_2\text{O}$ .

Ppts. (Hall, J. Am. Chem. Soc. 1907, 29, 705.)

**Lead chromicomolybdate**,  $4\text{PbO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 22\text{H}_2\text{O}$ , and  $+24\text{H}_2\text{O}$ .

Ppts. (Hall, J. Am. Chem. Soc. 1907, 29, 708.)

**Mercurous chromicomolybdate**,  $8\text{Hg}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 16\text{H}_2\text{O}$ .

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29, 707.)

**Potassium chromicomolybdate**,  $\text{K}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $3\text{MoO}_3$ .

Sol. in  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$ . (Bradbury, Z. anorg. 1894, 7, 46.)

$3\text{K}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 20\text{H}_2\text{O}$  Sol. in 38.51 pts  $\text{H}_2\text{O}$  at  $17^\circ$ . (Strüve; Hall)  $+24\text{H}_2\text{O}$ . (Hall)

$4\text{K}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 15\text{H}_2\text{O}$ . (Hall, J. Am. Chem. Soc. 1907, 29, 709)

$7\text{K}_2\text{O}$ ,  $2\text{Cr}_2\text{O}_3$ ,  $24\text{MoO}_3 + 32\text{H}_2\text{O}$  (Hall.)

**Silver chromicomolybdate**,  $5\text{Ag}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 17\text{H}_2\text{O}$ .

Ppt. (Hall.)

**Sodium chromicomolybdate**,  $3\text{Na}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 21\text{H}_2\text{O}$

Efflorescent Easily sol in  $\text{H}_2\text{O}$  (Struve.)

**Chromic sulphuric acid.**

See Sulphochromic acid.

**Chromicyanhydric acid,**

$\text{H}_2\text{Cr}(\text{CN})_6(?)$

Insol. in  $\text{H}_2\text{O}$ . (Kaiser, A. Suppl. 3, 163.)

**Ammonium chromicyanide**,  $(\text{NH}_4)_2\text{Cr}(\text{CN})_6$

Easily sol. in  $\text{H}_2\text{O}$  (Kaiser, A. Suppl. 3, 163.)

**Cupric chromicyanide**,  $\text{Cu}_2[\text{Cr}(\text{CN})_6]$ .

Ppt. Insol. in dil. or conc. acids, except on heating. Insol. in  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . (Kaiser.)

**Lead chromicyanide, basic**,  $3\text{Pb}(\text{CN})_2$ ,  $2\text{Cr}(\text{CN})_6$ ,  $\text{Pb}(\text{OH})_2$ .

Ppt. Sol. in  $\text{HNO}_3$ ,  $\text{NaOH} + \text{Aq}$ , or  $\text{Pb}$  salts  $+ \text{Aq}$ . (Kaiser.)

**Potassium chromicyanide**,  $\text{K}_2\text{Cr}(\text{CN})_6$ .

Very sol in  $\text{H}_2\text{O}$ .

100 pts. cold  $\text{H}_2\text{O}$  dissolve 30.9 pts. salt. Insol. in absolute alcohol, but somewhat sol. in dil. alcohol.

Sol. in conc.  $\text{H}_2\text{SO}_4$  without decomp. (Kaiser, A. Suppl. 3, 170.)

**Silver chromicyanide**,  $\text{Ag}_2\text{Cr}(\text{CN})_6$ .

Insol. in all solvents, excepting  $\text{KCN} + \text{Aq}$ . (Kaiser.)

Sol. in large excess of  $\text{HCl} + \text{Aq}$ . Sl. sol. in cold, easily sol. in hot conc.  $\text{HNO}_3$ . Very sol. in conc.  $\text{H}_2\text{SO}_4$ . Insol. in hot or cold acetic acid. (Cruser, Dissert. 1896.)

**Chromisulphocyanhydric acid.**

$\text{H}_2\text{Cr}(\text{SCN})_6$

Known only in aqueous solution.

**Ammonium chromisulphocyanide,**

$(\text{NH}_4)_2\text{Cr}(\text{SCN})_6 + 4\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Rossler, A. 141, 185.)

**Barium chromisulphocyanide**,  $\text{Ba}_4[\text{Cr}(\text{SCN})_6]_3 + 16\text{H}_2\text{O}$ .

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . (R.)

**Lead chromisulphocyanide**,  $\text{Pb}_4[\text{Cr}(\text{SCN})_6]_3$ ,  $4\text{PbO}$ ,  $\text{H}_2\text{S} + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby into— $\text{Pb}_2[\text{Cr}(\text{SCN})_6]_3$ ,  $4\text{PbO}$ ,  $\text{H}_2\text{S} + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .

**Potassium chromisulphocyanide**,  $\text{K}_2\text{Cr}(\text{SCN})_6 + 4\text{H}_2\text{O}$

Sol. in 0.72 pt  $\text{H}_2\text{O}$ . and 0.91 pt. alcohol.

**Silver chromisulphocyanide**,  $\text{Ag}_2\text{Cr}(\text{SCN})_6$ .

Insol. in  $\text{H}_2\text{O}$  or conc.  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ .

**Sodium chromisulphocyanide**,  $\text{Na}_6\text{Cr}(\text{SCN})_6 + 7\text{H}_2\text{O}$

Deliquescent, sol. in  $\text{H}_2\text{O}$

**Chromium,**

*Two modifications*—(a) Not attacked by  $\text{H}_2\text{O}$ . Easily sol. in cold  $\text{HCl} + \text{Aq}$ . Sl. sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Deville.) Easily sol. in a hot mixture of 1 pt  $\text{H}_2\text{SO}_4$  and 20 pts.  $\text{H}_2\text{O}$ . (Regnault, A. ch. 62, 357.) Easily sol. in warm conc.  $\text{H}_2\text{SO}_4$ . (Gmelin.) Very slowly sol. in hot  $\text{HNO}_3 + \text{Aq}$ . (Vauquelin.) Insol. in dil. or conc.  $\text{HNO}_3 + \text{Aq}$ . (Deville.) Very slowly (Richter), not at all (Berzelius) sol. in hot aqua regia. Easily sol. in  $\text{HF} + \text{Aq}$ . (b) Insol. in all acids, even aqua regia (Fremy), probably contains Si.

Pure Cr is sol. in conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and dil.  $\text{HNO}_3$  sol. in  $\text{HgCl}_2 + \text{Aq}$ . Insol. in fuming  $\text{HNO}_3$  and aqua regia. (Moissan, C. R. 1894, 119, 187.)

Cr prepared by aluminothermic method is sol. in haloid acids to form chromic and chromous salts, even in absence of air. (Doring, J. pr 1902, (2) 66, 65; 1908, (2) 73, 393.)

*Aluminothermic* Cr is active in contact

with HCl, HBr, HI, HF,  $H_2SO_4$ ,  $H_2C_2O_4$ , i. e., sol in cold conc. or warm dil. acids. Is inactive in contact with conc  $HNO_3$ ,  $H_2C_2O_4$ ,  $HClO_3$ ,  $HClO_4$ ,  $H_3PO_4$ , KOH, citric, formic, acetic and tartaric acids. Cause attributed to a different electric state (Hittorf, Z. phys. Ch. 1898, 26. 729.)

#### Chromium ammonia compounds.

See—

Bromotetramine chromium compounds,  
 $BrCr(NH_3)_4X_3$ .

Bromopurpleochromium compounds,  
 $BrCr(NH_3)_4X_3$ .

Chlorotetramine chromium compounds,  
 $ClCr(NH_3)_4X_3$ .

Chloropurpleochromium compounds,  
 $ClCr(NH_3)_4X_3$ .

Diamine chromium sulphocyanides,  
 $Cr(NH_3)_2(SCN)_2M$ .

Erythrochromium compounds,  
 $(HO)Cr_2(NH_3)_{10}X_3$ .

Iodopurpleochromium compounds,  
 $ICr(NH_3)_4X_3$ .

Iodotetramine chromium compounds,  
 $ICr(NH_3)_4X_3$ .

Luteochromium compounds,  $Cr(NH_3)_6X_3$ .

Rhodochromium compounds,  
 $(HO)Cr_2(NH_3)_{10}X_3$ .

Rhodochromium compounds,  
 $(HO)_2Cr_2(NH_3)_8X_3$ .

Roseochromium compounds,  
 $Cr(NH_3)_3(OH)_2X_3$ .

Xanthochromium compounds,  
 $(HO)_2Cr(NH_3)_4X_3$ .

#### Chromium arsenide, $CrAs$ .

Insol. in mineral acids (Dieckmann, Z. anorg. 1914, 86. 294.)

$Cr_3As_2$  Insol in mineral acids (Dieckmann.)

#### Chromium azoimide, $CrN_3$ .

Pptd. by addition of alcohol and ether  
Insol. in  $H_2O$  (Curtius, J. pr. 1900, (2) 61. 410.)

#### Chromium boride, $CrB$ .

Insol in HCl, dil  $H_2SO_4$ , HF, HF+ $HNO_3$   
Sl sol. in  $HNO_3$  and in aqua regia. (Wedekind, B 1907, 40. 299.)

Sol in cold dil or conc. HCl, HF, and  $H_2SO_4$ . (Jassonneix, C. R. 1906, 143. 1151)  
 $Cr_2B_3$ . Sol. in conc or dil. HF, HCl,  $H_2SO_4$ ; insol in  $HNO_3$  or alkalis+Ag. (Jassonneix.)

#### Chromous bromide, $CrBr_2$ .

Sol. in  $H_2O$ . Not deliquescent in dry air (Moissan, C. R. 92. 1051.)

#### Chromic bromide, $CrBr_3$ .

Anhydrous Insol in  $H_2O$ , but dissolves at once in presence of the least trace of  $CrBr_2$  (Bauck, A. 111. 382.)

+ $6H_2O$ . Deliquescent. Very sol in  $H_2O$ .  $H_2O$  dissolves more than 2 pts. crystals at ord. temp. Very sol. in alcohol Insol in ether. (Recoura, C. R. 110. 1029.)

Blue modification. Insol in alcohol. (Recoura, C. R. 110. 1193.)

Very hygroscopic. Easily sol. in alcohol and acetone. Insol in ether (Werner, A. 1902, 322. 343.)

+ $8H_2O$ . Sol. in  $H_2O$ . (Varenne, C. R. 93. 727.)

#### Chromium molybdenyl bromide,

$CrMo_3O_3Br_4$ .

Apparently wholly insol. in dil acids. Sol. in hot conc. HCl+Ag with decomp. Insol in  $M_2CrO_4$ +Ag (Atterberg.)

+ $2H_2O$ . Apparently wholly insol. in dil acids

Sol. in hot conc. HCl+Ag with decomp. Insol. in  $M_2CrO_4$ +Ag (Atterberg.)

#### Chromic rubidium bromide, $CrBr_3 \cdot 2RbBr + H_2O$

Sol. in  $H_2O$  with decomp. (Werner, A. 1902, 322. 345.)

#### Chromic bromide ammonia.

See Bromotetramine chromium bromide.

#### Chromous bromide hydrazine,

$CrBr_2 \cdot 2N_2H_4$ .

Insol in  $H_2O$ . Sol in acids. Insol. in alcohol, ether and similar solvents. (Traube, B. 1913, 46. 1507.)

#### Chromium carbide, $Cr_3C_2$ .

(Moissan, C. R. 1894, 118. 187.)

$Cr_3C_2$  Does not decomp.  $H_2O$  at ordinary temp or at  $100^\circ$ ; insol. in conc. HCl,  $HNO_3$  and aqua regia; sol in dil HCl (slowly); insol. in fused KOH; sol in fused  $KNO_3$ . (Moissan, Bull. Soc. 1894, (3) 117. 1016.)

#### Chromium iron carbide, $3Fe_3C, 2Cr_3C_2$

Decomp by  $H_2O$ ; sol. in gaseous hydrocarbons; insol. in  $HNO_3$  and aqua regia (Williams, C. R. 1898, 127. 484.)

#### Chromium tungsten carbide, $CW_3, 3Cr_3C_2$ .

Not attacked by acids

Slowly attacked by fused KOH or alkali carbonates. Rapidly decomp. by fused alkali nitrates or  $KClO_4$ . (Moissan, C. R. 1903, 137. 294.)

#### Chromous chloride, $CrCl_2$ .

Deliquescent. Very sol. in  $H_2O$  with evolution of much heat. (Moberg, J. pr. 29. 175.)

Practically insol in other Moderately sol in absolute alcohol, methyl alcohol, and acetaldehyde. (Rohland, Z. anorg. 1899, 21, 39.)

+1½H<sub>2</sub>O. (Moussan, A. ch. (5) 25, 40.)  
+2H<sub>2</sub>O (Knight and Rich, Chem. Soc. 1911, 99, 89.)  
+3H<sub>2</sub>O. (Knight and Rich.)

Chromous hydrogen chloride, 3CrCl<sub>2</sub>·2HCl+13H<sub>2</sub>O

Decomp by H<sub>2</sub>O. (Recura, C. R. 100, 1227.)

Sl. sol in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20, 827.)

Chromic chloride, CrCl<sub>3</sub>.

*Anhydrous.*—*Peach-blossom-colored modification.* Insol. in pure H<sub>2</sub>O (Peligot), but by long continued boiling of the finely divided salt with H<sub>2</sub>O, traces are dissolved with decomp. Not decomp. by boiling conc H<sub>2</sub>SO<sub>4</sub>, or other acids, even aqua regia.

Easily sol. with evolution of heat in H<sub>2</sub>O containing only 1/10,000 pt CrCl<sub>3</sub> (Peligot, J. pr. 36, 150). Also sol in presence of traces of SnCl<sub>2</sub> (5 mg SnCl<sub>2</sub> cause 1 g CrCl<sub>3</sub> to dissolve), FeCl<sub>3</sub>, Cu<sub>2</sub>Cl<sub>2</sub>, Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, and other reducing substances; chlorides without reducing properties have no effect. (Pelouze, A. ch. (3) 14, 251). TiCl<sub>4</sub> and SO<sub>2</sub> have similar solvent action (Ebelmen, A. ch. (3) 20, 390); also Zn+dil. acids (Moberg.)

Insol in dil. alkalis+aq; very slowly decomp. by boiling conc alkalis or alkali carbonates+aq (Fellenberg, Pogg 50, 76.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in CS<sub>2</sub>. (Aretowski, Z. anorg. 1894, 6, 257.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014.)

Practically insol in absolute ethyl alcohol, methyl alcohol, acetaldehyde and ether. (Rohland, Z. anorg. 1899, 21, 39.)

*Yellow* Sl. sol. in benzonitrile (Naumann, B. 1914, 47, 1369.)

*Violet modification.* Very sol in H<sub>2</sub>O to form a green solution (Moberg, J. pr. 44, 325.)

The violet mod. is almost insol. in H<sub>2</sub>O but if 1/10,000 pt. chromous chloride is present, it is readily sol. (Rohland, Z. anorg. 1899, 21, 39.)

+4H<sub>2</sub>O Sl. deliquescent. Very sol. in H<sub>2</sub>O, alcohol, and ethyl acetate (Godefroy, Bull. Soc. (2) 43, 229.)

+6H<sub>2</sub>O Deliquescent. Sol in H<sub>2</sub>O, but probably decomp. to CrOCl<sub>2</sub>.

Practically insol. in ether. Moderately sol. in absolute ethyl alcohol, methyl alcohol and acetaldehyde. (Rohland, Z. anorg. 1899, 21, 39.)

"Monochlorochromic chloride" is sol. in ether and fuming HCl(1.1). (Bjerrum, B. 1906, 39, 1599.)

*Green modification.*

Solubility in H<sub>2</sub>O at 25°.

25 g. green CrCl<sub>3</sub>+6H<sub>2</sub>O and 10 g. H<sub>2</sub>O

Time	Total solubility in %	Composition of the solution	
		% violet salt	% green salt
¼ hr.	58.36	8.30	91.70
½ hr		12.57	87.43
4 hrs	63.27	24.80	75.20
1 day	68.50	37.64	62.36
2 days		40.90	59.10
3 "	68.05	43.78	57.22
11 "		42.84	57.16
13 "		42.39	57.61
19 "	68.58	42.62	57.38

(Olie, Z. anorg. 1906, 51, 55.)

Solubility of green CrCl<sub>3</sub>+6H<sub>2</sub>O in H<sub>2</sub>O at 32°

10 g CrCl<sub>3</sub>+6H<sub>2</sub>O and 4 g H<sub>2</sub>O.

Time	Total solubility in %	Composition of the dissolved substance		Solid phase
		% violet salt	% green salt	
7'	63.09	12.87	87.13	Almost all dissolved
45'	66.24	21.43	78.57	
2½ h	69.53	34.53	65.47	
48h	69.33	45.27	54.73	
* 11 dys.	70.81	45.27	54.73	

\* First 8 days at 35°.

(Olie, Z. anorg. 1907, 53, 276.)

Solubility of green CrCl<sub>3</sub>+6H<sub>2</sub>O in H<sub>2</sub>O at 35°.

10 g CrCl<sub>3</sub>+6H<sub>2</sub>O and 3.3 g. H<sub>2</sub>O

Time	Total solubility in %	Composition of the dissolved substance	
		% violet salt	% green salt
8'	65.85	16.47	83.53
38'	66.74	25.02	74.98
1h	66.21	25.45	74.55
2h 10'	68.90	31.47	68.53
4h	70.79	36.28	63.72
23h	71.34	42.95	57.05
72h	70.79	42.88	57.12

(Olie, l. c.)

If a solution saturated with the green hexahydrate below 32° is cooled, the decahydrate separates out; if the solution is saturated above 32°, both the decahydrate and hexahydrate separate out on cooling. (Olie, l. c.)

*Violet modification*Solubility in H<sub>2</sub>O at 25°25 g violet CrCl<sub>3</sub>·6H<sub>2</sub>O and 10 cc of a 35% solution of green CrCl<sub>3</sub>·6H<sub>2</sub>O

Time	Total Solubility in %	Composition of the sol. solution	
		% violet salt	% green salt
1 1/2 hr	65.49	84.05	15.95
5 "		84.47	15.53
29 "		78.16	21.84
2 dys.	70.47	73.19	26.81
4 "		68.71	31.29
5 "		60.66	39.34
5 dys, 6 hrs	76.38	60.36	39.64
6 dys		65.10	34.90
8 "		65.80	34.20
10 "	73.26	58.08	41.92
12 "		41.40	58.60

(Ohe, Z. anorg. 1906, 51. 57)

Solubility in H<sub>2</sub>O at 25°.25 g violet CrCl<sub>3</sub>·6H<sub>2</sub>O and 10 g H<sub>2</sub>O.

Time	Total Solubility in %	Composition of the sol. solution	
		% violet salt	% green salt
1 1/2 hr	61.90	98.47	1.53
4 1/2 hrs		96.70	3.30
1 dy	63.88	91.54	8.46
2 "		83.37	16.63
4 "	70.68	69.11	30.89
5 "		62.20	37.80
7 "	72.11	62.72	37.28
8 "		54.63	45.37
12 "	70.02	46.39	53.61
13 "		47.66	52.34
26 "		48.55	51.45

(Ohe, l. c)

+6 1/2 H<sub>2</sub>O. *Green modification.* 100 pts. H<sub>2</sub>O dissolve 130 pts salt at 15°. Sol. in alcohol. (Recoeur, C. R. 102. 518.)

*Grayish-blue modification.* Very sol in H<sub>2</sub>O. (Recoeur, C. R. 102. 548.)

+10H<sub>2</sub>O. Very deliquescent; melts in crystal H<sub>2</sub>O at 6-7°. Very sol. in H<sub>2</sub>O, alcohol, and ethyl acetate (Godeffroy)

Easily sol in H<sub>2</sub>O; can be recryst. from H<sub>2</sub>O. Sol. in alcohol and ether. (Werner, B. 1906, 39. 1827.)

*Green modification*Solubility of green CrCl<sub>3</sub>·10H<sub>2</sub>O in H<sub>2</sub>O at 29°14.2 g CrCl<sub>3</sub>·10H<sub>2</sub>O and 2.5 g. H<sub>2</sub>O.

Time	Total solubility in %	Composition of the dissolved substance		Solid phase
		% violet salt	% green salt	
7'	61.35	8.71	91.29	CrCl <sub>3</sub> ·10H <sub>2</sub> O
20'	62.46	9.90	90.10	"
1 <sup>h</sup> 55'	65.04	25.05	74.95	CrCl <sub>3</sub> ·6H <sub>2</sub> O
4 <sup>h</sup> 30'	67.41	32.90	67.10	all dissolved
24 <sup>h</sup>	69.44	42.93	57.07	CrCl <sub>3</sub> ·10H <sub>2</sub> O
28 <sup>h</sup>	67.59	31.78	68.22	CrCl <sub>3</sub> ·6H <sub>2</sub> O
29 <sup>h</sup>	67.59	33.65	66.35	"
48 <sup>h</sup>	69.42	42.17	57.83	"
72 <sup>h</sup>	68.69	43.80	56.20	"

(Ohe, Z. anorg. 1907, 53. 275.)

The composition of the hydrates formed by CrCl<sub>3</sub> at different dilutions is calculated from determinations of the lowering of the fr. pt produced by CrCl<sub>3</sub> and of the conductivity and sp. gr of CrCl<sub>3</sub>·Δq. (Jones, Am. Ch. J. 1905, 34. 310.)

**Chromic glucinum chloride, CrCl<sub>3</sub>, GICl<sub>2</sub> + H<sub>2</sub>O**

Sol. in H<sub>2</sub>O with decomp (Neumann, A. 244. 329.)

**Chromic lithium chloride, CrCl<sub>3</sub>, 2LiCl + 4H<sub>2</sub>O.**

Very hygroscopic. Sol in ice water but solution soon decomp.

Easily sol in alcohol. (Werner, B. 1901, 34. 1603.)

[Cr(OH<sub>2</sub>)Cl<sub>2</sub>Li<sub>2</sub> + 4H<sub>2</sub>O.

Very hygroscopic. Sol in ice cold H<sub>2</sub>O and in alcohol. (Werner, B. 1901, 34. 1604.)

**Chromic magnesium chloride, CrCl<sub>3</sub>, MgCl<sub>2</sub> + H<sub>2</sub>O.**

Decomp. by H<sub>2</sub>O. (Neumann)

**Chromic phosphoric chloride, CrCl<sub>3</sub>, PCl<sub>3</sub>.**

Decomp. by H<sub>2</sub>O. (Cronander)

**Chromium platinum chloride.**

See chloroplatinate, chromium.

**Chromic potassium chloride, CrCl<sub>3</sub>, KCl.**

Decomp. by H<sub>2</sub>O.

CrCl<sub>3</sub>, 2KCl + H<sub>2</sub>O. (Neumann, A. 244. 329.)

CrCl<sub>3</sub>, 3KCl. Easily sol. in H<sub>2</sub>O with decomp. (Fremy, A. ch. (3) 12. 361.)

**Chromic rubidium chloride**,  $\text{CrCl}_3 \cdot 2\text{RbCl} + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  (Neumann, A. 244. 329.)

Slowly sol. in cold, rapidly sol. in hot  $\text{H}_2\text{O}$  with decomp. (Werner, B. 1901, 34. 1603.)  
 $\text{CrCl}_3 \cdot 3\text{RbCl} + 8\text{H}_2\text{O}$ . Unstable. Decomp. by alcohol. (Werner, B. 1906, 39. 1830.)

**Chromic sodium chloride**,  $\text{CrCl}_3 \cdot \text{NaCl}$ .

Sol. in  $\text{H}_2\text{O}$  (Berzelius.)

$\text{CrCl}_3 \cdot 3\text{NaCl}$ . Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Chromic thallium chloride**,  $\text{CrCl}_3 \cdot 3\text{TlCl}$

Sol. with decomp. in  $\text{H}_2\text{O}$ . (Neumann, A. 244. 329.)

**Chromic chloride ammonia.**

See Chlorotetramine chromium chloride.

**Chromous chloride hydrazine**,  $\text{CrCl}_2 \cdot 2\text{N}_2\text{H}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Insol. in alcohol, ether and similar solvents. (Traube, B. 1913, 46. 1506.)

**Chromic chloride ferric oxide.**

$\text{Fe}_2\text{O}_3$  is easily sol. in dil., difficultly sol. in conc.  $\text{CrCl}_3 + \text{Aq}$  (Béchamp, A. ch. (3) 57. 311.)

**Chromous fluoride**,  $\text{CrF}_2$

Sl. sol. in  $\text{H}_2\text{O}$ , hot  $\text{H}_2\text{SO}_4$  or dil.  $\text{HNO}_3$ . Sol. in boiling  $\text{HCl}$ . Insol. in alcohol. (Poulenc, C. R. 1893, 116. 254.)

**Chromic fluoride**,  $\text{CrF}_3$ .

Perfectly sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

Insol. in methyl acetate. (Naumann) B. 1909, 42. 3790; ethyl acetate. (Naumann, B. 1910, 43. 314.)

+  $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Werner and Costachescu, B. 1908, 41. 4243.)

+  $3\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Poulenc, C. R. 1893, 116. 255.)

+  $6\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Werner and Costachescu, B. 1908, 41. 4242.)

+  $9\text{H}_2\text{O}$ . Violet modification. Very sl. sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. Sol. in  $\text{HCl}$  and  $\text{KOH} + \text{Aq}$ . (Fabris, Gazz. ch. it. 20. 582.)

**Chromium hexafluoride**,  $\text{CrF}_6$ .

Decomp. by  $\text{H}_2\text{O}$  with evolution of heat. (Berzelius.)

Correct composition is  $\text{CrO}_2\text{F}_2$ . (Olivieri, Gazz. ch. it. 16. 218.)

**Chromic cobaltous fluoride**,  $\text{CrF}_3 \cdot \text{CoF}_2 + 7\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 60.)

**Chromic cupric fluoride**,  $\text{CrCuF}_5 + 5\text{H}_2\text{O}$ .

Can be cryst. from  $\text{HF} + \text{Aq}$ . (Higley, J. Am. Chem. Soc. 1904, 26. 630.)

**Chromic nickel fluoride**,  $\text{CrF}_3 \cdot \text{NiF}_2 + 7\text{H}_2\text{O}$ .

Somewhat more sol. in  $\text{H}_2\text{O}$  than  $\text{CrF}_3$ ,  $\text{CoF}_2 + 7\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 61.)

**Chromic potassium fluoride**,  $\text{CrF}_3 \cdot 3\text{KF}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Christensen, J. pr. (2) 36. 161.)

$\text{CrF}_3 \cdot 2\text{KF} + \text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl} + \text{Aq}$ . (Christensen.)

**Chromic sodium fluoride**,  $\text{CrF}_3 \cdot 2\text{NaF} + \text{H}_2\text{O}$ .

(Wagner, B. 19. 896.)

**Chromic thallous fluoride**,  $3\text{CrF}_3 \cdot 3\text{TlF}$ .

Sol. in hot  $\text{H}_2\text{O}$ , less sol. in cold. Sl. sol. in  $\text{HF}$  (Ephraim, Z. anorg. 1909, 61. 242.)

**Chromic zinc fluoride**,  $\text{CrF}_3 \cdot \text{ZnF}_2 + 7\text{H}_2\text{O}$ .

Can be cryst. from  $\text{HF} + \text{Aq}$ . (Higley, J. Am. Chem. Soc. 1904, 26. 630.)

Colloidal solution is perfectly clear. (Biltz, B. 1902, 35. 4433.)

**Chromous hydroxide**,  $\text{Cr}_2\text{O}_3\text{H}_2$ .

Decomp. by  $\text{H}_2\text{O}$ , especially if hot. (Pellet, A. ch. (3) 12. 539.)

Slowly sol. in cold conc acids, even aqua regia, almost insol. in dil. acids. (Moberg, J. pr. 43. 119.)

**Chromic hydroxide**,  $\text{Cr}_2\text{O}_3 \cdot n\text{H}_2\text{O}$ , probably  $\text{Cr}_2\text{O}_3\text{H}_6$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. Easily sol. in cold  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ ; much less sol. in cold  $\text{NH}_4\text{OH} + \text{Aq}$ ; the presence of  $\text{NH}_4\text{Cl}$  has no influence upon solubility in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Fresenius.) Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  if it has been thoroughly washed.

Insol. in  $\text{KCN} + \text{Aq}$ , but sl. sol. in  $\text{KCN} + \text{HCN} + \text{Aq}$ . (Rodgers, 1834.)

Gradually sol. in dil.  $\text{FeCl}_3 + \text{Aq}$ ; after three months, 2 mols.  $\text{Cr}_2\text{O}_3\text{H}_6$  are dissolved by 1 mol.  $\text{FeCl}_3$  without pptn. of  $\text{Fe}_2\text{O}_3\text{H}_6$ . (Béchamp, A. ch. (3) 57. 296.)

Also sol. in  $\text{CrCl}_3 + \text{Aq}$ ; in four months,  $1\frac{1}{2}$  mols.  $\text{Cr}_2\text{O}_3\text{H}_6$  are dissolved by 1 mol.  $\text{CrCl}_3$ . (Béchamp.)

Sol. in  $\text{Cr}(\text{NO}_3)_3 + \text{Aq}$ , and clear solution formed as long as 3 mols.  $\text{HNO}_3$  are present for 8 mols.  $\text{Cr}_2\text{O}_3$ . (Ordway, Sil. Am. J. (2) 27. 197.)

Chromic hydroxide, pptd. by alkalis is easily sol. in excess of the reagent; after being dried in a vacuum, however, it is insol. in alkalis. (Herz, Z. anorg. 1901, 28. 344.)

Freshly pptd. it is sol. in aq. alkali, but it is readily changed into a modification which is insol. (Herz, Z. anorg. 1902, 31. 352.)

The solubility of chromic hydroxide in an

aqueous solution of red chromic chloride is not directly proportional to the concentration of the latter—a basic chloride is probably formed. (Fischer, Z. anorg. 1901, 40. 43.)  
Not pptd. in presence of Na citrate. (Spiller.)

Insol in amylumme + Aq; not pptd in presence of alkali tartrates, sugar, etc.

$\text{Cr}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Difficultly sol in acids.

$\text{Cr}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Extremely hygroscopic. Exists in a soluble modification, obtained by dialysis; solution can be diluted with pure  $\text{H}_2\text{O}$ , but gelatinizes with traces of salts (Graham, Roy. Soc. Trans. 1861. 183.)

$\text{Cr}_2\text{O}_3(\text{OH})_2$ . Insol in boiling dil  $\text{HCl}$  + Aq.

$\text{Cr}_2\text{O}(\text{OH})_4$  (Guignet's green). Scarcely sol. in boiling  $\text{HCl}$  + Aq (Salvétat, C. R. 48. 295.)

Guignet gave formula as  $2\text{Cr}_2\text{O}_3 + 3\text{H}_2\text{O}$ .

#### Chromo-chromic hydroxide, $\text{Cr}_2\text{O}_4 \cdot \text{H}_2\text{O}$ (?).

Slightly attacked by acids (Peligot, A. ch. (3) 12. 539.)

#### Chromous iodide, $\text{CrI}_2$ .

Easily sol in  $\text{H}_2\text{O}$  (Moissan, A. ch. (5) 25. 401.)

#### Chromic iodide, $\text{CrI}_3$ (?).

Insol. in cold, sol. in hot  $\text{H}_2\text{O}$ , but no separation occurs on cooling. (Berlin.)

+  $9\text{H}_2\text{O}$ . Hygroscopic. Sol in alcohol and acetone. Insol. in  $\text{CHCl}_3$ . (Higley, J. Am. Chem. Soc. 1904, 26. 628.)

#### Chromous iodide hydrazine, $\text{CrI}_2 \cdot 2\text{N}_2\text{H}_4$ (Traube, B. 1913, 46. 1507.)

#### Chromium nitride, $\text{CrN}$ .

Insol. in dil. acids and alkalis, conc.  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{HF}$  + Aq, even on heating. Slowly sol. in hot aqua regia or cold  $\text{H}_2\text{SO}_4$ . Sol. in cold solutions of alkali hypochlorites (Ufer, A. 112. 281.)

Insol. in  $\text{HCl}$ ,  $\text{HNO}_3$  and aqua regia. (Féree, Bull. Soc. 1901, (3) 25. 618.)

Unacted upon by acids at ordinary temperatures. (Smits, Chem. Soc. 1897, 72. (2) 33.)

$\text{Cr}_2\text{N}_2$ . Slowly attacked by conc.  $\text{HNO}_3$  and by  $\text{HNO}_3$  +  $\text{HCl}$ . All other reagents are without action. (Henderson and Galletly, J. Soc. Chem. Ind. 1908, 27. 387.)

$\text{CrN}_2$ . See Chromium azonide.

#### Chromous oxide, $\text{CrO}$ .

Insol. in  $\text{HNO}_3$  and dil.  $\text{H}_2\text{SO}_4$  + Aq  
Sol. in  $\text{HCl}$ . (Féree, Bull. Soc. 1901, (3) 25. 619.)

#### Chromic oxide, $\text{Cr}_2\text{O}_3$ .

When ignited is nearly insol. in acids, but dissolves in  $\text{H}_2\text{SO}_4$  by long boiling. Insol in liquid  $\text{HCl}$ . (Gore.)

Insol in acetone (Fidmann, C. C. 1899. II, 1014.)

Solubility in (calcium sacrate + sugar) + Aq.

1 l. solution containing 418 g. sugar and 34.3 g.  $\text{CaO}$  dissolves 1.07 g.  $\text{Cr}_2\text{O}_3$ , 1 l. solution containing 296.5 g. sugar and 24.2 g.  $\text{CaO}$  dissolves 0.56 g.  $\text{Cr}_2\text{O}_3$ ; 1 l. solution containing 174.4 g. sugar and 14.1 g.  $\text{CaO}$  dissolves 0.20 g.  $\text{Cr}_2\text{O}_3$ . (Bodenbender, J. B. 1885. 600.)

See also Chromic hydroxide.

+  $\text{H}_2\text{O}$ . The compound to which Bunsen gave the formula  $\text{Cr}_2\text{O}_4$ . Insol. in acids, but easily attacked by  $\text{HNO}_3$ . (Féree, Bull. Soc. 1901, (3) 25. 620.)

#### Chromo-chromic oxide, $\text{Cr}_2\text{O}_4 = \text{CrO}, \text{Cr}_2\text{O}_3$ .

Known only in form of hydroxide, which see.

+  $3\text{H}_2\text{O}$ . Stable in dry air. Decomp. in moist air. (Baugé, C. R. 1898, 127. 552.)

$\text{Cr}_2\text{O}_4$ , or  $\text{Cr}_2\text{O}_5$ (?). Insol. in acids or in aqua regia (Bunsen, Pogg. 91. 622.)

Not obtainable. (Geuther, A. 118. 66.)

Formula is  $\text{Cr}_2\text{O}_3 + \text{H}_2\text{O}$  (Féree.)

#### Chromium trioxide, $\text{CrO}_3$ .

Deliquescent, and very sol in  $\text{H}_2\text{O}$ , to form solution of  $\text{H}_2\text{CrO}_4$  or  $\text{H}_2\text{Cr}_2\text{O}_7$ .

Solubility in  $\text{H}_2\text{O}$  at t°.

t°	0°	15°	50°	90°
% $\text{CrO}_3$	62.08	62.38	64.55	67.30

(Mylus and Funk, Gm. K. 3. 1, 1332.)

Sat.  $\text{CrO}_3$  + Aq contains at.

0°	20°	60°
61.54	62.52	65.12% $\text{CrO}_3$ .

(Koppel and Blumenthal, Z. anorg. 1907, 53. 228.)

The system  $\text{CrO}_3 - \text{H}_2\text{O}$  has been studied at temp. from 0° to -74°. In the limits of concentration investigated, from 0—71.2%  $\text{CrO}_3$ , no hydrate of  $\text{CrO}_3$  cryst. from the aq. solution. (Kremann, M. 1911, 32. 622.)

Sat.  $\text{CrO}_3$  + Aq contains at:

82°	100°	115°
66	67.4	68.4% $\text{CrO}_3$ .

(Kremann, M. 1911, 32. 620.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	% by wt $CrO_3$	Solid phase.
-0 9°	3.6	Ice
-1 9	7.8	"
-3.7	11.5	"
-4.8	14.1	"
-10 95	24.9	"
-11 7	25.2	"
-18.75	33.5	"
-25.25	39.2	"
-43.5	49.1	"
-60	53.3	"
-20	61.7	$CrO_3$
0	62.24	"
+24 8	62.88	"
40	63.50	"
65	64.83	"
90	68.5	"
122	70.7	"
193-196	100	"

(Büchner and Prins, Z. phys. Ch. 1912, 81, 114.)

Sp. gr. of  $CrO_3$  + Aq at  $t^\circ$ .

$t^\circ$	Sp. gr.	% $CrO_3$
16.0	1.0906	8.25
18.0	1.0879	8.79
14.5	1.0694	8.79
19.5	1.0957	12.34
19.0	1.1569	19.33
20.9	1.20269	31.83
20.1	1.20264	31.83
12.0	1.20714	31.83
35.0	1.20940	32.59
18.6	1.21914	32.59
15.2	1.22106	32.59
9.7	1.22384	32.59
22.0	1.3441	37.77
19.2	1.3448	37.82
22.0	1.34418	37.82
.	1.7028	62.23

(Zettnow, Pogg. 143. 474.)

Sp. gr. of  $CrO_3$  + Aq ( $112CrO_3$  + Aq). M = according to Mendeleeff at  $15^\circ$ ; Z = according to Zettnow, calculated by Gerlach (Z. anal. 27. 300).

% $CrO_3$	M	Z	% $CrO_3$	M	Z
5	1.036	1.037	35	1.324	1.312
10	1.076	1.076	40	1.383	1.373
15	1.119	1.118	45	1.445	1.440
20	1.166	1.162	50	1.510	1.512
25	1.215	1.208	55	1.579	1.587
30	1.268	1.258	60		1.656

B-pt. of  $CrO_3$  + Aq at ord. pressure.

B-pt.	G. $CrO_3$ in 100 g. of the solution
102°	10.81
101	24.08
107	36.47
110 5	45.15
116	54.50
120	61.54
127	71.24 sat. solution

(Koppel and Blumenthal, Z. anorg. 1907, 53, 254.)

Sol. in  $H_2SO_4$ ; the solubility is least when the acid contains 66%  $H_2SO_4$  (Schrotter), 84.5%  $H_2SO_4$  (Bolley).

Very sol. in  $H_2SO_4$  of 1.85 sp. gr. Sl. sol. in cold  $KHSO_4$  + Aq (Fritzsche.)

The statement that  $CrO_3$  is insol. in acids is incorrect. 2.85 g. (ignited) are sol. in  $HNO_3$  to the extent of 2.58 g. 0.81 g. (ignited) are sol. in  $HNO_3$  to the extent of 0.77 g. (Jovitschitsch, M. 1909, 30. 48.)

Practically insol. in  $POCl_3$  (Walden, Z. anorg. 1910, 68. 312.)

Sl. sol. in liquid  $NH_3$  (Franklin, Am. Ch. J. 1898, 20. 327.)

Sol. in alcohol with decomp.

Sol. in anhydrous ether.

Sol. in acetic anhydride. (Fry, J. Am. Chem. Soc. 1911, 33. 702.)

Sol. in acetone. (Naumann, B. 1904, 4328.)

Sol. in benzonitrile (Naumann, B. 1914, 47, 1369.)

Sol. in methyl acetate (Naumann, B. 1909, 42. 3790.)

Difficultly sol. in ethyl acetate (Naumann, B. 1910, 43. 314.)

Chromium oxide,  $Cr_2O_3 = 2Cr_2O_3$ ,  $CrO_3$ .

$Cr_2O_{11} = 3Cr_2O_3$ ,  $2CrO_3$ .

$CrO_3 = Cr_2O_3$ ,  $CrO_3$ .

$Cr_2O_{11} = Cr_2O_3$ ,  $3CrO_3$ .

$CrO_{11} = Cr_2O_3$ ,  $4CrO_3$ .

See Chromate, chromium.

Chromium peroxide,  $Cr_2O_7(?)$

More sol. in ether than in  $H_2O$ . Ether solution is somewhat more stable than aqueous solution. (Aschoff, J. pr. 61. 401.)

Formula is  $CrO_3$ ,  $H_2O_2$  (Moissan, C. R. 97. 96.)

Chromium peroxide ammonia,  $CrO_4$ ,  $3NH_3$ .

Sol. in  $H_2O$  with partial decomp.

Sl. sol. in  $NH_4OH$  + Aq.

Sol. with decomp. in 20% acetic acid. (Hofmann, B. 1905, 38. 3060.)

Chromium *tebo* oxide potassium cyanide,

$CrO_4$ ,  $3KCN$ .

Sol. in  $H_2O$ . Insol. in other ordinary solvents (Wiede, B. 1899, 32, 381.)

**Chromic oxychloride.**

From  $\text{Cr}_2\text{O}_3$ . Sol. in  $\text{H}_2\text{O}$  as long as 1 mol.  $\text{CrCl}_3$  is present for  $2\frac{1}{2}$  mols  $\text{Cr}_2\text{O}_3\text{H}_2$  (Ordway, *Sill. Am. J.* (2) 27, 197.)

$\text{Cr}_2\text{O}_3$ ,  $2\text{CrCl}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Kletziusky, *Zett. Ch.* 1866, 277.)

$\text{Cr}_2\text{O}_3$ ,  $\text{CrCl}_3 = \text{CrOCl}$ . *Anhydrous*. Only partly sol. in  $\text{H}_2\text{O}$ .

+  $3\text{H}_2\text{O}$ . Very deliquescent, and sol in  $\text{H}_2\text{O}$ . (Peligot.)

$\text{Cr}_2\text{O}_3$ ,  $4\text{CrCl}_3 + 6\text{H}_2\text{O} = \text{Cr}_2\text{OCl}_2 + 2\text{H}_2\text{O}$  (Peligot, *J. pr.* 37, 38.)

+  $9\text{H}_2\text{O} = \text{Cr}_2\text{OCl}_2 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Moberg); =  $\text{Cr}_2(\text{OH})_2\text{Cl}_4 + 2\text{H}_2\text{O}$  (Schiff, *A.* 124, 157.)

$\text{Cr}_2\text{O}_3$ ,  $7\text{CrCl}_3 = \text{Cr}_2\text{OCl}_2$ . Very sol. in  $\text{H}_2\text{O}$  with decomp. (Besson and Fourmei, *C. R.* 1900, 148, 1194.)

$\text{Cr}_2\text{O}_3$ ,  $8\text{CrCl}_3 + 24\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Moberg); =  $\text{Cr}_2(\text{OH})_2\text{Cl}_4 + 4\text{H}_2\text{O}$ . (Schiff, *l. c.*)

$(\text{Cr}_2\text{O})_2\text{Cl}_2$ . (Pascal, *C. R.* 1900, 148, 1464.)

$\text{Cr}_2\text{O}_3\text{Cl}_2$ . Insol. in  $\text{H}_2\text{O}$  (Pascal, *C. R.* 1900, 148, 1464.)

From  $\text{CrO}_3$

See **Chromyl chloride**.

**Chromic oxychloride potassium chloride,  $\text{CrOCl}_2$ ,  $2\text{KCl}$ .**

Decomp. in the air.  
Sol. in conc.  $\text{HCl}$  without decomp. (Weinland, *B.* 1906, 39, 4043.)

**Chromic oxychloride rubidium chloride,  $\text{CrOCl}_2$ ,  $2\text{RbCl}$ .**

Decomp. in the air.  
Sol. in conc.  $\text{HCl}$  without decomp. (Weinland, *B.* 1906, 39, 4045.)

**Chromium oxyfluoride,  $\text{Cr}_2\text{O}_2\text{F}_2$ .**

See **Chromyl fluoride**.

**Chromium phosphide,  $\text{CrP}$ .**

Insol. in acids, but a trace dissolves in aqua regia. Insol. in  $\text{HF} + \text{Aq}$ . (Berzelius.)  
Not attacked by acids or by aqua regia. (Granger, *C. N.* 1898, 77, 228.)

Insol. in all acids except a mixture of  $\text{HNO}_3$  and  $\text{HF}$ . (Maronneau, *C. R.* 1900, 130, 658.)

Insol. in mineral acids. (Dieckmann, *Z. anorg.* 1914, 86, 295.)

Insol. in aqua regia (Granger, *C. R.* 1897, 124, 191.)

$\text{Cr}_2\text{P}_2$ . Insol. in mineral acids. (Dieckmann, *Z. anorg.* 1914, 86, 295.)

**Chromous selenide,  $\text{CrSe}$ .**

(Moissan, *C. R.* 90, 817.)

**Chromic selenide,  $\text{Cr}_2\text{Se}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . (Moissan, *C. R.* 90, 817.)

**Chromic potassium selenide,  $\text{K}_2\text{Cr}_2\text{Se}_4$ .**

Insol. in  $\text{HCl}$ . Easily sol. in conc.  $\text{HNO}_3$ . (Milbauer, *Z. anorg.* 1904, 42, 451.)

**Chromium silicide,  $\text{Cr}_2\text{Si}$** 

Sol. in fused  $\text{KNO}_3$ ; insol. in cold  $\text{HCl}$  and aqua regia.

Insol. in  $\text{HF} + \text{Aq}$ . (Moissan, *C. R.* 1895, 121, 625.)

$\text{Cr}_2\text{Si}_2$ . Sol. in  $\text{HF}$ . Insol. in  $\text{HCl}$  and aqua regia (Chalmot, *Am. Ch. J.* 1897, 19, 69.)

$\text{Cr}_2\text{Si}_2$ . Insol. in dil.  $\text{HCl}$ , sol. in warm conc.  $\text{HCl}$  and in  $\text{HF}$ , insol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Lebeau, *C. R.* 1903, 136, 1330.)

$\text{Cr}_2\text{Si}$ . Sol. in  $\text{HF}$ ; insol. in other acids, sol. in fused  $\text{KOH}$  and fused alkali nitrates and carbonates. (Zettl, *C. R.* 1898, 126, 834.)

**Chromous sulphide,  $\text{CrS}$** 

Insol. in  $\text{H}_2\text{O}$  or  $\text{K}_2\text{S} + \text{Aq}$ . (Peligot.)

Easily sol. in acids. (Moissan, *C. R.* 90, 817.)

Sol. in cold conc. acids.

Sol. in molten alkalies (Mourlot, *C. R.* 1895, 121, 944.)

Min *Daubretille*

**Chromic sulphide,  $\text{Cr}_2\text{S}_3$** 

Insol. in  $\text{H}_2\text{O}$  or alkali sulphides +  $\text{Aq}$ . Sl. attacked by  $\text{HCl} + \text{Aq}$ . (W. Müller, *Pogg.* 127, 404.)

$\text{HNO}_3 + \text{Aq}$  decomposes or not according to method of preparation. Easily decomp. by aqua regia.

Insol. in caustic alkalies +  $\text{Aq}$ .

Insol. in  $\text{K}_2\text{S} + \text{Aq}$ . (Berzelius.)

**Chromochromic sulphide,  $\text{Cr}_2\text{S}_4 = \text{CrS}$ ,  $\text{Cr}_2\text{S}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (Grogger, *W. A. B.* 81, (2) 531.)

**Chromic zinc sulphide,  $\text{Cr}_2\text{ZnS}_4$ .**

(Gröger, *W. A. B.* 1880, 81, 534.)

**Chromicyanhydric acid.****Cadmium chromicyanide,  $\text{Cd}_2[\text{Cr}(\text{CN})_6]$ .**

Readily sol. in an excess of  $\text{KCN}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by conc.  $\text{HCl}$ ,  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Slowly decomp. by cold, rapidly by hot dil.  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$ . Quickly dissolved by aqua regia. Decomp. by boiling with  $\text{Na}_2\text{O}_2$ , by  $\text{NaOH} + \text{Aq}$  and by  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Slowly decomp. by boiling acetic acid. (Cruser and Miller, *J. Am. Chem. Soc.* 1906, 28, 1136.)

**Cobaltous chromicyanide,  $\text{Co}_2[\text{Cr}(\text{CN})_6]$ .**

Sol. in cold, readily sol. in hot conc.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . Sl. sol. even in boiling conc.

**HNO<sub>2</sub>** Slowly sol. in cold dil. H<sub>2</sub>SO<sub>4</sub>, HCl or HNO<sub>3</sub>. Readily sol. in boiling dil. HCl or H<sub>2</sub>SO<sub>4</sub>. Decomp. but not entirely dissolved by aqua regia. Readily sol. in an excess of KCN. Decomp. by NH<sub>4</sub>OH, NaOH or Na<sub>2</sub>CO<sub>3</sub>+Aq. Decomp. by boiling with Na<sub>2</sub>O<sub>2</sub>. Insol. in cold or boiling acetic acid (Cruser and Miller.)

**Cuprous chromocyanide, Cu<sub>2</sub>Cr(CN)<sub>6</sub>**

Sol. in KCN, cold conc. or boiling dil. HNO<sub>3</sub>+Aq. Slowly sol. in cold conc. H<sub>2</sub>SO<sub>4</sub>, still more slowly sol. in dil. H<sub>2</sub>SO<sub>4</sub>, but rapidly sol. in hot dil. and conc. H<sub>2</sub>SO<sub>4</sub>. Readily decomp. by aqua regia. Decomp. by dil. or conc. HCl, slowly going into solution in the cold, but quickly on boiling. (Cruser and Miller.)

**Cupric chromocyanide, Cu<sub>2</sub>Cr(CN)<sub>6</sub>**

Slowly sol. in cold dil. HCl, HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>; on boiling the first two readily dissolve it, but the H<sub>2</sub>SO<sub>4</sub> dissolves it only slowly. Sol. in aqua regia or cold conc. H<sub>2</sub>SO<sub>4</sub>. Readily sol. in cold or hot conc. HCl. Decomp. by cold, dissolved by boiling HNO<sub>3</sub>. Decomp. by boiling Na<sub>2</sub>O<sub>2</sub>+Aq. Decomp. by NH<sub>4</sub>OH, NaOH or Na<sub>2</sub>CO<sub>3</sub>+Aq. Readily sol. in an excess of KCN+Aq. Insol. in cold acetic acid (Cruser and Miller.)

**Nickel chromocyanide, Ni<sub>2</sub>Cr(CN)<sub>6</sub>**

Slowly sol. in cold, readily sol. in hot dil. HCl, HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>. Slowly sol. in cold, readily sol. in hot conc. H<sub>2</sub>SO<sub>4</sub>, HCl or HNO<sub>3</sub>. Slowly decomp. by cold, rapidly by boiling aqua regia. Readily sol. in excess of KCN. Sol. in NH<sub>4</sub>OH+Aq. Decomp. by NaOH, Na<sub>2</sub>CO<sub>3</sub>+Aq. or Na<sub>2</sub>O<sub>2</sub>+Aq. Insol. in cold, sl. sol. in boiling acetic acid. (Cruser and Miller.)

**Potassium thallous chromocyanide,**



(Fischer and Benzian, Ch. Z. 1902, 26. 50)

**Thallous chromocyanide, Tl<sub>2</sub>Cr(CN)<sub>6</sub>**

Easily sol. in H<sub>2</sub>O (Fischer and Benzian, Ch. Z. 1902, 26. 50)

**Zinc chromocyanide, Zn<sub>2</sub>Cr(CN)<sub>6</sub>**

Insol. in H<sub>2</sub>O. Sol. in excess of NH<sub>4</sub>OH, NaOH and KCN+Aq. Decomp. by Na<sub>2</sub>CO<sub>3</sub>+Aq. Sol. in cold dil. HCl. Slowly sol. in dil. H<sub>2</sub>SO<sub>4</sub> and in dil. HNO<sub>3</sub>. By boiling with dil. acids a clear solution is quickly obtained. (Cruser, Dissert 1906.)

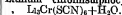
**Chromisulphocyanhydric acid.**

**Cæsium chromisulphocyanide,**



Less sol. in H<sub>2</sub>O than K salt (Osann, Dissert. 1907.)

**Lithium chromisulphocyanide,**



Extremely deliquescent. (Osann.)

**Rubidium chromisulphocyanide,**



Appreciably less sol. in H<sub>2</sub>O and alcohol than the K salt. (Osann.)

**Chromocyanidric acid, H<sub>2</sub>Cr(CN)<sub>6</sub>**

Decomp. rapidly on air. Sol. in H<sub>2</sub>O (Moussan, A. ch. (6) 4. 141)

**Potassium chromocyanide, K<sub>2</sub>Cr(CN)<sub>6</sub>**

Very sol. in H<sub>2</sub>O; 100 pts. H<sub>2</sub>O dissolve 32.33 pts. at 20°. Much more sol. in hot H<sub>2</sub>O. Insol. in alcohol, ether, benzene, or chloroform. (Moussan, A. ch. (6) 4. 136.)

Above salt was K<sub>2</sub>Cr(CN)<sub>6</sub> (Christensen.) +3H<sub>2</sub>O (Christensen, J. pr. (2) 31. 166.)

**Chromiodic acid, CrO<sub>3</sub>, HIO<sub>3</sub>+2H<sub>2</sub>O.**

Deliquescent (Berg, C. R. 104. 1514.)

**Ammonium chromiodate, CrO<sub>3</sub>, NH<sub>4</sub>IO<sub>3</sub>+H<sub>2</sub>O.**

Moderately sol. in H<sub>2</sub>O. (Berg.)

**Lithium chromiodate, CrO<sub>3</sub>, LiIO<sub>3</sub>+H<sub>2</sub>O.**

Very sol. in H<sub>2</sub>O. (Berg.)

**Magnesium chromiodate.**

Sol. in H<sub>2</sub>O. (Berg.)

**Potassium chromiodate, CrO<sub>3</sub>, KIO<sub>3</sub>.**

Sol. in H<sub>2</sub>O. (Berg.)

+H<sub>2</sub>O=KCrIH<sub>2</sub>O<sub>7</sub>. Sl. decomp. by H<sub>2</sub>O. (Blomstrand, J. pr. (2) 40. 331.)

**Silver chromiodate, CrO<sub>3</sub>, AgIO<sub>3</sub>**

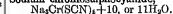
Sl. attacked by cold, rapidly decomp. by hot H<sub>2</sub>O. (Berg, C. R. 111. 42.)

**Sodium chromiodate, CrO<sub>3</sub>, NaIO<sub>3</sub>+H<sub>2</sub>O.**

Very sol. in H<sub>2</sub>O. (Berg.)

**Chromosulphocyanhydric acid.**

**Sodium chromosulphocyanide,**



Unstable.

Decomp. by H<sub>2</sub>O (Koppel, Z. anorg. 1905, 45. 360.)

**Chromosulphuric acid, H<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>.**

Sol. in H<sub>2</sub>O in all proportions, but solution is easily decomp. on standing or boiling. (Recoura, Bull. Soc. (3) 9. 586.)

H<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>. As above.

H<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>. As above.

- Ammonium chromosulphate**,  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 \cdot 5\text{H}_2\text{O}$ .  
Sol in  $\text{H}_2\text{O}$  after a few minutes. (Recoura.)
- Chromium potassium chromosulphate**,  $[\text{Cr}_2(\text{SO}_4)_2\text{CrO}_4]_2\text{K}_2$ ,  $[\text{Cr}_2(\text{SO}_4)_2(\text{CrO}_4)_2]\text{K}_4$ , and  $[\text{Cr}_2(\text{SO}_4)_2(\text{CrO}_4)_3]\text{K}_6$ .  
Sol. in  $\text{H}_2\text{O}$ . (Recoura, Bull. Soc. 1897, (3) 17. 934.)
- Potassium chromosulphate**,  $\text{K}_2\text{Cr}_2(\text{SO}_4)_4 \cdot 4\text{H}_2\text{O}$ .  
Sol in  $\text{H}_2\text{O}$  in a few minutes. (Recoura, Bull. Soc. (3) 9. 590.)
- Sodium chromosulphate**,  $\text{Na}_2\text{Cr}_2(\text{SO}_4)_4 \cdot 10\text{H}_2\text{O}$ .  
As K salt. (Recoura.)
- Chromotelluric acid**.
- Ammonium chromotellurate**,  $2(\text{NH}_4)_2\text{O} \cdot 4\text{CrO}_3 \cdot \text{TeO}_3$ .  
Sol in  $\text{H}_2\text{O}$ . (Berg, C. R. 1911, 152. 1588.)
- Potassium chromotellurate**,  $2\text{K}_2\text{O} \cdot 4\text{CrO}_3 \cdot \text{TeO}_3$ .  
Sl. sol. in cold  $\text{H}_2\text{O}$  without decomp.  
Sol in boiling  $\text{H}_2\text{O}$ . (Berg, Bull. Soc. 1911, (4) 9. 583.)
- Chromous acid**,  $\text{H}_2\text{Cr}_2\text{O}_4 = \text{Cr}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .  
Chromic hydride shows slightly acid properties, and salts corresponding to the above acid are known.
- Aluminum ferrous magnesium chromite** (chrome iron ore),  $(\text{Fe}, \text{Mg})\text{O} \cdot (\text{Cr}_2, \text{Al}_2)\text{O}_3$ .  
Insol. in  $\text{H}_2\text{O}$  or acids, even a mixture of  $\text{H}_2\text{SO}_4$  and  $\text{HF}$  (Ebelmen.)
- Barium chromite**,  $\text{BaCr}_2\text{O}_4$ .  
Insol. in  $\text{H}_2\text{O}$ . (Gerber, Bull. Soc. (2) 27. 436.)
- Barium tetrachromite**,  $\text{BaO} \cdot 4\text{Cr}_2\text{O}_3$ .  
Undecomp. by steam at red heat; insol in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , sol in fused  $\text{KOH} + \text{KNO}_3$ ; decomp. in the air. (Dufau, C. R. 1896, 122. 1126.)
- Cadmium chromite**,  $\text{CdCr}_2\text{O}_4$ .  
Not attacked by acids. (Viard, C. R. 109. 142.)
- Calcium chromite**,  $\text{CaCr}_2\text{O}_4$ .  
Insol. in  $\text{H}_2\text{O}$ . (Gerber, Bull. Soc. (2) 27. 436.)  
Insol. in  $\text{HCl}$ ,  $\text{HF}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ; sol. in gaseous  $\text{HCl}$  and  $\text{HF}$  at red heat; sol. in fused  $\text{KOH}$ ,  $\text{KNO}_3$ ,  $\text{KClO}_4$ ,  $\text{K}_2\text{CO}_3$ . (Dufau, C. R. 1895, 121. 690.)
- $2\text{CaO} \cdot \text{Cr}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ ,  $\text{KOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ , slowly decomp. by  $\text{H}_2\text{CO}_3$ , or  $\text{MgCO}_3 + \text{Aq}$ ; insol. in sugar solution (Pelouze, A. ch. (3) 33. 9.)  
 $4\text{CaO} \cdot \text{Cr}_2\text{O}_3$ . Attacked by  $\text{H}_2\text{O}$ . (Moissan, C. R. 1894, 119. 188.)
- Cobaltous chromite**,  $\text{CoCr}_2\text{O}_4$ .  
(Elliot, Dissert, Göttingen, 1862.)
- Cuprous chromite**,  $\text{Cu}_2\text{O} \cdot \text{Cr}_2\text{O}_3$ .  
Insol. in  $\text{HNO}_3 + \text{Aq}$  (sp. gr 1.4). (Wöhler, Z. phys. Ch. 1903, 62. 445.)
- Cupric chromite basic**,  $5\text{CuO} \cdot 4\text{Cr}_2\text{O}_3$ .  
(Wöhler, Z. phys. Ch. 1908, 62. 445.)
- Cupric chromite**,  $\text{CuCr}_2\text{O}_4$ .  
Not attacked by  $\text{HNO}_3 + \text{Aq}$  (Persoz, A. ch. (3) 25. 283.)  
Not attacked by conc.  $\text{HCl}$ .  
Insol. in dil. acids. (Wöhler, Z. phys. Ch. 1908, 62. 446.)  
 $\text{CuO} \cdot 3\text{Cr}_2\text{O}_3$ . (Rosenfeld, B. 1879, 12. 958.)
- Glucinum chromite**,  $\text{GlCr}_2\text{O}_4$ .  
Insol. in  $\text{H}_2\text{O}$ . (Mallard, C. R. 105. 1260.)
- Iron (ferrous) chromite** (chrome iron ore).  
See Chromite, aluminum ferrous magnesium.
- Iron (ferroferrie) chromite**,  $\text{FeO} \cdot \text{Fe}_2\text{O}_3 \cdot \text{Cr}_2\text{O}_3$ .  
Not attacked by  $\text{HCl} + \text{Aq}$ . (Ebelmen.)
- Iron (ferrous) magnesium chromite**.  
Insol. in  $\text{HCl} + \text{Aq}$ . Scarcely attacked by  $\text{H}_2\text{SO}_4$ .
- Lead chromite**,  $\text{PbCr}_2\text{O}_4$ .  
Ppt. Insol. in  $\text{KOH} + \text{Aq}$  (Chancel, C. R. 42. 927.)
- Lithium chromite**,  $\text{Li}_2\text{Cr}_2\text{O}_4$ .  
Very sl. sol. in acids (Weyberg, C. C. 1906, II. 1659.)
- Magnesium chromite**,  $\text{MgO} \cdot 2\text{Cr}_2\text{O}_3$ .  
Insol. in  $\text{H}_2\text{O}$ . (Nichols, Sil. Am. J. (2) 47. 16.)  
 $\text{MgCr}_2\text{O}_4$ . Insol. in acids or alkalis, except boiling  $\text{H}_2\text{SO}_4$ . (Schweitzer, J. pr. 39. 259.)  
Could not be obtained. (Viard, Bull. Soc. (3) 6. 934.)  
Easily attacked by boiling  $\text{H}_2\text{SO}_4 + \text{Aq}$ .  
Less easily by  $\text{HCl}$  or  $\text{HF} + \text{Aq}$  not attacked by boiling  $\text{HNO}_3$ . (Dufau, C. R. 1896, 123. 886.)  
 $2\text{MgO} \cdot \text{Cr}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$  or acids. (Nichols.)  
 $5\text{MgO} \cdot 4\text{Cr}_2\text{O}_3$ . Insol. in acids. (Viard, C. R. 112. 1003.)  
 $3\text{MgO} \cdot 2\text{Cr}_2\text{O}_3$ . As above. (V.)

**Manganese chromite,  $MnCr_2O_4$ .**

Entirely insol. in acids. (Ebelmen, A. ch. (3) 33. 44)

**Zinc chromite,  $ZnCr_2O_4$ .**

Insol. in acids and alkalies (Viard, C. R. 109. 142)

+  $H_2O$ . (Chance, C. R. 43. 927.)  
 $3ZnO, 2Cr_2O_3$  As above. (Viard, C. R. 112. 1003.)

$6ZnO, 5Cr_2O_3$ . As above. (V.)

$8ZnO, 3Cr_2O_3$ . (Gröger, M. 1904, 25, 520.)

**Chromovanadic acid.**

Ammonium chromovanadate,  $2(NH_4)_2O, 2CrO_3, V_2O_5 + 7H_2O$ .

Sol. in  $H_2O$  (Ditte, C. R. 102. 1105.)

**Chromyl amide,  $CrO_2(NH_2)_2$ .**

Sol. in  $H_2O$  (Ohly, C. N. 1899, 80. 134.)

**Chromyl subchloride,  $(CrO_2)_3Cl_3$ .**

Deliquescent, sol. in  $H_2O$  with decomp., insol. in dry ether (Pascal, C. R. 1909, 148, 1463.)

**Chromyl chloride (chlorochromic acid),  $CrO_2Cl_2$ .**

Decomp. by  $H_2O$  with evolution of much heat. Sol. in glacial acetic acid without decomposition.

Sol. in  $CCl_4, C_2H_6$  (mol. wt. det.). (Oddo, Gazz. ch. it. 1899, 29 (2) 318; Chem. Soc. 1900, 78. (2) 75.)

**Trichromyl chloride,  $Cr_3O_6Cl_3$ .**

Deliquescent. Sol. in  $H_2O$  with gradual decomposition. Sol. in conc  $HCl + Aq$ . (Thorpe, Chem. Soc. (2) 8. 31.)

Scarcely sol. in  $CS_2$ .

Sol. in alcohol and ether (Rawson, C. N. 1889, 59. 185)

**Chromyl chlorides.**

From  $Cr_2O_3$ .

See Chromium oxychlorides.

**Chromyl chloride nitrogen tetroxide,**

$Cr_2Cl_2O_7, 2NO_2$ .

Sol. in  $H_2O$  with decomp. (Thomas, C. R. 1899, 129. 828.)

**Chromyl fluoride,  $CrO_2F_2$ .**

Decomp. by  $H_2O$  with evolution of heat. (Oliver, Gazz. ch. it. 18. 218.)

**Clay.**

See Silicate, aluminum,  $Al_2O_3, SiO_2 + 2H_2O$ .

**Cobalt, Co.**

Not attacked by  $H_2O$

Sol in dil.  $HCl$ , or  $H_2SO_4$ , or  $HNO_3 + Aq$ . Conc. hot  $H_2SO_4$  and  $HNO_3$  decomp. with evolution of  $SO_2$  or  $NO$  gas.

Exists also in passive state. See Iron. (Nickles, J. pr. 61. 186.)

Sol. in conc.  $KOH + Aq$  when in finely divided state. (Winkler, J. pr. 91. 211.)

Sol. in  $NH_4OH + Aq$  in presence of air. (Hodgkinson and Bellars, C. N. 1895, 71. 73)

**Cobalt ammonia compounds.**

See—

Anhydrooxycobaltamine compounds,

$[Co(NH_3)_6]_x [Cl(OH)]_x X_4$ .

Bromotetramine cobaltic compounds,

$BrCo(NH_3)_4 X_2$ .

Bromopurpureocobaltic compounds,

$BrCo(NH_3)_4 X_2$ .

Carbonatotetramine cobaltic compounds,

$(CO)_2Co(NH_3)_4 X$ .

Chlorotetramine cobaltic compounds,

$ClCo(NH_3)_4 X_2$ .

Chloropurpureocobaltic compounds,

$ClCo(NH_3)_4 X_2$ .

Croceocobaltic compounds,

$Co(NH_3)_6(NO_2)_2 X$ .

Decamine cobaltic sulphite,

$Co_2(NH_3)_{10}(SO_3)_2$ .

Diamine cobaltic nitrites,

$Co(NH_3)_2(NO_2)_2 M$ .

Dichrocoaltic compounds,  $Co(NH_3)_2 X_2$ .

Flavocobaltic compounds,

$(NO_2)_2Co(NH_3)_4 X$ .

Fuscoaltic compounds,

$(OH)Co(NH_3)_4 X_2$ .

Iodotetramine cobaltic compounds,

$ICO(NH_3)_4 X_2$ .

Luteocobaltic compounds,  $Co(NH_3)_6 X_2$ .

Melanocobaltic compounds,

$[Co(NH_3)_2Cl]_2, NH_2Cl$ .

Nitratotetramine cobaltic compounds,

$(NO_3)Co(NH_3)_4 X_2$ .

Nitratopurpureocobaltic compounds,

$(NO)_2Co(NH_3)_4 X_2$ .

Nitrocobaltic compounds,

$(NO_2)Co(NH_3)_4 X_2$ .

Octamine cobaltic compounds,

$Co_2(NH_3)_8 X_4$ .

(= Tetramine cobaltic compounds,

$Co(NH_3)_4 X_2$ .

Oxycobaltamine compounds,

$Co_2(NH_3)_{10}(OOH)_4 X_4$ .

Praseocobaltic compounds,  $Co(NH_3)_4 X_2$ .

Purpureocobaltic compounds,

$Co(NH_3)_4 X_2$ .

Roseocobaltic compounds,

$Co(NH_3)_4(OH)_2 X_2$ .

Sulphatotetramine cobaltic compounds,

$(SO_4)Co(NH_3)_4 X$ .

Sulphatopurpureocobaltic compounds,

$(SO_4)Co(NH_3)_4 X$ .

"Tetramine cobaltic" compounds,

$\text{Co}(\text{NH}_3)_2\text{X}_3$ .

Xanthocobaltic compounds,

$(\text{NO})_2\text{Co}(\text{NH}_3)_2\text{X}_2$ .

Cobalt arsenide,  $\text{CoAs}_2$ .

As  $\text{Co}_3\text{As}_2$ . (Ducelliez, C. R. 1908, 147. 425.)

$\text{CoAs}_2$ . As  $\text{Co}_3\text{As}_2$ . (Ducelliez, C. R. 1908, 147. 425.)

$\text{Co}_3\text{As}_2$ . As  $\text{Co}_3\text{As}_2$ . (Ducelliez, C. R. 1908, 147. 425.)

$\text{Co}_3\text{As}_2$ . Very sl. attacked by hot conc.  $\text{HCl}$ , less by  $\text{H}_2\text{SO}_4$ . Easily sol. in  $\text{HNO}_3$  and aqua regia. Sl. attacked by fused alkalis and alkali carbonates. (Ducelliez, C. R. 1908, 147. 425.)

$\text{CoAs}_2$ . Min. *Skutterudite*. Sol in  $\text{HNO}_3$  + Aq, with separation of  $\text{As}_2\text{O}_3$ .

Cobalt arsenide sulphide,  $\text{CoAs}_2\text{S}_2$ ,  $\text{CoS}_2$ .

Min. *Cobaltite*. Sol. in  $\text{HNO}_3$  + Aq, with separation of S and  $\text{As}_2\text{O}_3$ .

*Glaucodote*. Completely sol. in  $\text{HNO}_3$  + Aq.

Cobalt azoimide, basic,  $\text{Co}(\text{OH})\text{N}_3$ .

Insol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{HN}_3$  + Aq. (Curtius, J. pr. 1898, (2) 58. 300.)

Cobalt potassium azoimide,  $\text{KN}_3$ ,  $\text{Co}(\text{N}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$ . Aq solution decomp. on boiling. (Curtius, J. pr. 1898, (2) 58. 301.)

Cobalt boride,  $\text{Co}_2\text{B}$ .

Attacked by  $\text{HNO}_3$ . (Jassonneux, C. R. 1907, 145. 240.)

$\text{Co}_2\text{B}$ . Decomp. by moist air and by alkali nitrates, chlorates, hydroxides and carbonates; decomp. by steam at red heat and by acids. (Moissan, C. R. 1890, 122. 425.)

Not attacked by  $\text{HCl}$ ; rapidly attacked by  $\text{HNO}_3$ . Not attacked by dil. but decomp. by conc.  $\text{H}_2\text{SO}_4$ . Rapidly attacked by aqua regia. (Moissan, A. ch. 1896, (7) 9. 272.)

$\text{Co}_2\text{B}$ . (Jassonneux, C. R. 1907, 145. 241.)

Cobaltous bromide,  $\text{CoBr}_2$ .

Deliquescent. Sol in  $\text{H}_2\text{O}$ , alcohol, and ether.

Sat.  $\text{CoBr}_2$  + Aq contains at:

59° 75° 97°  
66.7 66.8 68.1%  $\text{CoBr}_2$ .  
(Étard, A. ch. 1894, (7) 2. 542.)

Nearly insol in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Sol. in  $\text{SO}_2\text{Cl}(\text{OH})$ . (Walden.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

1g.  $\text{CoBr}_2$  is sol. in 9.74g. methyl acetate at 18°. Sp. gr. 18°/4° of sat. solution = 1.013. (Naumann, B. 1909, 42. 3792.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sol in acetone (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

Mol. weight determined in pyridine (Werner, Z. anorg. 1897, 15. 24.)

+2, and 6 $\text{H}_2\text{O}$  (Hartley, Chem Soc (2) 12. 214.)

Cobaltous hydrazine bromide hydrazine,  $2\text{CoBr}_2 \cdot 4\text{N}_2\text{H}_4 \cdot \text{HBr}$ ,  $\text{N}_2\text{H}_4$ (?).

Sol. in  $\text{H}_2\text{O}$  with decomp. (Ferradini, C. A. 1912. 1613.)

Cobaltous mercuric bromide, basic,

$\text{CoBr}_2 \cdot \text{HgBr}_2 \cdot 6\text{CoO} + 20\text{H}_2\text{O}$ .

(Mailhe, A. ch. 1902, (7) 27. 369.)

Cobalt stannic bromide.

See Bromostannate, cobalt.

Cobaltous bromide ammonia,  $\text{CoBr}_2 \cdot 6\text{NH}_3$ .

Sol in  $\text{H}_2\text{O}$  with residue of cobalt hydroxide. (Rammelsberg, Pogg. 55. 245.)

Cobaltous bromide hydrazine,  $\text{CoBr}_2 \cdot 2\text{N}_2\text{H}_4$ .

Decomp. by boiling with  $\text{H}_2\text{O}$  (Franzen, Z. anorg. 1908, 60. 270.)

Cobalt carbonyl,  $\text{Co}(\text{CO})_4$ .

Insol. in  $\text{H}_2\text{O}$ . More or less sol. in  $\text{CS}_2$ , ether, alcohol and  $\text{Ni}(\text{CO})_4$ . Relatively stable with non-oxidizing acids. Quickly decomp. by oxidizing acids (Mond, Hirtz and Cowap, C. N. 1908, 98. 165.)

Cobaltous chloride,  $\text{CoCl}_2$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  with evolution of heat. 100 pts.  $\text{H}_2\text{O}$  dissolve 43.3 pts  $\text{CoCl}_2$  at 0° (Engel, A. ch. (6) 17. 355.)

100 pts sat  $\text{CoCl}_2$  + Aq at t° contain pts.  $\text{CoCl}_2$ .

t°	Pts $\text{CoCl}_2$	t°	Pts $\text{CoCl}_2$	t°	Pts $\text{CoCl}_2$
-22	24.7	25	34.4	56	48.4
-4	28.0	34	37.5	78	48.8
+7	31.2	41	39.8	94	50.5
11	31.3	45	41.7	96	51.2
12	32.5	49	46.7	112	52.3

(Étard, C. R. 113. 699.)

Sp. gr. of  $\text{CoCl}_2$  + Aq containing—  
5 10 12 20 25%  $\text{CoCl}_2$ .  
1.0496 1.0997 1.1579 1.2245 1.3002  
Sat. solution, 1.3613.

(Franz, J. pr. (2) 5. 284.)

Sp. gr. of  $\text{CoCl}_2$  + Aq containing in 1000 g.  $\text{H}_2\text{O}$ , g.  $\text{CoCl}_2 + 6\text{H}_2\text{O}$ —  
119 g. (=  $\frac{1}{2}$  mol.) 238 357 476 594  
1.055 1.101 1.141 1.177 1.209  
833 952 1071 1190  
1.238 1.264 1.287 1.309

Containing g.  $\text{CoCl}_2$  (anhydrous)—  
 65 g. (=  $\frac{1}{2}$  mol.) 130 195 260 325 390  
 1.058 1.112 1.164 1.213 1.260 1.304  
 (Gerlach, Z. anal. 28, 466)

Sp. gr of  $\text{CoCl}_2 + \text{Aq}$  at room temp containing:  
 7.97 14 858 22.27%  $\text{CoCl}_2$   
 1.0807 1.1613 1.2645  
 (Wagner, W. Ann. 1883, 18, 267.)

Sp. gr. of  $\text{CoCl}_2 + \text{Aq}$  at  $20^\circ$  containing M g mols. of salt per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.001159	1.003052	1.006065	1.009190

M	0.10	0.25	0.50	0.75
Sp. gr.	1.012386	1.03049	1.05492	1.09118

M	1.0	1.5	2.0
Sp. gr.	1.11847	1.17502	1.23637

(Jones and Pearce, Am. Ch. J. 1907, 38, 711)

Sp. gr. of  $\text{CoCl}_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{CoCl}_2 + \text{Aq}$	Sp. gr.
1—normal	1.0571
$\frac{1}{2}$ —	1.0286
$\frac{1}{4}$ —	1.0144
$\frac{1}{8}$ —	1.0058

(Wagner, Z. phys. Ch. 1890, 5, 37.)

Solubility in  $\text{HCl} + \text{Aq}$  at  $0^\circ$   $\frac{\text{CoCl}_2}{2} = \frac{1}{2}$  mols.

$\text{CoCl}_2$  in mgs. in 10 ccm. of solution.  
 $\text{HCl}$  = mols.  $\text{HCl}$  in mgs. in ditto.  $\text{H}_2\text{O}$   
 = g.  $\text{H}_2\text{O}$

$\frac{\text{CoCl}_2}{2}$	$\text{HCl}$	$\frac{\text{CoCl}_2}{2} + \text{HCl}$	Sp. gr.	$\frac{1}{2} \text{H}_2\text{O}$
62.4	0	62.4	1.343	9.36
58.525	3.7	62.2	1.328	9.34
50.8	11.45	62.25	1.299	9.27
37.25	25.2	62.45	1.248	9.13
12.85	55.0	67.85	1.167	
4.76	74.75	79.50	1.150	8.46
12.0	104.5	116.5	1.229	7.5
25.0	139.0	164.0	1.323	

(Engel, A. ch. (6) 17, 355.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Sol. in alcohol

Sat. solution in alcohol (0.792 sp. gr.) contains 23.66 %  $\text{CoCl}_2$  and has sp. gr. = 1.0107. (Winkler, J. pr. 91, 209.)

Very sol. in ether.

100 pts. absolute ether dissolve only 0.021 g.  $\text{CoCl}_2$ . (Böttker, Z. phys. Ch. 1897, 22, 511.)

100 g. formic acid (95%) dissolve 6.2 g.  $\text{CoCl}_2$  at  $20^\circ$ . (Aschan, Ch. Z. 1913, 37, 1117.)

1g.  $\text{CoCl}_2$  is sol. in 271g. methyl acetate at  $18^\circ$ . Sp. gr.  $18^\circ/1^\circ$  of sat. solution = 0.938. (Naumann, B. 1909, 42, 3791.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

100 pts. acetone dissolve 8.62 pts. anhydrous  $\text{CoCl}_2$ . (Krug and McElroy, J. Anal. Ch. 6, 184.)

0.08 pts sol in 100 pts. ethyl acetate at $14^\circ$ .
0.26 " " " 100 " " " 79°.
9.11 " " " 100 " acetone " 0°.
9.28 " " " 100 " " " 22.5°.

(Laszczyński, B. 1894, 27, 2286.)

Sol. in acetone (Eidmann, C. C. 1899, II 1014.)

1 g.  $\text{CoCl}_2$  is sol. in 36.4 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ$  = 0.825 (Naumann, B. 1904, 37, 4334.)

100 g. acetonitrile dissolve 4.08 g.  $\text{CoCl}_2$  at  $18^\circ$ . (Naumann and Scher, B. 1914, 97, 249.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51, 236.)

Solubility in pyridine at  $t^\circ$ .

$t^\circ$	G $\text{CoCl}_2$ sol in 100 g pyridine	Solid phase
-50.3	0.4200	$\text{CoCl}_2, 6\text{C}_5\text{H}_7\text{N}$
-45.0	0.4204	
-30.0	0.4224	
-19.6	0.4227	
-10.0	0.4329	
0	0.4326	
+23.0	0.572	
25.0	0.578	
34.6	0.755	
37.6	0.760	
44.6	0.950	$\text{CoCl}_2, 4\text{C}_5\text{H}_7\text{N}$
47.2	1.029	
51.0	1.132	
55.0	1.206	
60.0	1.342	
64.2	1.433	$\text{CoCl}_2, 2\text{C}_5\text{H}_7\text{N}$
68.0	1.597	
74.8	2.079	
78.2	2.330	
79.8	2.488	
88.0	3.397	$\text{CoCl}_2$
96.5	7.817	
98.8	8.862	
106.0	14.340	
110.0	16.500	

(Pearce and Moore, Am. Ch. J. 1913, 50, 226.)

Mol. weight determined in piperidine, and pyridine. (Werner Z. anorg 1897, 15, 18 and 23.)

Sol. in urethane (Castoro, Z. anorg 1899, 20, 61.)  
 +  $\text{H}_2\text{O}$ .

+2H<sub>2</sub>O. Very deliquescent (Bersoh, J. B. 1867. 291.)  
 17.16 pts. sol. in 100 pts. acetone at 0°  
 17.06 " " 100 " " 25°  
 (Laszczynski, B. 1894, 27. 2287.)  
 +4H<sub>2</sub>O. Deliquescent. (Bersoh.)  
 +6H<sub>2</sub>O. Not deliquescent. Easily sol. in H<sub>2</sub>O.

Solubility of CoCl<sub>2</sub>+6H<sub>2</sub>O in ethyl alcohol +Aq at 11.5° under addition of increasing amounts of CoCl<sub>2</sub>.

P = Percent of alcohol by volume

G = Grams of CoCl<sub>2</sub> added.

C<sub>c</sub> = Grams of CoCl<sub>2</sub> in 5 cc. of the solution.

C<sub>w</sub> = Grams of water in 5 cc. of the solution, calculated from

- (1) the water content of the alcohol.
- (2) the water of crystallization which had gone into solution.
- (3) the water held mechanically in CoCl<sub>2</sub>+6H<sub>2</sub>O

P	G	C <sub>w</sub>	C <sub>c</sub>
91.3	0.0	1.325	1.168
98.3	0.0	1.134	1.214
98.3	0.0	1.068	1.181
99.3	0.0	1.045	1.199
"	0.194	0.899	1.204
"	0.400	0.829	1.325
"	0.612	0.764	1.459
"	0.813	0.688	1.568
"	1.022	0.634	1.713
"	1.240	0.553	1.831
"	1.446	0.483	1.943
"	0.650	0.500	2.186

(Bodtker, Z. phys. Ch 1897, 22. 508)

Easily soluble in absolute ethyl alcohol. 100 pts absolute alcohol dissolve at room temperature 56.20 pts. CoCl<sub>2</sub>. Water precipitates CoCl<sub>2</sub>+6H<sub>2</sub>O from a solution of CoCl<sub>2</sub> in absolute alcohol. (Bodtker.)

100 pts. absolute ether dissolve 0.291g. CoCl<sub>2</sub>+6H<sub>2</sub>O (Bodtker, Z. phys. Ch 1897, 22. 511.)

Anhydrous ethylene glycol dissolves 10.6% CoCl<sub>2</sub>+6H<sub>2</sub>O at 16.4°. (de Coninck, Chem. Soc 1904, 86, (2) 741)

**Cobaltous hydrazine chloride,**  
 CoCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.HCl+2½H<sub>2</sub>O

Sol. in H<sub>2</sub>O (Ferrattini, C. A. 1912. 1613.)

**Cobaltous iodine chloride, CoCl<sub>2</sub>, 2ICl<sub>3</sub>+8H<sub>2</sub>O.**

Hygroscopic. Decomp. by H<sub>2</sub>O. CCl<sub>4</sub> separates ICl<sub>3</sub> (Weinland and Schlegelmilch, Z. anorg. 1902, 30. 137.)

**Cobalt lithium chloride, CoCl<sub>2</sub>, LiCl+3H<sub>2</sub>O.**

Very deliquescent. Sol. in H<sub>2</sub>O with decomp. Sol. in LiCl+Aq without decomp. Sol. in alcohol without decomp. (Chassevant, A. ch. (6) 30. 27)

**Cobaltous mercuric chloride basic, CoCl<sub>2</sub>, HgCl<sub>2</sub>, 6CoO+20H<sub>2</sub>O.**

(Mailhe, A. ch 1902, (7) 27. 369.)

**Cobaltous mercuric chloride, CoCl<sub>2</sub>, HgCl<sub>2</sub>.**  
 Very deliquescent. (v. Bonsdorff.)

**Cobaltous thallic chloride, 2TlCl<sub>3</sub>, CoCl<sub>2</sub>+8H<sub>2</sub>O.**

Hygroscopic; can be cryst. from H<sub>2</sub>O. (Gewecke, A. 1909, 366. 222.)

**Cobaltous tin (stannic) chloride, CoCl<sub>2</sub>, SnCl<sub>4</sub>+6H<sub>2</sub>O**

See Chlorostannate, cobaltous.

**Cobaltous chloride ammonia, CoCl<sub>2</sub>, 2NH<sub>3</sub>.**

Decomp. by H<sub>2</sub>O. (F. Rose.)

CoCl<sub>2</sub>, 4NH<sub>3</sub> Decomp. by H<sub>2</sub>O (H. Rose)

CoCl<sub>2</sub>, 6NH<sub>3</sub> Decomp. by H<sub>2</sub>O. Sol. in dil. NH<sub>4</sub>OH+Aq with ease, but difficultly in conc. NH<sub>4</sub>OH+Aq. Insol. in absolute alcohol (Fremy.)

**Cobaltous chloride hydrazine, CoCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.**

Insol. in cold H<sub>2</sub>O.

Slowly decomp. by cold, rapidly by hot H<sub>2</sub>O.

Easily sol. in dil. acids and NH<sub>4</sub>OH+Aq. (Franzen, Z. anorg 1908, 80. 270.)

**Cobaltous chloride hydroxylamine,**  
 CoCl<sub>2</sub>, 2NH<sub>2</sub>OH.

Decomp. in the air; sol in H<sub>2</sub>O (Feldt, B. 1894, 27. 403.)

**Cobaltic chloride hydroxylamine,**  
 CoCl<sub>3</sub>, 6NH<sub>2</sub>OH.

Insol in alcohol.

Sol. in acidified H<sub>2</sub>O without decomp.; sol in conc. H<sub>2</sub>SO<sub>4</sub> without decomp (Feldt, B. 1894, 27. 404.)

**Cobaltous fluoride, CoF<sub>2</sub>**

Sl. sol. in H<sub>2</sub>O; insol. in alcohol and ether, slowly attacked by cold HCl, H<sub>2</sub>SO<sub>4</sub>, or HNO<sub>3</sub>+Aq. (Poulenc, C. R. 114. 1429.)

Insol in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 29. 827.)

+2H<sub>2</sub>O. Sol. in a little H<sub>2</sub>O without decomp. Decomp. into oxyfluoride by boiling with much H<sub>2</sub>O. Sol. in HF+Aq. (Berzelius.)

+4H<sub>2</sub>O. Two modifications.

Solubility of α mod. at 7° = 2.2328 %

" " β " " " = 2.3203 %

(Costachescu, Ann. Sci. Univ. Jassy, 1912, 7, 1, 10.)

**Cobaltic fluoride, CoF<sub>3</sub>.**

Sol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Barbieri, Chem. Soc. 1905, 88, (2) 393.)

Cobaltous hydrogen fluoride,  $\text{CoF}_2 \cdot 5\text{HF} + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and dil. acids  
Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp. (Bohm, Z. anorg. 1905, 43. 330.)

Cobalt columbium fluoride.

See Fluocolumbate, cobalt.

Cobaltous iron (ferrie) fluoride,  
 $\text{CoF}_2 \cdot \text{FeF}_2 + 7\text{H}_2\text{O}$ .

Sol. in dil.  $\text{HF} + \text{Aq}$  (Weinland, Z. anorg. 1899, 22. 269.)

Cobaltous manganic fluoride,  $2\text{CoF}_2 \cdot \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$ .

(Christensen, J. pr. (2) 34. 41.)

Cobalt molybdenyl fluoride.

See Fluoxymolybdate, cobalt.

Cobaltous potassium fluoride,  $\text{CoF}_2 \cdot \text{KF}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; less in ethyl or methyl alcohol, insol. in amyl alcohol or benzene  
Decomp. by hot  $\text{H}_2\text{SO}_4$ . (Poulenc, C. R. 114. 747.)

+  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Wagner, B. 19. 896.)

$\text{CoF}_2 \cdot 2\text{KF}$

Cobaltous sodium fluoride,  $\text{CoF}_2 \cdot \text{NaF} + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wagner, B. 19. 896.)

Cobaltous stannic fluoride.

See Fluostannate, cobaltous.

Cobalt vanadium fluoride.

See Fluovanadate, cobalt.

Cobaltous hydroxide,  $\text{CoO} \cdot \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Insol. in  $\text{KOH} + \text{Aq}$ . Sol. in ammonium sulphate, chloride, nitrate, or succinate +  $\text{Aq}$ . (Brett)

Sol. in warm acetic acid; insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  and cold  $\text{NH}_4\text{Cl} + \text{Aq}$ , but sol. in warm  $\text{NH}_4\text{Cl} + \text{Aq}$ . (de Schulten, C. R. 109. 266)

Insol. in  $\text{H}_2\text{O}$  and dil.  $\text{KOH} + \text{Aq}$ , somewhat sol. in conc.  $\text{KOH} + \text{Aq}$ ; easily sol. in  $\text{NH}_4$  salts +  $\text{Aq}$ . (Fresenius.)

Easily sol. in  $\text{KCN} + \text{Aq}$  (Rodgers, 1834.)

Sol. in conc.  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Gmelin.)

Not pptd. by  $\text{KOH} + \text{Aq}$  in presence of  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  or  $\text{NH}_4$  citrate. (Spiller.)

Sol. in large amt. in boiling  $\text{NH}_4\text{SCN} + \text{Aq}$ . (Grossmann, Z. anorg. 1908, 68. 209.)

Insol. in methyl, or amyl amine +  $\text{Aq}$ . (Wurtz.)

Many non-volatile organic substances prevent its pptn.

Cobaltic hydroxide,  $3\text{CoO} \cdot \text{O}_2 \cdot 2\text{H}_2\text{O}$ .

(Mills, Phil. Mag. (4) 35. 257.)

$\text{Co}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  Decomp. by  $\text{HCl} + \text{Aq}$ ;

gives brown solutions with cold  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , which soon decomp. (Wernicke, Pogg. 141. 120.)

$\text{Co}_2\text{O}_3 \cdot \text{H}_2\text{O} = \text{Co}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$  Sol. in warm  $\text{HCl}$ ,  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4$  with decomp. (Proust.)

Sol. in cold  $\text{H}_4\text{PO}_4$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ , but decomp. on standing or warming (Winkblech.)

Sol. in racemic, tartaric, oxalic, or citric acid as cobaltous salt

Sol. in conc. acetic acid without immediate decomp. (Remele.)

Solution is not decomp. by boiling Sol. in warm sat.  $(\text{NH}_4)_2\text{C}_2\text{O}_4 + \text{Aq}$  with decomp.

Not attacked by cold or hot  $\text{NH}_4\text{OH} + \text{Aq}$

Insol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Sol. when freshly pptd. in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Geuther, A. 128. 157.)

Cobaltocobaltic hydroxide,  $\text{Co}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$ . Sol. in oxalic acid; solution decomp. by heat Sol. in  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$ . (Gibbs and Genth, Sill. Am. J. (2) 23. 257.)

$\text{Co}_2\text{O}_3 \cdot 7\text{H}_2\text{O}$  Sol. in weak acids, especially  $\text{HCl} + \text{H}_2\text{O}_2$  without decomp. (Fremy.)

$\text{Co}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$  Min. *Heterogeneous*. Sol. in dil.  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$ .

Cobaltous iodide,  $\text{CoI}_2$ .

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ .

100 pts. sat.  $\text{CoI}_2 + \text{Aq}$  at  $t^\circ$  contain  
pts.  $\text{CoI}_2$ .

$t^\circ$	Pts. $\text{CoI}_2$	$t^\circ$	Pts. $\text{CoI}_2$	$t^\circ$	Pts. $\text{CoI}_2$
-22	52.4	14	61.6	60	79.2
-8	56.7	25	66.4	82	80.7
-2	58.7	34	73.0	111	80.9
+9	61.4	40	79.0	156	83.1

(Étard, C. R. 113. 699)

Sol. in  $\text{SO}_2(\text{OCH}_3)_2$ . (Walden, Z. anorg. 1902, 29. 338.)

Sol. in  $\text{SOCl}_2$ . (Walden, Z. anorg. 1900, 25. 216.)

Sol. in  $\text{POCl}_2$ . (Walden, Z. anorg. 1900, 25. 212.)

Sol. in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 217.)

Nearly insol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Sol. in  $\text{AsCl}_3$ . (Walden, Z. anorg. 1900, 25. 214.)

Easily sol. in alcohol.

Sol. in acetone. (Eidmann, C. C. 1899, 11. 1014.) (Naumann, B. 1904, 37. 4328.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 61. 236.)

Sol. in methylacetate. (Naumann, B. 1909, 42. 3790.)

+  $2\text{H}_2\text{O}$ .

+  $4\text{H}_2\text{O}$ . Very deliquescent. (Étard.)

+6H<sub>2</sub>O. (Hartley, Chem. Soc. (2) 12. 214.)  
 +9H<sub>2</sub>O Very hygroscopic (Bolschakoff, C. C. 1898, II. 660.)

Cobaltous lead iodide, 2 CoI<sub>2</sub>, PbI<sub>2</sub>+3H<sub>2</sub>O  
 Decomp. by H<sub>2</sub>O. (Mosnier, A. ch. 1897, (7) 12. 412.)

Cobaltous mercuric iodide, CoI<sub>2</sub>, HgI<sub>2</sub>+6H<sub>2</sub>O.

Partially decomp. by H<sub>2</sub>O.  
 Sol. in alcohol and acetone. (Dobroserdoff, C. C. 1901, II. 332.)  
 CoI<sub>2</sub>, 2HgI<sub>2</sub>+6H<sub>2</sub>O. Decomp. by H<sub>2</sub>O; sol. in alcohol and acetone. (Dobroserdoff, C. C. 1901, II. 332.)

Cobaltous iodide ammonia, CoI<sub>2</sub>, 4NH<sub>3</sub>.  
 Decomp. by H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH+Ag. (Rammelsberg, Pogg. 48. 155.)  
 CoI<sub>2</sub>, 6NH<sub>3</sub>. Insol. in NH<sub>4</sub>OH+Ag. (Rammelsberg.)

Cobaltous iodide hydrazine, CoI<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.  
 Sl. sol. in H<sub>2</sub>O. Easily sol. in acids (Franzen, Z. anorg. 1911, 70. 147.)

Cobaltic octamine compounds.  
*See* Octamine cobaltic compounds.

Cobaltous oxide, CoO  
 Insol. in H<sub>2</sub>O. Easily sol. in dil. or conc. HCl or HNO<sub>3</sub>+Aq. Slowly sol. in cold, but easily in hot dil. H<sub>2</sub>SO<sub>4</sub>+Aq. acetic, or tartaric acid +Aq. Insol. in NH<sub>4</sub>OH+Ag. Sol. in hot NH<sub>4</sub>Cl+Ag, KOH, or NaOH+Ag (Rose)  
 Insol. in NH<sub>4</sub>Cl or NH<sub>4</sub>NO<sub>3</sub>+Aq. (Brett, 1834.)

Insol. in K<sub>2</sub>CO<sub>3</sub>+Aq. Sol. in boiling Ce and Ni nitrates +Aq. with pptn. of the oxides. (Persoz.)

Easily sol. in dil. acids, even tartaric, acetic, and oxalic acids. Not attacked by NH<sub>4</sub>OH+Ag. Sol. in 13% NH<sub>4</sub>Cl+Ag with evolution of NH<sub>3</sub>; also in NH<sub>4</sub>SCN+Ag. Sol. in warm conc. NaOH, and KOH+Ag (Zimmerman, A. 232. 324.)

Solubility in (calcium sucrate+sugar)+Aq.  
 1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 1.56 g. CoO; 1 l. solution containing 296.5 g. sugar and 24.2 g. CaO dissolves 0.29 g. CoO. (Bodenbender, J. B. 1865. 600.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)  
*See also* Cobaltous hydroxide.

Cobaltic oxide, Co<sub>2</sub>O<sub>3</sub>.

Decomp. by most acids, even in the cold, with formation of cobaltous salts. Sol. in acetic acid without immediate decomp.  
*See also* Cobaltic hydroxide.

Cobaltocobaltic oxide, Co<sub>2</sub>O<sub>3</sub>=CoO, Co<sub>2</sub>O<sub>3</sub>.  
 Insol. in boiling conc. HCl, HNO<sub>3</sub>, or aqua regia. Sol. by long standing with H<sub>2</sub>SO<sub>4</sub>. (Gibbs and Genth, Sil. Am. J. (2) 23. 267.)  
*See also* Cobaltocobaltic hydroxide.

Co<sub>2</sub>O<sub>3</sub>=2CoO, Co<sub>2</sub>O<sub>3</sub>.  
 Co<sub>2</sub>O<sub>7</sub>=4CoO, Co<sub>2</sub>O<sub>3</sub>. Not attacked by boiling dil. HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>+Aq. (Beetz.)  
 Co<sub>2</sub>O<sub>3</sub>=6CoO, Co<sub>2</sub>O<sub>3</sub>+20H<sub>2</sub>O. Sol. in dil. acids, with residue of Co<sub>2</sub>O<sub>3</sub>, which dissolves on warming. (Gentile, J. pr. 69. 131.)  
 +8H<sub>2</sub>O As above. (Gentile.)

Cobaltous oxychloride, CoCl<sub>2</sub>, 3CoO+3 $\frac{1}{2}$ H<sub>2</sub>O.  
 Ppt. Very sl. sol. in H<sub>2</sub>O. (Habermann, M. 5. 432.)

Cobaltous oxychloride hydroxylamine, CoOCl, 2NH<sub>2</sub>OH.  
 Insol. in H<sub>2</sub>O; unstable; insol. in alcohol. (Feldt, B. 1894, 27. 404.)

Cobaltous oxyfluoride, CoO, CoF<sub>2</sub>+H<sub>2</sub>O.  
 Ppt. (Berzelius, Pogg. 1. 26.)

Cobaltous oxyiodide, CoO, CoI<sub>2</sub>.  
 Insol. in H<sub>2</sub>O. (Rammelsberg.)

Cobaltous oxysulphide, CoO, CoS.  
 Cold HCl+Ag dissolves out CoO; hot HCl+Ag decomp. with evolution of H<sub>2</sub>S. (Arfvedson, Pogg. 1. 64.)

Cobalt phosphide, Co<sub>2</sub>P  
 Sol. in conc. HNO<sub>3</sub>. Slowly attacked by HCl and H<sub>2</sub>SO<sub>4</sub>. (Maronneau, C. R. 1900, 130. 358.)  
 Sol. in HNO<sub>3</sub>, aqua regia, and in fused alkalis. (Granger, Bull. Soc. 1896, (3) 15. 1089.)

Co<sub>2</sub>P<sub>2</sub>. Insol. in HNO<sub>3</sub> and aqua regia; stable in the air even when heated (Granger, Bull. Soc. 1896, (3) 15. 1087)

Co<sub>2</sub>P<sub>3</sub>. Insol. in conc. HCl+Ag. Sol. in HNO<sub>3</sub>+Aq. (Rose, Pogg. 24. 332.)

Cobalt subselenide, Co<sub>2</sub>Se.  
 Sol. in bromine water.  
 Only sl. attacked by boiling fuming HCl. (Fonze-Diacon, C. R. 1900, 131. 704.)

Cobalt monoselenide, CoSe  
 (Little, A. 112. 211.)

Cobalt diselenide CoSe<sub>2</sub>.  
 Sol. in Br<sub>2</sub>+Aq.  
 Only sl. attacked by boiling fuming HCl. (Fonze-Diacon, C. R. 1900, 131. 705.)

**Cobalt sesquiselenide,  $\text{Co}_2\text{Se}_3$ .**Sol. in  $\text{Br}_2 + \text{Aq}$ .Only sl. attacked by boiling fuming  $\text{HCl}$ . (Fonzes-Diacon, C. R. 1900, 131. 704.)**Cobalt selenide,  $\text{Co}_2\text{Se}_3$ .**Sol. in  $\text{Br}_2 + \text{Aq}$ .Only sl. attacked by boiling fuming  $\text{HCl}$ . (Fonzes-Diacon, C. R. 190, 131. 704.)**Cobalt silicide,  $\text{Co}_3\text{Si}$ .**Sol. in  $\text{HF}$  and aqua regia. Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by steam at red heat. Sol. in fused alkali carbonates. (Vigououx, C. R. 1895, 121. 687.)CoSi. Insol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . Sol. in aqua regia and  $\text{HCl}$ , and in fused KOH. (Lebeau, C. R. 1901, 132. 557.)Not attacked by dil. or conc.  $\text{HNO}_3$ , or conc.  $\text{H}_2\text{SO}_4$ . Sol. in aqua regia and in conc.  $\text{HCl}$ .Not attacked by dil. alkali hydroxides +  $\text{Aq}$ .; attacked by fused alkali. (Lebau, Bull. Soc. 1901, (3), 26. 540.)CoSi<sub>2</sub>. Sl. sol. in hot conc.  $\text{HCl}$  and hot conc. alkali +  $\text{Aq}$ . Sol. in  $\text{HF}$ ; insol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Lebeau, C. R. 1902, 135. 476.)**Cobaltous sulphide,  $\text{CoS}$ .**Anhydrous. Easily sol. in acids, even  $\text{HCl}$ , but only slowly in the latter case. (Erdtshil, C. R. 66. 75.)Not attacked by cold dil.  $\text{HCl} + \text{Aq}$ . (Ebelmen, A. ch. (3) 25. 94.)Min. Seypoorte +  $2\text{H}_2\text{O}$ . 1 l.  $\text{H}_2\text{O}$  dissolve  $41.02 + 10^{-6}$  moles  $\text{CoS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)

Sol. in conc. mineral acids; very sl. sol. in cold dil. acids; scarcely sol. in acetic acid. (Wackenroder.)

Sol. when still moist in  $\text{SO}_2 + \text{Aq}$  (Berthier.)Easily sol. in  $\text{HNO}_3$ , but only very sl. sol. in  $\text{HCl} + \text{Aq}$ . Not pptd. from very dil. acid solutions by  $\text{H}_2\text{S}$ .Insol. in  $\text{H}_2\text{O}$ , alkalies, and alkali carbonates, or sulphides +  $\text{Aq}$ . (Fresenius.)Insol. in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett.)When pptd. by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ , shows a brown colour in presence of 200,000 pts  $\text{H}_2\text{O}$  (Pfaff.)Tartaric acid, etc. does not hinder the pptn. by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Rose.)Sol. in potassium thiocarbonate +  $\text{Aq}$  (Rosenblatt, Z. anal. 26. 15.)Sol. in  $\text{Na}_2\text{S}_2$  or  $\text{K}_2\text{S}_2 + \text{Aq}$ . (de Kounek, Zeit. angew. Ch. 1891. 202.)**Cobaltic sulphide,  $\text{Co}_2\text{S}_3$ .**Partially decomp. by  $\text{HCl} + \text{Aq}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$  with decomposition.Sl. attacked by  $\text{HCl} + \text{Aq}$ ; and slowly even by aqua regia. (Schneider, J. pr. (2) 9. 200.)**Min. Cobalt pyrite**+  $1\text{H}_2\text{O}$ . Insol. in  $\text{KCN} + \text{Aq}$  (Fleck, J. pr. 97. 303.) More sol. in  $\text{HCl} + \text{Aq}$  than  $\text{CoS}_2$ . (Dugler, Beiz, J. B. 10. 139.)**Cobalto-cobaltic sulphide,  $\text{Co}_2\text{S}_4$ .**Min. Lannette. Sol. in warm  $\text{HNO}_3 + \text{Aq}$ , with residue of  $\text{S}$ .**Cobalt disulphide,  $\text{CoS}_2$ .**Not attacked by alkalis or acids except  $\text{HNO}_3$  and aqua regia. (Setterberg, Pogg. 7. 40.)**Cobalt sulphide,  $\text{Co}_2\text{S}_3$ .**Easily sol. in hot  $\text{HCl}$  with evolution of  $\text{H}_2\text{S}$  (and  $\text{H}_2\text{S}^*$ ) (Pioust.)**Cobalt potassium sulphide,  $\text{K}_2\text{Co}_{11}\text{S}_{10}$ .**Slowly sol. in cold  $\text{HCl}$  and aqua regia. Quickly sol. in warm aqua regia.Sol. in  $\text{HF}$  and  $\text{H}_2\text{SO}_4$ , only on warming.Insol. in  $(\text{NH}_4)_2\text{S}$ , organic acids, alkalies, 12%  $\text{HCl} + \text{Aq}$  and  $\text{KCN} + \text{Aq}$  (Milbauer, Z. anorg. 1904, 42. 447.)**Cobalt telluride,  $\text{CoTe}$ .**

(Fabre, C. R. 105. 673.)

**Cobalt decamine sulphurous acid.**

Sec Decamine cobaltisulphurous acid.

**Cobaltic acid.**Potassium cobaltate,  $\text{K}_2\text{Co}_2\text{O}_{11} + 2\text{H}_2\text{O}$ , or  $3\text{H}_2\text{O}$ .Insol. in  $\text{H}_2\text{O}$  (Pebal, A. 100. 262), but decomp. by long boiling. Sol. in conc. acids. $\text{K}_2\text{O}$ ,  $1\text{CoO}_2$ . Sol. in  $\text{H}_2\text{O}$  (Winkler, J. pr. 91. 351.)

Does not exist (Donath, W. A. B. 102, 2b. 71.)

**Cobalticyanhydric acid,  $\text{H}_2\text{Co}(\text{CN})_6 + \frac{1}{2}\text{H}_2\text{O}$ .**Deliquescent. Very sol. in  $\text{H}_2\text{O}$  and only sl. decomp. on boiling.Sol. in  $\text{HCl} + \text{Aq}$  without decomp. even on boiling. Sl. sol. in conc. more sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . Not decomp. by boiling conc.  $\text{HNO}_3 + \text{Aq}$  or aqua regia. Insol. in conc. sl. sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in alcohol. Insol. in ether. (Zweuger, A. 162. 157.)**Ammonium cobaltcyanide,  $(\text{NH}_4)_2\text{Co}(\text{CN})_6 + \frac{1}{2}\text{H}_2\text{O}$ .**Very sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol.**Ammonium barium cobaltcyanide,** $\text{NH}_4\text{BaCo}(\text{CN})_6 + \text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Weselsky.)**Ammonium calcium cobaltcyanide,** $\text{NH}_4\text{CaCo}(\text{CN})_6 + 10\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .

**Ammonium lead cobalticyanide,**  
 $\text{NH}_4\text{PbCo(CN)}_6 + 3\text{H}_2\text{O}$ .Sol. in 8-31 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and sl. sol. in 93% alcohol. (Schuler.)**Ammonium mercuric cobalticyanide,**  
 $(\text{NH}_4)_2\text{HgCo(CN)}_6 + \text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$  with decomp.

Insol. in alcohol (Soenderop, Dissert. 1899.)

**Ammonium sodium cobalticyanide,**  
 $\text{NH}_4\text{Na}_2\text{Co(CN)}_6$ .Only sl sol. in  $\text{H}_2\text{O}$  (Weselsky, B. 2. 508)**Ammonium strontium cobalticyanide,**  
 $\text{NH}_4\text{SrCo(CN)}_6 + 9\text{H}_2\text{O}$ Sol. in  $\text{H}_2\text{O}$ . (W)**Barium cobalticyanide, basic,**  $\text{Ba}_2[\text{Co(CN)}_6]_2 + \text{BaO}_2\text{H}_2$ .

Not very stable. Cannot be recryst. without partial decomp. (W)

**Barium cobalticyanide,**  $\text{Ba}_2[\text{Co(CN)}_6]_2 + 10\text{H}_2\text{O}$ Sl efflorescent. Very sol in  $\text{H}_2\text{O}$  Insol. in alcohol.**Barium cobalticyanide chloride,**  
 $\text{Ba}_2[\text{Co(CN)}_6]_2 + \text{BaCl}_2 + 16\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$  without decomp. (W.)**Barium lithium cobalticyanide,**  $\text{BaLiCo(CN)}_6 + 15\text{H}_2\text{O}$ .

The most sol. of the double cobalticyanides. (Weselsky)

**Barium potassium cobalticyanide,**  
 $\text{BaKCo(CN)}_6 + 11\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (W.)**Bismuth cobalticyanide**  $\text{BiCo(CN)}_6$ 

Ppt (Mathews, J. Am Chem Soc. 1900, 22. 275.)

+  $5\text{H}_2\text{O}$ . Moderately stable with dil. min. acids; more stable with conc. acids than Cd or Zn comp.Decomp. by  $\text{NH}_3$  and alkalis. (Fischer and Cuntze, Ch. Z. 1902, 26. 872.)**Cadmium cobalticyanide,**  $\text{Cd}_2[\text{Co(CN)}_6]_2 + 7\frac{1}{2}\text{H}_2\text{O}$ Attacked by strong min. acids only when hot. Behaves as Zn salt, toward conc.  $\text{H}_2\text{SO}_4$  and dil. and conc.  $\text{HCl}$ .Insol. in  $\text{K}_2\text{Co(CN)}_6 + \text{Aq}$  Sol. in  $\text{NH}_4\text{OH}$  and  $\text{NH}_4\text{Cl} + \text{Aq}$  (Fischer and Cuntze, Ch. Z. 1902, 26. 873)**Cadmium potassium cobalticyanide,**  
 $\text{KCdCo(CN)}_6$ .Not attacked by  $\text{H}_2\text{O}$ . (Fischer and Cuntze, Ch. Z. 1902, 26. 873)**Cadmium sodium cobalticyanide,**  
 $\text{NaCdCo(CN)}_6$ .

(Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

**Cadmium cobalticyanide ammonia,**  
 $\text{Cd}_2[\text{Co(CN)}_6]_2 + 4\text{NH}_3 + 2\text{H}_2\text{O}$ .

(Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

**Cadmium cobalticyanide ammonia,**  
 $\text{Cd}_2[\text{Co(CN)}_6]_2 + 5\text{NH}_3 + 3\text{H}_2\text{O}$ . (Fischer and Cuntze, Ch. Z. 1902, 26. 873.) $\text{Cd}_2[\text{Co(CN)}_6]_2 + 7\text{NH}_3$  (Fischer and Cuntze, Ch. Z. 1902, 26. 873)**Cadmium cobalticyanide ammonia,**  
 $\text{Cd}_2[\text{Co(CN)}_6]_2 + 9\text{NH}_3 + 2\text{H}_2\text{O}$ . (Fischer and Cuntze, Ch. Z. 1902, 26. 873.)**Calcium potassium cobalticyanide,**  
 $\text{CaKCo(CN)}_6 + 9\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$  (W)**Cobaltous cobalticyanide,**  $\text{Co}_2[\text{Co(CN)}_6]_2 + 14\text{H}_2\text{O}$ Insol. in  $\text{H}_2\text{O}$  and acids. Sl sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp. by  $\text{KOH} + \text{Aq}$ **Cupric cobalticyanide,**  $\text{Cu}_2[\text{Co(CN)}_6]_2 + 7\text{H}_2\text{O}$ Insol. in  $\text{H}_2\text{O}$  and acids. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .**Cupric cobalticyanide ammonia,**  
 $\text{Cu}_2[\text{Co(CN)}_6]_2 + 4\text{NH}_3 + 7\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$  (Zwenger.)**Lead cobalticyanide, basic,**  $\text{Pb}_2[\text{Co(CN)}_6]_2 + 3\text{PbO} + 11\text{H}_2\text{O}$ .Insol. in  $\text{H}_2\text{O}$  or alcohol; somewhat sol. in hot  $\text{Pb(C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . (Schuler.)**Lead cobalticyanide,**  $\text{Pb}_2[\text{Co(CN)}_6]_2 + 4\text{H}_2\text{O}$ Very sol. in  $\text{H}_2\text{O}$  Insol. in alcohol(Zwenger)  
+  $7\text{H}_2\text{O}$ . Sol. in 1.77 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and 1.63 pts. at  $19^\circ$  Insol. in absolute alcohol. Sl. sol. in 93% alcohol. (Schuler, W. A. B. 79. 302.)**Lead potassium cobalticyanide,**  $\text{PbKCo(CN)}_6 + 3\text{H}_2\text{O}$ .Sol. in 6.74 pts  $\text{H}_2\text{O}$  at  $18^\circ$  and much more easily in hot  $\text{H}_2\text{O}$ . Insol. in absolute, sl sol. in 93% alcohol. (Schuler)**Lead cobalticyanide nitrate,**  $\text{Pb}_2[\text{Co(CN)}_6]_2 + \text{Pb(NO}_3)_2 + 12\text{H}_2\text{O}$ .Sol. in 16.91 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , 16.79 pts at  $19^\circ$ , and much less hot  $\text{H}_2\text{O}$ .

Nearly insol. in 93% alcohol. (Schuler.)

**Mercurous cobalticyanide,**  $\text{Hg}_2\text{Co(CN)}_6$ .Ppt. Decomp. by  $\text{HCl}$  Not attacked by cold, but by hot conc.  $\text{H}_2\text{SO}_4$ . Not attacked by  $\text{HNO}_3$ , acetic or oxalic acid. Decomp. by alkalis +  $\text{Aq}$ . (Miller and Mathews, J. Am Chem Soc 1900, 22. 64.)

Mercuric cobalticyanide,  $\text{Hg}_2[\text{Co}(\text{CN})_6]$ .  
Sl. sol. in  $\text{H}_2\text{O}$ , decomp. by boiling.  
Insol. in alcohol and ether. Not attacked  
by  $\text{HCl}$  (Soenderop, Dissert, 1899.)

Mercuric potassium cobalticyanide,  
 $\text{K}_2\text{HgCo}_2(\text{CN})_{14}$ .  
Sol. in  $\text{H}_2\text{O}$  with decomp. Insol. in al-  
cohol. Sl. sol. in ether. (Soenderop, Dissert,  
1899.)  
 $\text{K}_2\text{Hg}_2\text{Co}_4(\text{CN})_{24}$  (Soenderop, Dissert.  
1899.)

Mercuric sodium cobalticyanide,  
 $\text{Na}_2\text{Hg}_2\text{Co}_4(\text{CN})_{24} + 4\text{H}_2\text{O}$ .  
Extremely deliquescent (Soenderop,  
Dissert, 1899.)

Nickel cobalticyanide,  $\text{Ni}_2[\text{Co}(\text{CN})_6]_2 +$   
 $12\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$  and acids. Not attacked by  
boiling  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
Decomp. by  $\text{KOH} + \text{Aq}$ .

Nickel cobalticyanide ammonia,  
 $\text{Ni}_2[\text{Co}(\text{CN})_6]_2, 4\text{NH}_3 + 7\text{H}_2\text{O}$   
Insol. in  $\text{H}_2\text{O}$ .

Potassium cobalticyanide,  $\text{K}_3\text{Co}(\text{CN})_6$ .  
Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol

Potassium strontium cobalticyanide,  
 $\text{K}_2\text{SrCo}(\text{CN})_6 + 9\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Weselsky.)

Potassium thallium cobalticyanide,  
 $\text{K}_4\text{Tl}_2[\text{Co}(\text{CN})_6]_2$ .  
More sol. in  $\text{H}_2\text{O}$  than corresponding  
 $\text{K}$  salt. (Fischer and Benzan, Ch. Z. 1902,  
26, 49.)

Potassium zinc cobalticyanide,  
 $\text{KZnCo}(\text{CN})_6 + 3\text{H}_2\text{O}$ .  
(Fischer and Cuntze, Ch. Z. 1902, 26, 873.)

Potassium cobalticyanide mercuric chloride,  
 $2\text{K}_3\text{Co}(\text{CN})_6, 3\text{HgCl}_2$ .  
(Soenderop, Dissert. 1899.)

Potassium cobalticyanide mercuric iodide,  
 $4\text{K}_3\text{Co}(\text{CN})_6, \text{HgI}_2$ .  
Sol. in  $\text{H}_2\text{O}$  with subsequent decomp.  
Sol. in alcohol and ether with decomp.  
(Soenderop, Dissert, 1899.)

Silver cobalticyanide,  $\text{Ag}_3\text{Co}(\text{CN})_6$ .  
Insol. in  $\text{H}_2\text{O}$  and acids. Sol. in  $\text{NH}_4\text{OH} +$   
 $\text{Aq}$ .

Silver cobalticyanide ammonia,  $\text{Ag}_3\text{Co}(\text{CN})_6$ ,  
 $\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$   
Insol. in  $\text{H}_2\text{O}$ . (Zwenger.)

Sodium cobalticyanide,  $\text{Na}_3\text{Co}(\text{CN})_6 + 2\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol.

Sodium zinc cobalticyanide,  $\text{NaZnCo}(\text{CN})_6$   
 $+ \text{H}_2\text{O}$ .  
(Fischer and Cuntze, Ch. Z. 1902, 26, 873.)

Strontium cobalticyanide,  $\text{Sr}_3[\text{Co}(\text{CN})_6]_2 +$   
 $10\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$ . (Weselsky.)

Thallium cobalticyanide,  $\text{Tl}_3\text{Co}(\text{CN})_6$ .  
100 pts.  $\text{H}_2\text{O}$  dissolve 3.0 pts. at  $0^\circ$ , 5.86 pts.  
at  $9.5^\circ$ , 10.04 pts. at  $19.5^\circ$ . (Fronmuller, B.  
11, 91.)

Yttrium cobalticyanide,  $\text{YCo}(\text{CN})_6 + 2\text{H}_2\text{O}$   
Nearly insol. in  $\text{H}_2\text{O}$ . (Cleve)

Zinc cobalticyanide,  $\text{Zn}_3[\text{Co}(\text{CN})_6]_2 + 12\text{H}_2\text{O}$ .  
Sol. in  $\text{HCl} + \text{Aq}$  and salt is pptd. by dilu-  
tion with  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{SO}_4$ . Insol  
in  $\text{K}_4\text{Co}(\text{CN})_6 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH}$  and  
 $\text{NH}_4\text{Cl} + \text{Aq}$ . (Fischer and Cuntze, Ch. Z.  
1902, 26, 873.)

Zinc cobalticyanide ammonia,  
 $\text{Zn}_3[\text{Co}(\text{CN})_6]_2, 5\text{NH}_3$ .  
Decomp. by  $\text{H}_2\text{O}$  and acids. (Fischer and  
Cuntze, Ch. Z. 1902, 26, 873.)  
 $\text{Zn}_4[\text{Co}(\text{CN})_6]_3, 8\text{NH}_3$ . (Fischer and  
Cuntze)  
 $+ 3\text{H}_2\text{O}$ . (Fischer and Cuntze)  
 $\text{Zn}_6[\text{Co}(\text{CN})_6]_3, 10\text{NH}_3 + 9\text{H}_2\text{O}$ . Decomp  
by  $\text{H}_2\text{O}$ . (Fischer and Cuntze.)

#### Cobaltimolybdic acid.

Ammonium barium cobaltous cobaltimolyb-  
date,  $\frac{1}{2}(\text{NH}_4)_2\text{O}, 1\frac{1}{2}\text{BaO}, \text{CoO}, \text{CoO}_2$ ,  
 $10\text{MoO}_3 + 18\frac{1}{2}\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$  (Friedheim and  
Keller, B. 1906, 39, 4306)

Ammonium cobaltous cobaltimolybdate,  
 $2(\text{NH}_4)_2\text{O}, \text{CoO}, \text{CoO}_2, 10\text{MoO}_3 + 12\text{H}_2\text{O}$ .

Much more sol. in  $\text{H}_2\text{O}$  than  $3(\text{NH}_4)_2\text{O}$ ,  
 $\text{CoO}, \text{CoO}_2, 12\text{MoO}_3 + 20\text{H}_2\text{O}$ . Sp. gr. of  
cold sat. solution = 1.006 (Friedheim and  
Keller.)

$3(\text{NH}_4)_2\text{O}, \text{CoO}, \text{CoO}_2, 12\text{MoO}_3 + 20\text{H}_2\text{O}$ .  
100 cc. cold sat. aqueous solution contain  
3 g. of the salt. Sp. gr. of the solution = 1.0234  
Sol. in conc.  $\text{HCl}$ .

Decomp. by conc.  $\text{H}_2\text{SO}_4$  by  $\text{KOH} + \text{Aq}$   
and by  $\text{NaOH} + \text{Aq}$ . (Friedheim and Keller.)

Barium cobaltous cobaltimolybdate,  
 $3\text{BaO}, \text{CoO}, \text{CoO}_2, 9\text{MoO}_3 + 25\text{H}_2\text{O}$   
Sl. sol. in  $\text{H}_2\text{O}$ . (Friedheim and Keller.)

**Cobaltous potassium cobaltimolybdate,**  
 $\text{CoO}, 3\text{K}_2\text{O}, \text{CoO}_2, 10\text{MoO}_3 + 10\text{H}_2\text{O}$   
 (Kurnakoff, Ch. Z. 1890, 14. 113.)

+11H<sub>2</sub>O. Sol. in conc. HCl. Decomp. by KOH+ $\text{Aq}$  and by NaOH+ $\text{Aq}$ . (Friedheim and Keller.)

$3\text{K}_2\text{O}, \text{CoO}, \text{CoO}_2, 12\text{MoO}_3 + 15\text{H}_2\text{O}$  Sl. sol. in H<sub>2</sub>O. Sol. in conc. HCl. Decomp. by KOH+ $\text{Aq}$  and by NaOH+ $\text{Aq}$ . (Friedheim and Keller.)  
 +20H<sub>2</sub>O. (Kurnakoff, Ch. Z. 1890, 14. 113.)

**Potassium cobaltimolybdate,**  
 $3\text{K}_2\text{O}, \text{CoO}_2, 9\text{MoO}_3 + 6\frac{1}{2}\text{H}_2\text{O}$

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 703)

**Cobaltinitrocyanhydric acid.**

**Potassium cobaltinitrocyanide,**  
 $\text{K}_4\text{Co}_2(\text{CN})_2\text{NO}_2 + 3\text{H}_2\text{O}$

Very sol. in H<sub>2</sub>O but quickly decomp. Insol. in alcohol (Rosenheim and Koppel, Z. anorg. 1898, 17. 68)

**Silver cobaltinitrocyanide,**  
 $\text{Co}_2\text{Ag}_3\text{NO}_2(\text{CN})_{10} + 6\text{H}_2\text{O}$ , and +21H<sub>2</sub>O  
 (Rosenheim and Koppel.)

**Sodium cobaltinitrocyanide,**  
 $\text{Na}_2\text{Co}_2(\text{NO}_2)(\text{CN})_{10} + 11\text{H}_2\text{O}$ .

Very deliquescent. Sol. in H<sub>2</sub>O (Rosenheim and Koppel)

**Cobaltisulphurous acid, H<sub>2</sub>Co<sub>2</sub>(SO<sub>2</sub>)<sub>2</sub>**  
 Not obtained in a solid state. (Berglund, Acta Lund. 1872.)

**Cobaltisulphites.**

The cobaltisulphites are insol. or at least very sl. sol. in H<sub>2</sub>O. (Berglund, Acta Lund. 1872. 23.)

**Ammonium cobaltous cobaltisulphite,**  
 $(\text{NH}_4)_2\text{SO}_3, 2\text{CoSO}_3, \text{Co}_2(\text{SO}_3)_2 + 14\text{H}_2\text{O} =$   
 $(\text{NH}_4)_2\text{Co}_2\text{Co}_2(\text{SO}_3)_6 + 14\text{H}_2\text{O}$

Scarcely sol. in H<sub>2</sub>O, but decomp. thereby. Easily sol. in acids, when finely divided, also in H<sub>2</sub>SO<sub>3</sub>+ $\text{Aq}$  (Berglund)

$2(\text{NH}_4)_2\text{SO}_3, \text{CoSO}_3, \text{Co}_2(\text{SO}_3)_2 + 8\text{H}_2\text{O} =$   
 $(\text{NH}_4)_4\text{CoCo}_2(\text{SO}_3)_6 + 8\text{H}_2\text{O}$  As above. (Berglund.)

**Barium cobaltisulphite, 3BaSO<sub>3</sub>, Co<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub> + 12H<sub>2</sub>O = Ba<sub>3</sub>Co<sub>2</sub>(SO<sub>3</sub>)<sub>6</sub> + 12H<sub>2</sub>O.**

Ppt. Insol. in H<sub>2</sub>O. Not attacked by cold acids even H<sub>2</sub>SO<sub>4</sub>, but is decomp. by boiling therewith. (Berglund, Acta Lund. 1872.)

**Bismuth cobaltisulphite, Bi<sub>2</sub>Co<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>.**

Insol. in H<sub>2</sub>O, dil. HNO<sub>3</sub>, or HCl+ $\text{Aq}$ . (Berglund, Acta Lund. 1872. 31.)

**Calcium cobaltisulphite, Ca<sub>2</sub>Co<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>.**

Ppt. Insol. in H<sub>2</sub>O or HCl+ $\text{Aq}$ . (Berglund, Acta Lund. 1872. 30)

**Cobaltous cobaltisulphite, Co<sub>2</sub>Co<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub> = 3CoSO<sub>3</sub>, Co<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>.**

Ppt. (Berglund, B. 7. 470.)

**Cobaltous potassium cobaltisulphite,**  
 $\text{CoK}_4\text{Co}_2(\text{SO}_3)_6$ .

Insol. in H<sub>2</sub>O. (Berglund.)

**Silver cobaltisulphite, Co<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>, 3Ag<sub>2</sub>SO<sub>3</sub>.**

Properties as the following comp. (Berglund)

**Silver cobaltous cobaltisulphite, CoSO<sub>3</sub>, Co<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>, 2Ag<sub>2</sub>SO<sub>3</sub>+9H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O. Insol. in HNO<sub>3</sub>+ $\text{Aq}$ . Decomp. by HCl or H<sub>2</sub>S+ $\text{Aq}$ . (Berglund.)

**Sodium cobaltous cobaltisulphite.**

Decomp. by H<sub>2</sub>O, so that it has not been obtained pure (Berglund, Acta Lund 1872, 29.)

**Cobaltoctamine sulphurous acid.**

See Octamine cobaltisulphurous acid.

**Cobaltocobalticyanhydric acid,**

$\text{H}_2\text{Co}_2(\text{CN})_{11}$ .

Unstable. (Jackson and Comey, Am. Ch. J. 1897. 19, 277.)

**Barium cobaltocobalticyanide,**

$\text{BaHCo}_2(\text{CN})_{11} + 1\frac{1}{2}\text{H}_2\text{O}$ .

Somewhat sol. in H<sub>2</sub>O when pure.

The crude salt is insol. even in hot H<sub>2</sub>O. (Jackson and Comey.)

**Cupric cobaltocobalticyanide, Cu<sub>2</sub>Co<sub>2</sub>(CN)<sub>22</sub> + 4H<sub>2</sub>O.**

Ppt. (Jackson and Comey)

**Potassium hydrogen cobaltocobalticyanide,**  
 $\text{K}_2\text{HCo}_2(\text{CN})_{11} + 2\text{H}_2\text{O}$

Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O.

Insol. in alcohol (Jackson and Comey.)

$\text{KH}_4\text{Co}_2(\text{CN})_{11} + \text{H}_2\text{O}$ . Insol. in cold or hot H<sub>2</sub>O when impure

The pure salt is slowly sol. in cold H<sub>2</sub>O.

More sol. in warm H<sub>2</sub>O. (Jackson and Comey)

**Silver cobaltocobalticyanide, Ag<sub>2</sub>Co<sub>2</sub>(CN)<sub>11</sub> + H<sub>2</sub>O.**

Ppt. (Jackson and Comey, B. 1896, 29. 1021.)

**Zinc cobaltocobalticyanide, ZnHCo<sub>2</sub>(CN)<sub>11</sub> + 3H<sub>2</sub>O.**

Ppt. (Jackson and Comey.)

**Cobaltocyanhydric acid,  $\text{H}_2\text{Co}(\text{CN})_6$ .**

Very unstable. Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

**Cuprous potassium cobaltocyanide,  $\text{K}_2\text{CuCo}(\text{CN})_6$ .**

(Straus, Z. anorg. 1895, 9, 17)

**Potassium cobaltocyanide,  $\text{K}_3\text{Co}(\text{CN})_6$ .**

Decomp. on air. Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and ether. (Descamps, Zeit. Ch. 1868, 952.)

**Cobaltous acid.****Barium cobaltite,  $\text{BaCoO}_3$ .**

Insol. in  $\text{H}_2\text{O}$  or dil  $\text{HCl}$ .  $\text{H}_2\text{O}_2 + \text{Aq}$ . Sol. in  $\text{HCl} + \text{Aq}$ . (Rousseau, C. R. 109, 64.)  $\text{BaCo}_2\text{O}_4$ . As above. (Rousseau.)

**Cobaltous potassium cobaltite,  $3\text{CoO}_3, \text{CoO}, \text{K}_2\text{O}$ .**

Rapidly hydrolysed by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl}$ . (Bellucci, Chem. Soc. 1907, 92, (2) 354)

**Magnesium cobaltite,  $\text{MgCoO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Easily sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ , from which it is pptd by  $\text{KOH} + \text{Aq}$  (Berzelius, Pogg. 33, 126.)

Sol. in  $\text{HF}$ ,  $\text{HCl}$ ,  $\text{HNO}_3 + \text{H}_2\text{SO}_4$ ; decomp. and partially dissolved by  $\text{NH}_4\text{OH} + \text{Aq}$ ; quite stable when heated. (Dufau, C. R. 1896, 123, 240.)

**Potassium cobaltite.**

According to Bellucci and Dominici the compounds formerly described are more or less decomp. by hydrolysis. (C. C. 1907, I, 1530.)

**Sodium cobaltite.**

Sol. in  $\text{NaOH} + \text{Aq}$ , but pptd. by diluting the solution.

**Columbic acid (Niobic acid),  $3\text{Cb}_2\text{O}_5, 4\text{H}_2\text{O}$ , or  $3\text{Cb}_2\text{O}_5, 7\text{H}_2\text{O}$ .**

Easily sol. in  $\text{HF}$ ; very sl. sol. in  $\text{HCl} + \text{Aq}$ , but is sol. in  $\text{H}_2\text{O}$  after being treated with  $\text{HCl} + \text{Aq}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{KOH} + \text{Aq}$ . Insol. in  $\text{NaOH} + \text{Aq}$ , but becomes sol. in  $\text{H}_2\text{O}$  by being treated with  $\text{NaOH} + \text{Aq}$ . Sol. in boiling  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . (Rose, Pogg. 113, 109.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 830.)

$\text{Cb}_2\text{O}_5, 4\text{H}_2\text{O}$ .

$\text{Cb}_2\text{O}_5, 7\text{H}_2\text{O}$ . (Santesson, Bull. Soc. (2) 24, 52.)

**Aluminum columbate,  $\text{Al}_2\text{O}_3, 3\text{Cb}_2\text{O}_5 + 12\text{H}_2\text{O}$ .**

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, 30, 1652.)

**Barium columbate,  $7\text{BaO}, 6\text{Cb}_2\text{O}_5 + 18\text{H}_2\text{O}$ .**  
Ppt. (Bedford, J. Am. Chem. Soc. 1905, 27, 1218.)**Cadmium columbate,  $\text{CdO}, \text{Cb}_2\text{O}_5$ .**

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{HKSO}_4$  at red heat. (Larsson, Z. anorg. 1896, 12, 190.)  
 $+ 3\frac{1}{2}\text{H}_2\text{O}$ . Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, 30, 1652.)

**Cæsium columbate,  $4\text{Cs}_2\text{O}, 3\text{Cb}_2\text{O}_5 + 14\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (E. F. Smith, J. Am. Chem. Soc. 1908, 30, 1654.)  
 $7\text{Cs}_2\text{O}, 6\text{Cb}_2\text{O}_5 + 30\text{H}_2\text{O}$ . Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, 30, 1655.)

**Calcium columbate,  $2\text{CaO}, \text{Cb}_2\text{O}_5$ .**

Insol. in  $\text{H}_2\text{O}$  (Joly, C. R. 81, 266.)  
 $\text{CaO}, \text{Cb}_2\text{O}_5$ . Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{HKSO}_4$  at red heat. (Larsson, Z. anorg. 1896, 12, 195.)

**Cobalt columbate,  $\text{CoO}, \text{Cb}_2\text{O}_5$ .**

Sol. in conc. boiling  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{HKSO}_4$  at red heat. (Larsson.)

**Copper columbate,  $\text{CuO}, \text{Cb}_2\text{O}_5$ .**

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{HKSO}_4$  at red heat. (Larsson.)  
 $+ 3\frac{1}{2}\text{H}_2\text{O}$ . Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, 30, 1652.)

**Iron (ferrous) columbate,  $\text{Fe}(\text{CbO})_2$ .**

Min. *Columbite*. Insol. in acids.

**Iron (ferrous)-columbate tantalate,  $x\text{Fe}(\text{TaO})_2, y\text{Fe}(\text{CbO})_2$ .**

Min. *Tantalite*. Not attacked by acids.  
 $\text{Fe}(\text{CbO})_2, 4\text{Fe}(\text{TaO})_2$ . Min. *Tapiachite*.

**Lithium columbate,  $7\text{Li}_2\text{O}, 6\text{Cb}_2\text{O}_5 + 26\text{H}_2\text{O}$ .**

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, 30, 1655.)

**Magnesium columbate,  $\text{MgO}, \text{Cb}_2\text{O}_5$ .**

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{KHSO}_4$  at red heat. (Larsson, Z. anorg. 1896, 12, 196.)  
 $+ 4\text{H}_2\text{O}$ . Precipitate. (Rammelsberg)  
 $+ 7\text{H}_2\text{O}$ . Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, 30, 1651.)

$4\text{MgO}, \text{Cb}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$  (Joly, C. R. 81, 266.)

$3\text{MgO}, \text{Cb}_2\text{O}_5$ . As above.

**Manganous columbate.**

Insol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 81, 266.)  
 $3\text{MnO}, 5\text{Cb}_2\text{O}_5$ . Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{HKSO}_4$  at red heat. (Larsson, Z. anorg., 1896, 12, 201.)

**Potassium columbate,  $\text{KCbO}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Joly, in Fremy's Encyc. Ch.)  
 $\text{K}_2\text{Cb}_2\text{O}_7 + 5\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  (Santesson.)

$\text{K}_2\text{Cb}_2\text{O}_{10} + 5\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ .  
 $\text{K}_2\text{Cb}_2\text{O}_7 + 11\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Santesson, Bull. Soc. (2) 24. 53.)

$\text{K}_2\text{Cb}_2\text{O}_{12} + 11\text{H}_2\text{O}$ . (Santesson.)  
 $\text{K}_2\text{Cb}_2\text{O}_{13} + 13\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .  
 $\text{K}_2\text{Cb}_2\text{O}_{10} + 10\text{H}_2\text{O}$ . Efflorescent Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (4) 8. 20)

Very sol. in  $\text{H}_2\text{O}$ . (E. F. Smith, J. Am. Chem. Soc. 1908, 30. 1652.)

$\text{K}_2\text{Cb}_2\text{O}_{17} + 27\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (E. F. Smith)

$\text{K}_2\text{Cb}_2\text{O}_{15} + 32\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

**Potassium sodium columbate,  $3\text{K}_2\text{O}, \text{Na}_2\text{O}, 3\text{Cb}_2\text{O}_5 + 9\text{H}_2\text{O}$ .**

Very slightly sol. in  $\text{H}_2\text{O}$ . Insol. in alkalis. (Marignac.)

**Rubidium columbate,  $3\text{Rb}_2\text{O}, 4\text{Cb}_2\text{O}_5 + 9\frac{1}{2}\text{H}_2\text{O}$ .**

(E. F. Smith, J. Am. Chem. Soc. 1908, 30. 1655.)

$4\text{Rb}_2\text{O}, 3\text{Cb}_2\text{O}_5 + 14\text{H}_2\text{O}$ . Very sol in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Silver columbate,  $\text{Ag}_2\text{O}, \text{Cb}_2\text{O}_5 + 2\text{H}_2\text{O}$** 

Ppt. (E. F. Smith.)

$7\text{Ag}_2\text{O}, 6\text{Cb}_2\text{O}_5 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Bedford, J. Am. Chem. Soc. 1905, 27. 1218.)

**Sodium columbate,  $\text{NaCbO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ .**

Completely sol. in  $\text{H}_2\text{O}$ . (Rose.)

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, 30. 1651.)

$+ 2\frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . Insol. in  $\text{NaOH} + \text{Ag}$ . (Santesson.)

$2\text{Na}_2\text{O}, 3\text{Cb}_2\text{O}_5 + 9\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or  $\text{NaOH} + \text{Ag}$ . (Santesson.)

$8\text{Na}_2\text{O}, 7\text{Cb}_2\text{O}_5$ . 1 pt. is sol. in 195–200 pts.  $\text{H}_2\text{O}$  at  $14-20^\circ$ ; in ether 75–80 pts. or in 103 pts. boiling water. (Rose.)

$7\text{Na}_2\text{O}, 3\text{Cb}_2\text{O}_5 + 32\text{H}_2\text{O}$ . Very stable. Sol. in  $\text{H}_2\text{O}$ . (Bedford, J. Am. Chem. Soc. 1905, 27. 1217.)

**Thorium columbate,  $5\text{Th}_2\text{O}_3, 16\text{Cb}_2\text{O}_5$ .**

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{H}_2\text{SO}_4$  at red heat. (Larsen, Z. anorg. 1896, 12. 202.)

**Yttrium columbate,  $\text{Y}_2\text{O}_3, \text{Cb}_2\text{O}_5$ .**

Insol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 81. 1261.)

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{H}_2\text{SO}_4$  at red heat. (Larsen)

**Zinc columbate,  $\text{ZnO}, \text{Cb}_2\text{O}_5$ .**

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{H}_2\text{SO}_4$  at red heat. (Larsen.)

$7\text{ZnO}, 6\text{Cb}_2\text{O}_5 + 25\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ . (Bedford, J. Am. Chem. Soc. 1905, 27. 1218.)

**Zirconium columbate,  $\text{ZrO}_2, 5\text{Cb}_2\text{O}_5$ .**

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{H}_2\text{SO}_4$  at red heat (Larsen.)

**Percolumbic acid.**

See Percolumbic acid.

**Columbium (Niobium),  $\text{Cb}$ .**

Slightly attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia. Conc.  $\text{H}_2\text{SO}_4$  dissolves easily on warming.

Sol. in fused oxidizing agents; sol. in hot conc.  $\text{H}_2\text{SO}_4$  and in  $\text{HF}$ ; also in  $\text{HF} + \text{HNO}_3$ ; insol. in other acids. (Moissan, C. R. 1901, 133. 24.)

**Columbium pentabromide,  $\text{CbBr}_5$ .**

(Rose, Pogg. 104. 422.)

**Columbium carbide nitride,  $3\text{CbC}, 2\text{CbN}$ .**

(Joly, Bull. Soc. (2) 25. 506)

**Columbium trichloride,  $\text{CbCl}_3$ .**

Not deliquescent; not attacked by  $\text{H}_2\text{O}$ , but easily oxidised by  $\text{HNO}_3 + \text{Ag}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Ag}$ . (Rose, C. N. 37. 25)

**Columbium pentachloride,  $\text{CbCl}_5$ .**

Decomp. by  $\text{H}_2\text{O}$  with separation of a hydrate of  $\text{Cb}_2\text{O}_5$ . Sol. in cold  $\text{HCl} + \text{Ag}$ , forming a solution which soon gelatinises, and separates out  $\text{Cb}_2\text{O}_5$  by heat or dilution, with hot  $\text{HCl} + \text{Ag}$ , forms a cloudy solution which does not gelatinise. Sol. in  $\text{H}_2\text{SO}_4$  to form a clear liquid which gelatinises on heating. Sol. in  $\text{KOH} + \text{Ag}$ . Sol. in alcohol with slight residue (Rose, Pogg. 104. 432.)

**Columbium pentafluoride,  $\text{CbF}_5$ .**

Very hygroscopic; sol. in  $\text{H}_2\text{O}$  without separation of columbic acid. (Ruff, B. 1906, 42. 492.)

**Columbium fluoride with MF.**

See Fluocolumbate, M.

**Columbium hydride,  $\text{CbH}(\text{?})$** 

Insol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , and dil.  $\text{H}_2\text{SO}_4 + \text{Ag}$ , even on boiling. Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ , and in fused  $\text{KHSO}_4$ . Sol. in cold  $\text{HF} + \text{Ag}$  if not too dilute. Also attacked by  $\text{KOH} + \text{Ag}$ . (Marignac, N. Arch. Phys. Nat. 31. 89.) Not attacked by boiling  $\text{H}_2\text{O}$ , or boiling  $\text{HCl}$ .

Oxidized by hot  $\text{H}_2\text{SO}_4$ . Insol. in boiling  $\text{HNO}_3$ . (Muthmann, A. 1907, 355. 90.)

**Columbium hydroxide  $\text{Cb}_2\text{O}_5, z\text{H}_2\text{O}$ .**

See Columbic acid.

**Columbium nitride.**

Not attacked by boiling nitric acid or aqua regia, but sol. in a cold mixture of  $\text{HNO}_3$  and  $\text{HF}$  (Rose, Pogg. 111. 420.)

$\text{Cb}_3\text{N}_4$ . Not attacked by boiling  $\text{H}_2\text{O}$  or  $\text{HCl}$ . Insol. in conc.  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ .

Decomp. by fused  $\text{KOH}$ . Not attacked by boiling with  $\text{KOH} + \text{Aq}$  (Muthmann, A. 1907, 365. 94)

**Columbium dioxide,  $\text{Cb}_2\text{O}_3$ .**

Sol. when still moist in boiling dil.  $\text{HCl} + \text{Aq}$ . Insol. in hot  $\text{HNO}_3$ , less sol. in aqua regia than in  $\text{HCl} + \text{Aq}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$  after long heating. (Rose.)

Insol. in  $\text{H}_2\text{O}$ ,  $\text{KOH}$ , or conc. acids, even when boiling. (Delafontaine.)

**Columbium trioxide,  $\text{Cb}_2\text{O}_3$ .**

Insol. in acids except  $\text{HF}$ . (Smith, Z. anorg. 1894, 7. 28)

**Columbium tetroxide,  $\text{Cb}_2\text{O}_4$ .**

Not attacked by cold or hot  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or aqua regia. Slightly attacked by boiling  $\text{KOH} + \text{Aq}$ . (Delafontaine.)

**Columbium pentoxide,  $\text{Cb}_2\text{O}_5$ .**

When ignited insol. in hot conc.  $\text{H}_2\text{SO}_4$ . When it has not been ignited it forms a clear solution with  $\text{H}_2\text{SO}_4$ , which can be diluted without forming any precipitate (Rose, Pogg. 112. 549.)

Sol. in fused  $\text{KHSO}_4$ , which can be diluted with  $\text{H}_2\text{O}$  without causing pptn. Insol. in  $\text{HF}$ .

**Columbium oxybromide,  $\text{CbOBr}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  into  $\text{Cb}_2\text{O}_3$  and  $\text{HBr}$ . Sol. in hot  $\text{H}_2\text{SO}_4$  and conc.  $\text{HCl} + \text{Aq}$ . (Rose, Pogg. 104. 442.)

$3\text{H}_2\text{O}$ ,  $\text{Cb}_2\text{O}_4$ ,  $\text{HBr}(\text{?})$ . Easily sublimed. (Smith, Z. anorg. 1894, 7. 97.)

**Columbium oxybromide rubidium bromide,  $\text{CbOBr}_3, 2\text{RbBr}$** 

Unstable in moist air. Decomp. by  $\text{H}_2\text{O}$  (Weinland, B. 1905, 39. 3059.)

**Columbium oxychloride,  $\text{CbOCl}_3$ .**

Attracts  $\text{H}_2\text{O}$  from air without deliquescent and decomposed. Decomp. with  $\text{H}_2\text{O}$  with evolution of heat. Insol. in hot or cold  $\text{HCl} + \text{Aq}$ . Sol. by long contact with  $\text{H}_2\text{SO}_4$  to a cloudy liquid, which clears up on warming, but soon separates out  $\text{Cb}_2\text{O}_3$ . Sol. in cold  $\text{KOH} + \text{Aq}$  and hot  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Rose.)

Sol. in alcohol, from which it is precipitated by ether. (Blomstrand.)

$3\text{H}_2\text{O}$ ,  $\text{Cb}_2\text{O}_4$ ,  $\text{HCl}$ . Sublimate. (Smith, Z. anorg. 1894, 7. 97)

**Columbium oxychloride rubidium chloride,  $\text{CbOCl}_3, 2\text{RbCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1906, 39. 3057)

**Columbium oxyfluoride,  $\text{CbOF}_3$ .**

(Joly, C. R. 81. 1266)

**Columbium oxyfluoride with MF.**

See Fluoxycolumbate, and Fluoxyhypocolumbate, M.

**Columbium oxysulphide,  $\text{Cb}_2\text{OS}_2$ .**

Insol. in boiling  $\text{HCl} + \text{Aq}$ . Slowly decomp. into  $\text{Cb}_2\text{O}_3$  by boiling with  $\text{HNO}_3$  or aqua regia. Insol. in boiling dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Converted into columbic sulphate, sol. in  $\text{H}_2\text{O}$ , by boiling conc.  $\text{H}_2\text{SO}_4$ . Sl. sol. in hot  $\text{HF}$ . Insol. in boiling  $\text{K}_2\text{S} + \text{Aq}$ . (Rose, Pogg. 111. 193.)

**Copper, Cu**

Copper is not attacked by distilled  $\text{H}_2\text{O}$ , or by  $\text{NH}_4\text{NO}_3$ ,  $\text{KNO}_3$ , or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ , or by a mixture of those salts in solution. (Muir, cited by Carnelly, Chem. Soc. 30. 1.)

Distilled  $\text{H}_2\text{O}$  has slight action on Cu. 100 ccm.  $\text{H}_2\text{O}$  dissolved from 2 sq. dem. Cu from 0.035 mg. Cu in one hour up to 0.280 mg. in 72 hours. 100 ccm.  $\text{H}_2\text{O}$  dissolved 0.44 mg. from 6 sq. dem. in 48 hours. Presence of solder diminishes solubility about one-half. At 90–100° the amount dissolved is about one-half that at ord. temp. (Carnelly, Chem. Soc. 30. 1.)

100 ccm. distilled  $\text{H}_2\text{O}$  dissolved only 1 mg. Cu from 11.8 sq. cm. during a week, while air free from  $\text{CO}_2$  was conducted through the solution. When the air contained  $\text{CO}_2$ , 3 mg. were dissolved. (Wagner, Dingl. 221. 259)

100 l. sea water dissolved 12.96 g. Cu from 1 sq. m. (Calvert and Johnson, C. N. 11. 171)

**Solubility in  $\text{H}_2\text{SO}_4$ .**

Not attacked by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Vogel, Schw. J. 32. 301.)

Action of  $\text{H}_2\text{SO}_4$  at ordinary temp. is very slight even after a long time. (Barruel, J. Pharm. 20. 13 [1834].)

$\text{H}_2\text{SO}_4$  has no action below 130°. (Calvert and Johnson, Chem. Soc. 19. 438.)

$\text{H}_2\text{SO}_4$  acts slightly even at 20°.

16.3 g.  $\text{H}_2\text{SO}_4$  (1.843 sp. gr.) dissolved the following amts. from 3 g. Cu, having a surface of 65 sq. cm. at the given temp.

Temp	Time	% Cu dissolved
19°	14 days	About 6
60	120 min.	2 5
80	30 "	1 5
100	30 "	3 1
124	30 "	22 7
130	30 "	32 6
137	30 "	35 0
150	30 "	69 2
170	10 "	51 92
195	2 "	53 5
220	½ "	70 57
270	few seconds	nearly 100

With dilute acid the action was much less violent, as is seen in the following table—

Temp	Time *	Acid	Sp. gr.	% Cu dissolved
100°	30 min.	H <sub>2</sub> SO <sub>4</sub>	1.843	2.380
100	30 "	2H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1.8295	0.585
100	30 "	H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1.780	0
100	30 "	H <sub>2</sub> SCl <sub>4</sub> , 2H <sub>2</sub> O	1.620	0
130	30 "	H <sub>2</sub> SO <sub>4</sub>	1.843	32.6
130	30 "	H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1.780	1.18
130	30 "	H <sub>2</sub> SO <sub>4</sub> , 2H <sub>2</sub> O	1.620	0
165	15 "	H <sub>2</sub> SO <sub>4</sub>	1.843	70
165	30 "	H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1.780	16.5
165	30 "	H <sub>2</sub> SO <sub>4</sub> , 2H <sub>2</sub> O	1.620	2.7

(Pickering, Chem. Soc. 33, 112.)

Cu is very sl. attacked by cold HCl + Aq. of 1.12 sp. gr., but somewhat more on warming. Even less sol. in dil. HCl + Aq. (Lowe, Z. anal. 4, 361.)

Sol. in warm conc. HI + Aq. (Rose.)

Slowly attacked by H<sub>2</sub>SO<sub>4</sub> + Aq. (Causse, Bull. Soc. (2) 45, 3.)

More or less sol. in all dil. mineral acids and also in organic acids, as acetic, tartaric, etc., when supply of air is afforded; but absolutely insol. in the latter acids when air is wholly excluded. The importance of this fact in the use of Cu cooking utensils is manifest.

Easily attacked by ord. HNO<sub>3</sub> + Aq.

With very conc. HNO<sub>3</sub> + Aq. (sp. gr. 1.52) it becomes passive, as in the case of Fe.

Pure dil. HNO<sub>3</sub> + Aq. of 1.07 sp. gr. or less does not attack Cu at 20°, but if NO<sub>2</sub> or KNO<sub>3</sub> is added the action begins at once. If HNO<sub>3</sub> + Aq. is more conc. the Cu is attacked. HNO<sub>3</sub> + Aq. of 1.108 sp. gr. begins to act at -2°, and of 1.217 sp. gr. at -10°.

HNO<sub>3</sub> + Aq. of 1.512 sp. gr. attacks Cu violently at 20°, but action soon ceases on account of formation of a crust of Cu(NO<sub>3</sub>)<sub>2</sub>, insol. in pure HNO<sub>3</sub>. (Millon, A. ch. (3) 6, 95.)

Easily sol. in 2N-HClO<sub>4</sub> + Aq. at 50°. (Hendrixson, J. Am. Chem. Soc. 1904, 26, 756.)

Not appreciably sol. in anhydrous HF. (Poulenc, A. ch. 1894, (7) 2, 12.)

When in contact with the air, Cu is soon oxidised by acids, alkalis (especially NH<sub>4</sub>OH + Aq.), and many fatty bodies.

Sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq. (Traube, B. 18, 1887.)

Slowly sol. in NH<sub>4</sub>OH + Aq. (Schönbein, B. A. B. 1856, 580.)

Sol. in KI + Aq. when warm and conc. (Rose.)

When finely divided, Cu is easily sol. in hot FeCl<sub>3</sub> + Aq.

Action of dilute solutions of salts on solubility of Cu in H<sub>2</sub>O.

100 ccm. solution of the following salts dissolve the amts. of Cu given below, from a surface of 1 sq. decm. in 48 hours.

Salts	G salt dissolved in 100 ccm. H <sub>2</sub> O	Mg. Cu dissolved
H <sub>2</sub> O		0.11
KNO <sub>3</sub>	{ 0.01 0.05 5.00	{ 0.07 0.13 0.16
NaNO <sub>3</sub>	{ 0.05 5.00	{ 0.18 0.19
CaSO <sub>4</sub>	0.05	0.11
K <sub>2</sub> SO <sub>4</sub>	{ 0.05 5.00	{ 0.12 0.28
MgSO <sub>4</sub>	{ 0.05 5.00	{ 0.16 0.34
Na <sub>2</sub> CO <sub>3</sub>	{ 0.01 0.05 5.00	{ 0.05 0.11 2.80
K <sub>2</sub> CO <sub>3</sub>	{ 0.05 5.00	{ 0.14 2.35
NaCl	{ 0.01 0.05 5.00	{ 0.05 0.13 7.50
KCl	5.00	8.17
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	{ 0.05 5.00	{ 0.66 28.50
NH <sub>4</sub> NO <sub>3</sub>	{ 0.01 0.05 5.00	{ 0.17 0.66 60.00
NH <sub>4</sub> Cl	{ 0.05 5.00	{ 0.92 158.75

At 100° the action of KNO<sub>3</sub>, K<sub>2</sub>SO<sub>4</sub>, and NH<sub>4</sub>NO<sub>3</sub> is diminished, while that of (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>CO<sub>3</sub>, and NaCl is increased.

Tables are also given for mixtures of the above salts. (Carnelley, Chem. Soc. 30, 1.)

Solubility of Cu in dilute salt solutions. 11.8 sq. cm. Cu were used, and the action continued one week, while air with or without CO<sub>2</sub> was passed through the solution continually.

100 ccm. solution of the following salts dissolved the given amts. Cu

Salt	G salt dissolved in 100 ccm. H <sub>2</sub> O	Mg Cu dissolved without CO <sub>2</sub>	Mg Cu dissolved with CO <sub>2</sub>
NaCl	0 50	4	115
KCl	0 50	4	115
MgCl <sub>2</sub>	0 83	5	112
NH <sub>4</sub> Cl	1 00	904	138
K <sub>2</sub> SO <sub>4</sub>	1 00	0	4
KNO <sub>3</sub>	1 00	0	3
Na <sub>2</sub> CO <sub>3</sub>	1 00	0	
NaOH	0.923	0	
CaO <sub>2</sub> H <sub>2</sub>	sat.	0	

(Wagner, Dingl. 221. 260)

Distilled H<sub>2</sub>O dissolved no Cu from 420 sq. mm in 150 hours at ord temp

NH<sub>4</sub>NO<sub>3</sub>+Aq with less than 0.4 g. per litre showed the same result.

KNO<sub>3</sub>+Aq or (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq containing 0.1 to 0.2 g. per litre dissolved no Cu.

H<sub>2</sub>O containing carbonates+nitrates, carbonates+sulphates, or chlorides+nitrates also dissolved no Cu.

NH<sub>4</sub>NO<sub>3</sub>+Aq containing 0.4 g. per litre dissolved 3 mg. per litre after 150 hours contact.

From a surface of 2100 sq. m. of Cu, H<sub>2</sub>O charged with CO<sub>2</sub> at ord. pressure, and containing the following salts in solution, dissolved the given amts Cu. in 120 hours

Salt	G salt dissolved in 1 l. H <sub>2</sub> O	Mg Cu dissolved
H <sub>2</sub> O	.	1 0
K <sub>2</sub> CO <sub>3</sub>	0 2	0.2
CaCl <sub>2</sub>	0 2	1 80
NH <sub>4</sub> NO <sub>3</sub>	0 02	1.40
NH <sub>4</sub> NO <sub>2</sub>	0 04	1.40
K <sub>2</sub> CO <sub>3</sub> + NH <sub>4</sub> NO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub> + NH <sub>4</sub> NO <sub>3</sub> + NH <sub>4</sub> NO <sub>2</sub> + CaCl <sub>2</sub>	0 1 0 02 0 2 0 04 0 2 0 2	1.00 0.1 3 6

From a surface of 2100 sq. m., H<sub>2</sub>O charged with CO<sub>2</sub> at pressure of 6 atmos. dissolved 0.6 mg in 48 hours.

H<sub>2</sub>O when charged with CO<sub>2</sub> at 6 atmos. and containing:

18 mg. NH<sub>4</sub>NO<sub>3</sub> per litre, dissolved 0.8 mg. in 48 hours.

80 mg. NH<sub>4</sub>NO<sub>3</sub> per litre, dissolved 1.4 mg. in 48 hours.

40 mg K<sub>2</sub>CO<sub>3</sub> per litre, dissolved 1.2 mg in 48 hours. (Muir, Proc. Soc. Manchester, 15. 31.)

Sol. in KCN+Aq. (Goyder, C. N. 1894, 69. 262.)

A solution of (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub> containing 0.829 g.

in 110 cc. dissolves 0.2050-0.2279 g. Cu. (Turrentine, J. phys Chem 1907, 11. 625.)  
Sol. attacked by liquid NH<sub>3</sub> (Franklin, Am. Ch. J. 1898, 20. 827.)

Amts. Cu dissolved by action of various oils on 8 sq. in Cu by 10 days' exposure and subsequent 67 days—

	Am. Cu dissolved in 10 days	Am. Cu dissolved in subsequent 67 days
Linseed oil	0.3000 grain	0 2435 grain
Olive oil	0 2200 "	0 0200 "
Colza oil	0 0170 "	0 1230 "
Almond oil	0 1030 "	0 1170 "
Seal oil	0.0485 "	0 0315 "
Sperm oil	0.0030 "	0 0575 "
Castor oil	0.0065 "	0 0035 "
Nestsfoot oil	0 1100 "	
Sesame oil	0 1700 "	0.0015 "
Paraffine oil	0.0015 "	

(Watson, C. N. 36. 200.)

Qualitative results of the action of various oils on Cu are also given by Thompson. (C. N. 34. 176, 200, 219.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0157 g Cu in 6 days. (Gates, J. phys Chem. 1911, 15. 143)

Sol in an alkaline solution of gelatine (3.54 %) copper gauze dissolved in 48 hours (Lidoff, C. C. 1899, II 471)

#### Cuprous acetylide, Cu<sub>2</sub>C<sub>2</sub>.

Decomp. by heating with H<sub>2</sub>O or KCN+Aq. Decomp. by HNO<sub>3</sub>. (Keiser, Am. Ch. J. 1892, 14. 289)

Not decomp. by H<sub>2</sub>SO<sub>4</sub>, NH<sub>4</sub>OH, KOH + Aq or acetic acid, even on warming. The dry salt is sol. in very dil. HCl+Aq without evolution of gas. Sol. in conc. KCN+Aq (Böttger, A. 1859, 109. 356.)

#### Cupric acetylide, CuC<sub>2</sub>.

Easily sol. in HCl. Turns brown in the air, and becomes insol. in acids. (Phillips, Z. anorg. 1894, 6. 241.)

3Cu<sub>2</sub>C<sub>2</sub>O+2H<sub>2</sub>O. Solubility as that of Cu<sub>2</sub>C<sub>2</sub>H<sub>2</sub>O<sub>4</sub>. (Söderbaum, B. 1897, 30. 764.)  
Cu<sub>2</sub>C<sub>2</sub>H<sub>2</sub>O<sub>4</sub>. Insol in H<sub>2</sub>O.

When dry is violently decomp. by conc. H<sub>2</sub>SO<sub>4</sub> or not too dil. HNO<sub>3</sub>. Rapidly decomp. by warming with dil. acids, especially HCl.

Insol. in NH<sub>4</sub>OH+Aq in absence of air, partially sol. in presence of air.

Insol. in organic solvents. (Söderbaum, B. 1897, 30. 762.)

#### Cuprous acetylide iodide, Cu<sub>2</sub>C<sub>2</sub>I, CuI.

Ppt. (Berthelot and Delépine, A. ch. 1900, (7) 19. 54.)

**Cupric arsenide,  $\text{Cu}_2\text{As}_2$ .**

(Rensch, J. pr. 24. 244.)

 $\text{Cu}_4\text{As}_2$ . (Gehlen.) $\text{Cu}_2\text{As}_2$  Ppt. Decomp. by acids. (Kane, Pogg. 44. 471) $\text{Cu}_4\text{As}$  Min. *Domeykite*. Insol in HCl+Aq; sol in  $\text{HNO}_3$  $\text{Cu}_4\text{As}$  Min *Algodonite*. $\text{Cu}_6\text{As}$  Min *Darwinite***Cuprous azoumide,  $\text{CuN}_3$ .**Insol. in  $\text{H}_2\text{O}$ . (Curtius)

Sensitive to sunlight. (Wohler, B. 1913, 46. 2053)

**Cupric azoumide, basic,  $\text{CuO}$ ,  $\text{CuN}_3$** Insol. in  $\text{H}_2\text{O}$ . (Wohler, B. 1913, 46. 2055.)**Cupric azoumide,  $\text{CuN}_3$ .**

Very explosive

Very sl sol in  $\text{H}_2\text{O}$ . Decomp by boiling with  $\text{H}_2\text{O}$ . (Curtius, J. pr 1898, (2) 58. 296.)**Copper azoumide ammonia,  $\text{CuN}_3$ ,  $2\text{NH}_3$ .**Ppt. Insol in  $\text{H}_2\text{O}$  Easily sol in dil acids. (Deems, J Am Chem. Soc 1907. 29, 19)**Copper boride,  $\text{Cu}_3\text{B}_2$ .**

(Marsden, J. B., 1880. 330.)

**Cuprous bromide,  $\text{Cu}_2\text{Br}_2$** 1 l.  $\text{H}_2\text{O}$  dissolves at  $18^\circ\text{--}20^\circ$ .

0.4320 millimols bromine.

0.3157 " cupric copper.

0.1061 " cuprous copper.

(Bodländer, Z. anorg. 1902, 31. 460.)

Sol. in  $\text{HBr}$ ,  $\text{HCl}$  without decomp., or  $\text{HNO}_3$ +Aq with decomp., also in  $\text{NH}_4\text{OH}$ +Aq. Insol. in boiling conc.  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$ + $\text{H}_2\text{O}_2$ +Aq (Berthelot, A. ch. 44. 385.)Sol. in  $\text{H}_2\text{SO}_4$ +Aq. (Lean and Whatmough, Chem Soc 1898, 73. 161.)Sol. in  $\text{NaCl}$  and  $\text{Na}_2\text{S}_2\text{O}_3$ +Aq (Re-nault, C. R. 69. 319)Solubility of  $\text{Cu}_2\text{Br}_2$  in  $\text{KBr}$ +Aq.

All values recorded in millimols per litre.

KBr	Total copper	Cupric copper	Cuprous copper
25	0.119	0.012	0.107
40	0.200	0.013	0.187
60	0.310	0.025	0.285
80	0.423	0.012	0.411
100	0.5836	.	0.5836
120	0.6934	.	0.6934
500	8.719	.	8.719

(Bodländer and Storbeck, Z. anorg 1902, 31. 469)

Difficultly sol. in methyl acetate (Naumann, B. 1909, 42. 3790)

Sol in ethyl acetate. (Naumann, B. 1910, 43. 314)

Insol in acetone (Naumann, B. 1904, 37. 4329, Eidmann, C. C. 1897, II. 1014.)

100 g. acetamide dissolve 3.86 g.  $\text{Cu}_2\text{Br}_2$  at  $18^\circ$ . (Naumann and Schier, B. 1914, 47. 249)

Sol. in pyridine. (Naumann, B. 1904, 37. 4609)

Mol. weight determined in pyridine, methyl and ethyl sulphides (Werner, Z. anorg 1897, 16. 19, 26, and 28)

**Cupric bromide,  $\text{CuBr}_2$ .**Deliquescent. Very sol in  $\text{H}_2\text{O}$ . Insol in benzene. (Franchmont, B. 16. 387.)Very sl attacked by cold or even hot  $\text{H}_2\text{SO}_4$ . (Viard, C. R. 1902, 135. 169.)Moderately sol in liquid  $\text{NH}_3$ . (Horn, Am Ch. J. 1908, 39. 219)100 g. 95% formic acid dissolve 0.16 g at  $21^\circ$ . (Aschan, Ch. Z. 1913, 37. 1117)100 g acetamide dissolve 24.43 g.  $\text{CuBr}_2$  at  $18^\circ$ . (Naumann and Schier, B. 1914, 47. 249)

Sol in benzonitrile. (Naumann, B. 1914, 47. 1369)

Sol in methyl acetate. (Naumann, B. 1909, 42. 3790)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Sol. in acetone with a brown color. (Eidmann, C. C. 1899, II. 1014.)

+ $2\text{H}_2\text{O}$ ? (Berthelot, A. ch. 1830, 44. 385)+ $\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Sabatier, Bull Soc 1894, (3) 11. 677.)**Cupric hydrogen bromide,  $\text{CuBr}_2$ ,  $\text{HBr}$ + $2\text{H}_2\text{O}$** Decomp. by  $\text{H}_2\text{O}$  (Sabatier, Bull. Soc. 1894, (3) 11. 681)+ $10\text{H}_2\text{O}$ . (Weinland and Knoll, Z. anorg. 1905, 44. 116.)**Cupric lithium bromide,  $\text{CuBr}_2$ ,  $2\text{LiBr}$ + $6\text{H}_2\text{O}$ .**

Very hygroscopic. (Sementschenko, Z. anorg. 1899, 19. 336)

Very hygroscopic; decomp. by  $\text{H}_2\text{O}$ . (Kurnakoff, C. C. 1899, I. 16.)**Cupric potassium bromide,  $\text{CuBr}_2$ ,  $\text{KBr}$ .**Decomp. by  $\text{H}_2\text{O}$ . (Sabatier, Bull. Soc. 1894, (3) 11. 683.)**Cuprous bromide ammonia,  $\text{Cu}_2\text{Br}_2$ ,  $2\text{NH}_3$ .**

Stable when dry.

Easily sol in  $\text{HNO}_3$  and  $\text{NH}_4\text{OH}$ +Aq.Other mineral acids and acetic acid separate  $\text{Cu}_2\text{Br}_2$ . (Richards, Z. anorg. 1898, 17. 245.) $\text{Cu}_2\text{Br}_2$ ,  $8\text{NH}_3$ . (Lloyd.) $\text{Cu}_2\text{Br}_2$ ,  $3\text{NH}_3$ . (Lloyd, J. phys. Chem. 1902, 19. 300)

Cupric bromide ammonia,  $\text{CuBr}_2 \cdot 2\text{NH}_3$

Sol in  $\text{NH}_4\text{Br} + \text{Aq}$  without decomp (Richards, B. 23. 3790.)

$3\text{CuBr}_2 \cdot 10\text{NH}_3$ . Decomp by  $\text{H}_2\text{O}$  (Richards, Am. Ch. J. 15. 651)

$\text{CuBr}_2 \cdot 3\text{NH}_3$ . Completely sol. in a little  $\text{H}_2\text{O}$ , but is decomp. by dilution. Insol. in alcohol (Rammelsberg, Pogg. 55. 246.)

$\text{CuBr}_2 \cdot 4\text{NH}_3 + \text{H}_2\text{O}$ . 100 pts  $\text{H}_2\text{O}$  dissolve 69.03 pts.  $\text{CuBr}_2 \cdot 4\text{NH}_3$  at  $25^\circ$  (Pudschies, Dissert.)

$\text{CuBr}_2 \cdot 5\text{NH}_3$ . As above. (Rammelsberg.)

$\text{CuBr}_2 \cdot 6\text{NH}_3$ . Sol. in small amts. of  $\text{H}_2\text{O}$ , but decomp. on dilution. (Richards.)

Cupric bromide nitric oxide,  $\text{CuBr}_2 \cdot \text{NO}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Manhot, B. 1914, 47. 1607.)

Cuprous chloride,  $\text{Cu}_2\text{Cl}_2$

1.53 g.  $\text{Cu}_2\text{Cl}_2$  dissolve in 100 g  $\text{H}_2\text{O}$  at  $21.5^\circ$ ; 1.55 g. at  $26.5^\circ$ . (Kremann and Noss, M. 1912, 33. 1206)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{H}_2\text{O}$  in an atmosphere of hydrogen.

Solubility is recorded in mg-atoms per l.

$t^\circ$	Total Cu	$\text{Cu}_2\text{Cl}_2$ by analysis	Cl	$\text{Cu}_2\text{Cl}_2$ calc.	$\text{Cu}_2\text{Cl}_2$ by analysis
20.2	2.752	2.124	5.672	0.628	0.420
21.7	2.919	2.254	5.525	0.645	0.474
19.6	2.971	2.294	5.464	0.677	0.499
19.3	2.861	2.245	5.464	0.616	0.499

(Bodländer, Z. anorg. 1902, 31. 12)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{H}_2\text{O}$  in an atmosphere of  $\text{CO}_2$ .

Solubility is recorded in mg-atoms per l.

$t^\circ$	Total Cu	$\text{Cu}_2\text{Cl}_2$ by analysis	Cl	$\text{Cu}_2\text{Cl}_2$ by analysis	$\text{Cu}_2\text{Cl}_2$ calc.
20.6	2.818	2.243	5.235	0.525	0.562
21.7	2.805	2.258	5.312	0.391	0.602
19.7	2.805	2.138	5.390	0.336	0.667

(Bodländer, l. c.)

Sol. in conc.  $\text{HCl} + \text{Aq}$ ; insol in dil  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ , and only sl. on warming. (Rosenfeld, B. 12. 954.) Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; sol. in hot  $\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{FeCl}_3$ ,  $\text{ZnCl}_2$ ,  $\text{MnCl}_2$ , etc. +  $\text{Aq}$ . 1 mol.  $\text{Na}_2\text{S}_2\text{O}_3$  in aqueous solution dissolves 1 mol.  $\text{Cu}_2\text{Cl}_2$  (Winkler, J. pr. 88. 428.) Sol. in  $\text{KI}$ ,  $\text{I}_2$ ,  $\text{KCN}$ , or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Renault, C. R. 59. 558.)

Solubility in  $\text{HCl} + \text{Aq}$  at  $17^\circ$ .  $\frac{\text{Cu}_2\text{Cl}_2}{2} = \frac{1}{2}$  mols.  $\text{CuCl}_2$  in mgs. in 10 cc. solution.  $\text{HCl} =$  mols.  $\text{HCl}$  in ditto.

$\frac{\text{Cu}_2\text{Cl}_2}{2}$	$\text{HCl}$	Sp. gr.
0.475	8.975	1.050
1.4	15.7	
1.575	18.2	
4.5	34.5	1.080
8.25	47.8	1.135
11.5	57.0	

(Chatelier, calc. by Engel, A. ch. (6) 17. 377.)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{HCl} + \text{Aq}$  at  $0^\circ$ .

$\frac{\text{Cu}_2\text{Cl}_2}{2}$	$\text{HCl}$	Sp. gr.
1.5	17.5	1.049
2.9	26.0	1.065
8.25	44.75	1.132
15.5	68.5	1.261
33.0	104.0	1.345

(Engel, l. c.)

Freshly pptd.  $\text{Cu}_2\text{Cl}_2$  is sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Lean and Whatmough, Chem. Soc. 1898, 73. 150.)

Sl. sol. in normal  $\text{NH}_4\text{OH} + \text{Aq}$  only by shaking several hours, a 0.02 normal solution of cuprous copper being obtained. (Gause, Z. anorg. 1900, 25. 258.)

Insol. in  $\text{Na}_2\text{S}_2\text{O}_4 + \text{Aq}$ . (Siewert, Gm. K. 5. 1. 803.)

Sol. in alkyl triphosphates. (Arbusoff, C. C. 1906, II 750.)

Solubility in  $\text{FeCl}_3, 4\text{H}_2\text{O} + \text{Aq}$  at  $21.5^\circ$ .

In 100 g. $\text{H}_2\text{O}$		Solid phase
g. $\text{FeCl}_3$	g. $\text{Cu}_2\text{Cl}_2$	
6.015	1.535	$\text{Cu}_2\text{Cl}_2$
11.62	1.33	"
16.30	1.81	"
26.305	3.11	"
29.35	7.125	"
33.125	8.06	"
43.75	9.565	"
54.00	12.44	"
66.40	17.04	"
73.20	21.60	"
71.895	23.20	$\text{Cu}_2\text{Cl}_2 + \text{FeCl}_3, 4\text{H}_2\text{O}$
69.34	21.655	$\text{FeCl}_3, 4\text{H}_2\text{O}$
65.10	11.895	"
	...	"

(Kremann and Noss, M. 1912, 33. 1208.)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{KCl}+\text{Aq}$  at  $t^\circ$ . Determined in an atmosphere of  $\text{CO}_2$ .

$t^\circ$	g. mol. KCl per l	g. atoms Cu per l
18.3	0.05	0.002411
18	0.1	0.004702
16	0.2	0.009458
19.2	1.0	0.0970
16.4	2.0	0.3840

(Bodländer and Storbeck, Z. anorg. 1902, 31. 17.)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{KCl}+\text{Aq}$  at  $t^\circ$ . Determined in an atmosphere of  $\text{CO}_2$ . All values recorded in millimols per litre.

$t^\circ$	KCl	Cuprie copper	Total copper	Cuprous copper calc	Cl
20°	0	2.222	2.851	0.629	5.436
19	1	1.901	2.385	0.484	5.287
19	2	1.571	2.150	0.589	5.614
19	2.5	1.421	1.955	0.534	6.015
19	3	1.523	1.983	0.460	6.247
18	5	1.008	1.522	0.514	7.525
18	10	0.475	1.236	0.761	11.735
20	15	0.322	1.344	1.022	16.437
19	20	0.324	1.446	1.122	21.356
19	30	0.1308	1.761	1.630	31.911
18	50	0.1038	2.411	2.302	..
18	100	0	4.702	4.702	..
18	200	0	9.485	9.485	..
19	1000	0	97.0	97.0	..
16	2000	0	384.0	384.0	..

(Bodländer and Storbeck, Z. anorg. 1902, 31. 24.)

Solutions of 0.05=0.4 normal KCl dissolve  $\text{Cu}_2\text{Cl}_2$  with the formation of  $\text{KCuCl}_2$ ; those of higher concentration with the formation of  $\text{K}_2\text{CuCl}_4$ . (Bodländer and Storbeck, Z. anorg. 1902, 31. 41.)

Solubility of  $\text{Cu}_2\text{Cl}_2+\text{KCl}$  in  $\text{H}_2\text{O}$  at  $22^\circ$ .

G. in 1 g of solution		Solid Phase
Cu <sub>2</sub> Cl <sub>2</sub>	KCl	
0.00115	0.0387	Cu <sub>2</sub> Cl <sub>2</sub>
0.00405	0.0656	"
0.00861	0.0824	"
0.0137	0.0984	"
0.0219	0.1133	"
0.0390	0.1406	"
0.0484	0.1530	"
0.0675	0.1639	"
0.0719	0.1747	"
0.0863	0.1839	"
0.1043	0.2027	"
0.1084	0.2018	"
0.1021	0.2031	"
0.1204	0.2095	"
0.1332	0.2164	"

Solubility of  $\text{Cu}_2\text{Cl}_2+\text{KCl}$  in  $\text{H}_2\text{O}$  at  $22^\circ$ —  
Continued

G in 1 g. of solution		Solid Phase
$\text{Cu}_2\text{Cl}_2$	KCl	
0.1621	0.2330	$\text{Cu}_2\text{Cl}_2$
0.1723	0.2384	"
0.1907	0.2374	"
0.2148	0.2516	"
0.2145	0.2506	$\text{Cu}_2\text{Cl}_2 + \text{Cu}_2\text{Cl}_2, 4\text{KCl}$
0.2149	0.2549	$\text{Cu}_2\text{Cl}_2, 4\text{KCl}$
0.1548	0.2387	"
0.1473	0.2363	"
0.1399	0.2357	"
0.1439	0.2389	"
0.1451	0.2363	"
0.1155	0.2320	"
0.1139	0.2350	"
0.0953	0.2359	"
0.0735	0.2349	"
0.0555	0.2389	"
0.0453	0.2404	"
0.0306	0.2433	"
0.0314	0.2503	"
0.0285	0.2499	"
0.0265	0.2523	"
0.0220	0.2628	"
0.0193	0.2687	"
0.0176	0.2698	"
0.0193	0.2703	$\text{Cu}_2\text{Cl}_2, 4\text{KCl} + \text{KCl}$
0.0160	0.2706	KCl
0.0124	0.2668	"
0.0058	0.2632	"
0.0000	0.2568	"

(Björnsted, Z. phys. Ch. 1912, 80. 208.)

Solubility in  $\text{NaCl}+\text{Aq}$ .

Sat.  $\text{NaCl}+\text{Aq}$  dissolves 16.9 %  $\text{Cu}_2\text{Cl}_2$  at  $90^\circ$ ; 11.9 % at  $40^\circ$ ; and 8.9 % at  $11^\circ$ .  
15%  $\text{NaCl}+\text{Aq}$  dissolves 10.3 %  $\text{Cu}_2\text{Cl}_2$  at  $90^\circ$ ; 6.0 % at  $40^\circ$ ; and 3.6 % at  $14^\circ$ .  
5%  $\text{NaCl}+\text{Aq}$  dissolves 2.6 %  $\text{Cu}_2\text{Cl}_2$  at  $90^\circ$ , and 1.1 % at  $40^\circ$ . (Hunt, Sil. Am. J. (2) 49. 154.)

Solubility in  $\text{NaCl}+\text{Aq}$  at  $26.5^\circ$ .

In 100 g H <sub>2</sub> O		Solid phase
Cu <sub>2</sub> Cl <sub>2</sub>	NaCl	
1.55	..	Cu <sub>2</sub> Cl <sub>2</sub>
3.15	10.80	"
7.30	20.70	"
40.60	27.00	"
49.10	36.48	"
57.21	44.14	Cu <sub>2</sub> Cl <sub>2</sub> +NaCl
41.40	55.95	NaCl
18.70	50.90	"

(Kreman and Noss, M. 1912, 33. 1210.)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{CuSO}_4 + \text{Aq}$  at  $t^\circ$ .  
Values recorded in millimols per l.

$t^\circ$	Conc. of $\text{CuSO}_4$	Cupric copper	Total copper	Cuprous copper calc.	Ct
19.7		2 358	2 880	0 622	5 312
16.3	0.49375	2 746	3 125	0 379	4 805
18.6	0.9875	3 145	3 602	0 457	4 908
17.5	1.4812	3 315	3 915	0 600	4 530
19.4	1.975	4 131	4 553	0 422	4 687
20.4	2.4687	4 349	4 786	0 437	4 287
20.5	2.9625	4 625	5 193	0 509	4 256
20.1	4.9375	6 546	7 276	0 730	4 329

(Bodländer and Storbeck, Z. anorg. 1902, 31, 22.)

Insol. in  $\text{SbCl}_3$ . (Klemensiewicz, Bull. Acad. Crac. 1908, 6, 485.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Insol. in alcohol.

Sl. sol. in ether (Gehlen.)

Sol in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 61, 236.)

Sol in pyridine. (Schroeder, Dissert. 1901.)

Insol in phosgene. (Eidmann, Dissert. 1899.)

Insol in acetone. (Naumann, B. 1904, 37, 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II, 1014.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol in ethyl acetate. (Alexander, Dissert. 1899.) (Naumann, B. 1904, 37, 3601.)

Difficultly sol. in ethyl acetate (Naumann, B. 1910, 43, 314.)

100 g. acetonitrile dissolve 13.33 g.  $\text{Cu}_2\text{Cl}_2$  at  $18^\circ$ . (Naumann and Schier, B. 1914, 47, 249.)

Sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Sol in hot benzonitrile and other aromatic nitriles. (Werner, Z. anorg. 1897, 15, 7.)

Mol weight determined in pyridine methyl and ethyl sulphides. (Werner, Z. anorg. 1897, 15, 19, 25 and 28.)

Min. Nantokite Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ .

Cupric chloride,  $\text{CuCl}_2$ .

Deliquescent. 100 pts.  $\text{H}_2\text{O}$  dissolve 70.6 pts.  $\text{CuCl}_2$  at  $0^\circ$ ; 100 pts.  $\text{CuCl}_2 + \text{Aq}$  contain 41.4 pts.  $\text{CuCl}_2$ . (Engel, A. ch. (6) 17, 350.)

100 pts.  $\text{H}_2\text{O}$  dissolve 76.2 pts.  $\text{CuCl}_2$  at  $16.1^\circ$ , or 100 pts.  $\text{CuCl}_2 + \text{Aq}$  sat. at  $16.1^\circ$  contain 43.25 pts.  $\text{CuCl}_2$ . (Rudorff, B. 6, 484.)

100 pts.  $\text{CuCl}_2 + \text{Aq}$  sat. at  $17^\circ$  contain 43.06 pts.  $\text{CuCl}_2$ ; at  $31.5^\circ$ , contain 44.7 pts.  $\text{CuCl}_2$ . Coefficient of solubility =  $41.4 + 0.105t$ . (Reicher and Deventer, Z. phys. Ch. 5, 560.)

Sat.  $\text{CuCl}_2 + \text{Aq}$  contains at:

$-20^\circ$	$-5^\circ$	$+12^\circ$	$17^\circ$	$33^\circ$
37	38.8	39.3	41.7	43.2%
39	55	68	73	91%
44.0	46.5	47.9	48.6	51.0%

(Étard, A. ch. 1894, (7) 2, 536.)

Sp. gr. of  $\text{CuCl}_2 + \text{Aq}$  at  $17.5^\circ$ .

% $\text{CuCl}_2$	Sp. gr.	% $\text{CuCl}_2$	Sp. gr.
5	1.0455	25	1.2918
10	1.0920	30	1.3618
15	1.1565	35	1.4447
20	1.2223	40	1.5284

(Franz, J. pr. (2) 5, 274.)

Sp. gr. of  $\text{CuCl}_2 + \text{Aq}$  at  $22.9^\circ$ , containing 1000 g.  $\text{H}_2\text{O}$ , g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ .

85.5 (=  $\frac{1}{2}$  mol.) 171 255.5 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ ,  
1.057 1.108 1.154

342 427.5 513 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ ,  
1.197 1.238 1.275

598.5 684 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ ,  
1.309 1.341

769.5 855 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ ,  
1.371 1.399

940.5 1026 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ ,  
1.425 1.449

Containing  $\text{CuCl}_2$  (anhydrous).

67.5 (=  $\frac{1}{2}$  mol.) 135 202.5 270 g.  $\text{CuCl}_2$ ,  
1.059 1.114 1.165 1.213

337.5 405 472.5 g.  $\text{CuCl}_2$ ,  
1.257 1.299 1.30

540 607.5 675 g.  $\text{CuCl}_2$ ,  
1.379 1.416 1.453

(Gerlach, Z. anal. 28, 468.)

Sp. gr. of  $\text{CuCl}_2 + \text{Aq}$  at  $0^\circ$  S = pts.  $\text{CuCl}_2$  in 100 pts. solution;  $S_1$  = mols.  $\text{CuCl}_2$  in 100 mols. of solution.

S	$S_1$	Sp. gr.
39 4170	3 00	1 4797
35 3839	6 82	1 4173
30.9255	5.65	1 3529
26 1129	4 51	1 2881
20 6697	3 36	1 2204
14 5820	2 23	1 1494
8 0732	1 16	1 0796

(Charpy, A. ch. (6) 29, 25.)

Tables for  $7^\circ$ ,  $30.5^\circ$ ,  $49.2^\circ$ , and  $65^\circ$  are also given by Charpy.

Sp. gr. of  $\text{CuCl}_2 + \text{Aq}$  at room temp., containing

12 006 21.349 33 027%  $\text{CuCl}_2$ ,  
1 1037 1 2154 1.3312

(Wagner, W. Ann. 1883, 18, 273.)

Sp. gr. at 20° of  $\text{CuCl}_2 + \text{Aq}$  containing M.  
mols.  $\text{CuCl}_2$  per liter.

M.	0 01	0 05	0 075
Sp. gr.	1 001208	1 00637	1.009264
M.	0 10	0 20	0 50
Sp. gr.	1 012614	1 030991	1 051479
M.	0 75	1 0	
Sp. gr.	1.090912		1 120249
M.	1.5	2 0	
Sp. gr.	1.177618		1 234551

(Jones and Pearce, Am. Ch. J. 1907, 38, 717.)

Sp. gr. of  $\text{CuCl}_2 + \text{Aq}$  at 25°.

Concentration of $\text{CuCl}_2 + \text{Aq}$	Sp. gr.
I—normal	1 0624
$\frac{1}{2}$ —	1 0313
$\frac{1}{4}$ —	1 0158
$\frac{1}{8}$ —	1 0077

(Wagner, Z. phys. Ch. 1890, 5, 38)

Much less sol. in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$   
1 l.  $\text{HCl} + \text{Aq}$  containing 45 pts  $\text{HCl}$  to 100  
pts.  $\text{H}_2\text{O}$  dissolves only 290 g.  $\text{CuCl}_2$  at 12°,  
whereas 1 l.  $\text{H}_2\text{O}$  at 12° dissolves 630 g.  $\text{CuCl}_2$ .  
(Ditte, C. R. 1881, 92, 853.)

Solubility in  $\text{HCl} + \text{Aq}$  at 0°  $\frac{\text{CuCl}_2}{2} =$

$\frac{3}{8}$  mols. in milligrammes in 10 cc.  
solution.  $\text{HCl} =$  mols.  $\text{HCl}$  in ditto,  $\text{H}_2\text{O}$   
 $=$  g.  $\text{H}_2\text{O}$ .

$\frac{\text{CuCl}_2}{2}$	$\text{HCl}$	Sum of equiv.	Sp. gr.	$\text{H}_2\text{O}$
91 75	0	91 75	1 490	8 73
86 8	4 5	91 3	1 475	8 74
83.2	7 8	91	1 458	
79 35	10 5	89 85	1 435	8 64
68.4	20 25	88 65	1 389	8 56
50.0	37 5	87 5	1 319	8 47
22 8	70.25	93 05	1 231	8 21
23 5	102 5	126	1 288	7 56
26.7	128	154 7	1 323	6 77

(Engel, A. ch (6) 17 351.)

Not decomp. by cold  $\text{H}_2\text{SO}_4$

Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Very sol in conc  
 $\text{NaCl} + \text{Aq}$ . (Boussingault)

Solubility of  $\text{CuCl}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at 30°.

$\frac{\text{NH}_4\text{Cl}}{\text{CuCl}_2}$	$\frac{\text{CuCl}_2}{\text{H}_2\text{O}}$	Solid phase
29 5	0	$\text{NH}_4\text{Cl}$
28 6	1 9	$\text{NH}_4\text{Cl} + \text{CuCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O}$
12 1	15 6	$\text{CuCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O}$
2 03	43 2	$\text{CuCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O} + \text{CuCl}_2, 2\text{H}_2\text{O}$
0	43 95	$\text{CuCl}_2, 2\text{H}_2\text{O}$

(Schrenemakers, Z. phys. Ch. 1909, 66, 688.)

See also  $\text{NH}_4\text{Cl} + \text{CuCl}_2$  under ammonium  
chloride.

Solubility of  $\text{CuCl}_2 + \text{HgCl}_2$  in  $\text{H}_2\text{O}$  at 35°.

% $\text{HgCl}_2$	% $\text{CuCl}_2$	Solid Phase
0	44.47	$\text{CuCl}_2, 2\text{H}_2\text{O}$
21 03	33 50	"
37 30	26 07	"
44 47	23 31	"
50 47	21 50	$\text{CuCl}_2 + \text{HgCl}_2$
52 44	19 40	$\text{HgCl}_2$
52 54	18 46	"
52 81	18 06	"
51 03	14 73	"
49 50	5 94	"
23 87	2 64	"
8 51	8 51	"

(Schrenemakers and Thonius, Proc. K. Akad.  
Wet. 1912, 15, 472.)

Solubility of  $\text{CuCl}_2 + \text{KCl}$  in  $\text{H}_2\text{O}$  at t°

t°	Cl per g of solution		Mols per 100 mols $\text{H}_2\text{O}$		
	As $\text{CuCl}_2$	As $\text{KCl}$	$\text{CuCl}_2$	$\text{KCl}$	
39 4	0 120	0 107	5 56	9 03	$\text{CuCl}_2, 2\text{KCl}, 2\text{H}_2\text{O} + \text{KCl}$
19 9	0 129	0 115	6 30	11 4	"
00 4	0 142	0 123	7 71	13 6	"
79 1	0 108	0 112	11 1	18 8	"
00 5	0 188	0 154	14 9	24 1	$\text{CuCl}_2, \text{KCl} + \text{KCl}$
93 7	0 164	0 156	10 2	25 0	"
98 8	0 197	0 162	17	28 0	$\text{CuCl}_2, 2\text{KCl}, 2\text{H}_2\text{O} + \text{CuCl}_2, 3\text{H}_2\text{O}$
0	0 214	0 021	0 84	1 61	"
30 0	0 232	0 049	12 9	5 44	"
50 1	0 233	0 059	13 7	6 90	"
52 9	0 241	0 062	14 8	7 03	"
60 2	0 240	0 060	15 8	8 49	$\text{CuCl}_2, \text{KCl} + \text{CuCl}_2, 2\text{H}_2\text{O}$
72 6	0 255	0 093	16 8	8 35	"
04 2			14 9	11 6	$\text{CuCl}_2, 2\text{KCl}, 2\text{H}_2\text{O} + \text{CuCl}_2, \text{KCl}$
72 5			14 8	1 50	"

(Meyerhoffer, Z. phys. Ch. 1890, 5, 102.)

100 g.  $\text{H}_2\text{O}$  dissolve 72.6 g.  $\text{CuCl}_2 + 16.0$  g  
 $\text{NaCl}$  (Rudorff, B. 6, 684.)

Solubility of  $\text{CuCl}_2 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at 30°

% $\text{NaCl}$	% $\text{CuCl}_2$	Solid Phase
0	43 95	$\text{CuCl}_2, 2\text{H}_2\text{O}$
3 10	41 14	"
4 28	41 06	"
6 41	39 40	"
10 25	36 86	"
12 02	32 38	$\text{CuCl}_2 + \text{NaCl}$
12 25	32 40	$\text{NaCl}$
13 54	28 64	"
15 40	23 72	"
18 44	16 98	"
20.61	11 03	"
26 47	0	"

(Schrenemakers and de Baat, Z. phys. Ch.  
1909, 65, 586.)

Solubility of  $\text{CuCl}_2$  in  $\text{CuSO}_4 + \text{Aq}$  at  $30^\circ$ 

Composition of the solution		Solid phase
$\frac{\text{g.}}{\text{100 g.}}$ $\text{CuCl}_2$	$\frac{\text{g.}}{\text{100 g.}}$ $\text{CuSO}_4$	
0	20.32	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
6.58	13.62	"
15.68	8.93	"
25.67	4.77	"
39.48	3.21	"
42.77	2.89	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + \text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
42.47	2.90	"
43.25	1.14	$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
43.95	0	"

(Schrenemakers, Z. phys. Ch. 1909, 69, 561.)

Insol in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 827.)Sol in liquid  $\text{HF}$ . (Franklin, Z. anorg. 1905, 46, 2.)

Sol. in alcohol and ether

Sol. in 1 pt strong alcohol.

100 pts absolute methyl alcohol dissolve 68 pts.  $\text{CuCl}_2$  at  $15.5^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 53 pts.  $\text{CuCl}_2$  at  $15.5^\circ$ . (de Bruyn, Z. phys. Ch. 10, 783.)See also under  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ Solubility of  $\text{CuCl}_2 + \text{KCl}$  in absolute alcohol at  $25^\circ$ 

$\frac{\text{g.}}{\text{100 g.}}$ $\text{CuCl}_2$	$\frac{\text{g.}}{\text{100 g.}}$ $\text{KCl}$	Solid Phase
1.27	0.28	
1.51	0.28	$\text{KCl} + \text{KCl}, \text{CuCl}_2$
2.15		"
5.25		$\text{KCl}, \text{CuCl}_2$
30.18		"
34.17	0.21	$\text{KCl}, \text{CuCl}_2 + \text{CuCl}_2, \text{C}_2\text{H}_5\text{OH}$
34.45	0.21	
34.29	0.21	"
33.97	0.00	$\text{CuCl}_2, \text{C}_2\text{H}_5\text{OH}$

(Foote and Walden, J. Am. Chem. Soc. 1911, 33, 1032.)

Solubility of  $\text{CuCl}_2 + \text{KCl}$  in acetone at  $25^\circ$ 

$\frac{\text{g.}}{\text{100 g.}}$ $\text{CuCl}_2$	$\frac{\text{g.}}{\text{100 g.}}$ $\text{KCl}$	Solid Phase
0.34	0.38	
0.48		$\text{KCl} + \text{KCl}, \text{CuCl}_2$
1.50		$\text{KCl}, \text{CuCl}_2$
2.06		"
2.49	0.27	$\text{KCl}, \text{CuCl}_2 + \text{CuCl}_2, \text{C}_2\text{H}_5\text{OH}$
2.32		

(Foote and Walden, J. Am. Chem. Soc. 1911, 33, 1032.)

\* 100 g. of sat. solution of  $\text{CuCl}_2$  in ethyl alcohol contains 33.97 g.  $\text{CuCl}_2$ . (Foote and Walden, J. Am. Chem. Soc. 1911, 33, 1032.)Easily sol in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)  
Insol. in benzene.

## Solubility in organic solvents

Solvent	$t^\circ$	Sat. solution contains $\frac{\text{g.}}{\text{100 g.}}$ $\text{CuCl}_2$
Methyl alcohol	22	36.8
	40	37.5
	50	37.1
	60	37.5
Abs. ethyl alcohol	0	32.0
	19	35.7
	20	35.9
	38	38.5
	50	41.7
Propyl alcohol	-15	26.8
	19	30.9
	37	30.7
	57	30.3
	62	30.5
Allyl alcohol	-20	23.4
	-4	23.6
	27	22.0
	32	23.3
N-butyl alcohol	0	15.2
	23	15.8
	37	15.7
	55	16.1
	84	16.2
	92	16.7
Ethyl formate	-20	10.2
	+24	9.4
	37	7.4
	50	7.2
Ethyl acetate	+20	3.0
	40	2.5
	72	1.3
Acetone	-20	18.4
	+8	18.8
Isopropyl alcohol	32	11.0
	70	28.3
	84	28.7

(Étard, A. ch. 1894, (7) 2, 565)

See also under  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ .1 g.  $\text{CuCl}_2$  is sol. in 181 g. methyl acetate at  $18^\circ$ . Sp. gr.  $18^\circ/4^\circ$  of the sat. solution = 0.939. (Naumann, B. 1909, 42, 3793.)1 g.  $\text{CuCl}_2$  is sol. in 249 g. ethyl acetate at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ$  = 0.9055. (Naumann, B. 1904, 37, 3603.)

Difficultly sol. in ethyl acetate (Naumann, B. 1910, 43, 314.)

1 pt. sol. in 249.3 pts. ethyl acetate at 10°.  
(Alexander, Dissert. 1899.)

Solubility in acetone.

34.7 g. acetone dissolve 1 g.  $\text{CuCl}_2$  at 18°.  
Sp. gr. of sat. solution  $18^\circ/4^\circ = 0.8154$  (Naumann, B. 1904, 37, 4329.)

1.40 pts. are sol. in 100 pts. acetone at 50°.  
(Laszczyński, B. 1894, 27, 2287.)

Sol. in acetone and methylal. 1 gram dissolves in 34.08 grams of acetone at 18°.  
(Eidmann, C. C. 1899, II, 1014.)

100 pts. absolute ether dissolve 0.043 g.  $\text{CuCl}_2$ . (Böttker, Z. phys. Ch. 1897, 22, 511.)

Mol weight determined in pyridine and methyl sulphide (Werner, Z. anorg. 1897, 15, 20 and 25.)

100 g. sat. solution in acetonitrile contains 1.57 g.  $\text{CuCl}_2$ . (Naumann and Schies, B. 1914, 47, 249.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Sol. in boiling dipropylamine. (Werner, Z. anorg. 1897, 15, 34.)

Sol. in urethane. (Ley, Z. phys. Ch. 1897, 22, 81); (Castoro Z. anorg. 1899, 20, 61.)

+ $\text{H}_2\text{O}$ . (Ditte, A. ch. (5) 22, 551.)

Sol. in  $\text{H}_2\text{O}$  with slight decomp. (Sabatier, Bull. Soc. 1895, (3) 13, 601.)

+ $2\text{H}_2\text{O}$ . Deliquescent. 100 g.  $\text{H}_2\text{O}$  dissolve 121.4 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  at 16.1°. (Rudorff.)

Aq. sol. at 35° contains 9.689 Mol. %  $\text{CuCl}_2$ .  
" 15° " 8.934 " % "

(Schreinemakers, C. C. 1911, II, 349.)

$\text{CuCl}_2 + 2\text{H}_2\text{O} + \text{Aq}$ . sat. at 30° contains 43.95%  $\text{CuCl}_2$ . (Meerburg, C. C. 1904, II, 1362.)

43.95 g. anhydrous  $\text{CuCl}_2$  are dissolved in 100 g.  $\text{CuCl}_2 + \text{Aq}$  at 30°. (Schreinemakers, Arch. near Sc. 1910 [2], 15, 117.)

44.47% by weight anhydrous  $\text{CuCl}_2$  is dissolved in  $\text{H}_2\text{O}$  at 35°. (Schreinemakers and Thonius, Verh. k. Akad. Wet. Amst. 1912, 21, 333.)

Solubility of  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  in ethyl alcohol  
+ Aq at 11.5°.

Percent of ethyl alcohol by volume	Grams $\text{CuCl}_2$ dissolved in 5 cc.
99.3	1.175
98.3	1.116
96.3	1.097
95.3	1.070
94.3	1.059

Anhydrous salt dissolves readily in absolute ethyl alcohol;  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  is precipitated by  $\text{H}_2\text{O}$

Solubility of  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  in ethyl alcohol + Aq at 11.5° C. under addition of increasing amounts of  $\text{CuCl}_2$

P = Percent of ethyl alcohol by volume.

G = Grams of  $\text{CuCl}_2$  added.

C<sub>a</sub> = Grams of  $\text{CuCl}_2$  in 5 cc. of the solution.

C<sub>w</sub> = Grams of water in 5 cc. of the solution, calculated from

- (1) the water content of the alcohol.
- (2) the water of crystallization which had gone into solution.
- (3) the water held mechanically in  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ .

P	G	C <sub>w</sub>	C <sub>a</sub>
89.3	0.000	0.794	1.137
90.3	"	0.744	1.122
91.3	"	0.695	1.104
92.3	"	0.648	1.090
94.3	"	0.561	1.096
95.3	"	0.517	1.095
96.3	"	0.478	1.116
97.3	"	0.440	1.140
98.3	"	0.396	1.194
99.3	"	0.369	1.208
"	0.223	0.330	1.295
"	0.444	0.290	1.395
"	0.665	0.270	1.506
"	0.887	0.247	1.639
"	1.106	0.223	1.772
"	1.324	0.205	1.921
"	1.540	0.191	2.086
"	1.739	0.179	2.236
"	1.957	0.164	2.400

(Böttker, Z. phys. Ch. 1897, 22, 506-507.)

100 pts. absolute ether dissolve 0.061 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ . (Böttker, Z. phys. Ch. 1897, 22, 511.)

0.11 pts. are sol. in 100 pts. ether at 16°.  
0.11 " " " 100 " " " 35°.  
8.86 " " " 100 " acetone " 0°.  
8.92 " " " 100 " " " 13.5°.  
(Laszczyński, B. 1894, 27, 2286 and 2287.)

Solubility in organic solvents at t°.

Solvent	t°	Pts of solvent required to dis- solve 1 pt $\text{CuCl}_2 + 2\text{H}_2\text{O}$ at t°.
Pure methyl alcohol	20°	7.3
"	18.9	7.6
Ethyl alcohol (95°)	20.3	11.6
"	19.6	11.9
Pure acetone	22.1	43.6
"	20.0	44.2
97 pts ethyl alcohol (98°) + 10 pts $\text{H}_2\text{O}$	21.8	9.0
"	23.0	8.5

## Solubility in organic solvents at t°.—Cont

Solvent	t°	Pts of solvent required to dissolve 1 pt CuCl <sub>2</sub> +2H <sub>2</sub> O at t°
80 pts abs alcohol+20 pts H <sub>2</sub> O	28 1	6 0
"	20 7	6 2
80 pts acetone+20 pts H <sub>2</sub> O	23 1	5 3
"	21.8	5 6
80 pts acetone+20 pts methyl alcohol	23.1	12.0
"	24.0	11 6
10 pts methyl alcohol+90 pts ethyl alcohol (98°)	24.2	5 4
"	25 0	5 1
20 pts methyl alcohol+80 pts. ord ether	24 1	15 1
"	22 4	15 7
80 pts abs alcohol+20 pts ord ether	24 1	8 8
"	25 0	8 5
Comm methyl alcohol	23.9	5 4
"	23 0	5 6
85 pts pyridine+15 pts H <sub>2</sub> O	24 4	63 4
"	23 6	63 7
00 pts. pyridine+40 pts H <sub>2</sub> O	27.3	26 7
"	28 0	26 2
75 pts. α picoline+25 pts H <sub>2</sub> O	26.1	51 6
"	25 1	52.3
70 pts α picoline+30 pts H <sub>2</sub> O	26.1	47.3

(de Connecq, C. R. 1900, 131. 59.)

## Solubility in organic solvents.

Sol. in propyl alcohol, hot glycol, hot glycerine, hot paraldehyde, hot crys. acetic acid, pure acetone, 30% methylamine+Aq, pure pyridine, pure α-picoline, acetonitrile; sl sol in isobutyl and amyl alcohols, crystallizable formic acid, ethyl acetate; insol. in cold glycol, cold glycerine, cold paraldehyde, benzaldehyde, cold crystallizable acetic acid, ord. ether, abs. ether, hot and cold CS<sub>2</sub>, cold aniline, cold orthotoluidine, methylene chloride, ethyl iodide, propyl iodide, ethylene bromide, benzene, toluene, xylene, ligroin, nitrobenzene, cold piperidine and essence of terebenthine. (de Connecq, C. R. 1900, 131. 59.)

+5H<sub>2</sub>O.Aq. sol. at 35° contains 2.921 Mol. % CuCl<sub>2</sub>.  
15° " 1 11

(Schreinemakers, C. C. 1911, II. 349.)

Cuprous hydrogen chloride, CuCl<sub>2</sub>HCl.Sol. in H<sub>2</sub>O. (Neumann, M. 1894, 15. 493.)Cupric hydrogen chloride, CuCl<sub>2</sub>, HCl+3H<sub>2</sub>ODecomp. by H<sub>2</sub>O. Sol. in HCl+Aq below 0° (Engel, C. R. 106. 273.)CuCl<sub>2</sub>, 2HCl Deliquescent Very sol in H<sub>2</sub>O (Alexander, Dissert 1899.)+5H<sub>2</sub>O. Properties as above. (Sabbatier, C. R. 106. 1724.)CuCl<sub>2</sub>, 3HCl. Sol in H<sub>2</sub>O. (Neumann M. 1894, 15. 493.)Cupric gold (auric) chloride, CuCl<sub>2</sub>, 2AuCl<sub>3</sub>+6H<sub>2</sub>O.10% is sol. in H<sub>2</sub>O at 18° (Mylius, Z. anorg 1911, 70. 210.)Cupric lithium chloride, CuCl<sub>2</sub>, LiCl+2½H<sub>2</sub>O.Decomp on air. Decomp. by dissolving in H<sub>2</sub>O. Sol. in conc LiCl+Aq without decomp. Decomp. by alcohol. (Chassevant, A. ch. (6) 30. 33.)+2H<sub>2</sub>O. (Meyerhoffer, W. A. B. 100, 2b. 621.)

## Cupric mercuric chloride.

Easily sol in H<sub>2</sub>O. (v Bonsdorff.)Cupric mercuric potassium chloride, CuCl<sub>2</sub>, 3HgCl<sub>2</sub>, 6KCl+2H<sub>2</sub>ODeliquescent in moist air. Sol. in boiling H<sub>2</sub>O without decomp, and recrystallises if cooled slowly. Insol. in absolute alcohol. (v. Bonsdorff, Pogg. 33. 81)Cuprous nitrosyl chloride, Cu<sub>2</sub>Cl<sub>2</sub>, 2NOCl.Very deliquescent and sol. in H<sub>2</sub>O with immediate decomp. (Sudborough, Chem. Soc. 59. 658.)Cuprous potassium chloride, Cu<sub>2</sub>Cl<sub>2</sub>, 4KCl.Sol. in H<sub>2</sub>O (Mitscherlich, A. ch. 73. 384.)For solubility data, see Cu<sub>2</sub>Cl<sub>2</sub>+KCl under cuprous chloride.

## Cupric potassium chloride.

CuCl<sub>2</sub>, KCl. (Meyerhoffer, Z. phys. Ch. 3. 336.)Sol. in H<sub>2</sub>O; only sl sol in conc. HCl+Aq. (Groger, Z. anorg. 1899, 19. 330)CuCl<sub>2</sub>, 2KCl+2H<sub>2</sub>O. Sol. in H<sub>2</sub>O and alcohol (Berzelius, Pogg. 13. 458.)

The composition of the hydrates formed by this salt at different dilutions is calculated from determinations of the lowering of the fr pt. produced by the salt and of the conductivity and sp. gr. of its aqueous solutions. (Jones, Am. Ch. J. 1905, 34. 322.)

For solubility data, see CuCl<sub>2</sub>+KCl under cupric chlorideCupric rubidium chloride, CuCl<sub>2</sub>, 2RbCl.Easily sol. in H<sub>2</sub>O and HCl+Aq. (Godefroy, B. 8. 9)+2H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Wyrouboff, J. B. 1887. 538.)

## Cuprous sodium chloride.

Very sol. in H<sub>2</sub>O.

**Cupric sodium chloride.**

Easily sol in conc NaCl+Aq. Sol. in alcohol of 0.837 sp. gr.

No double salt exists. (Schreinemakers and de Baat, Z phys Ch 1909, 66. 586)

**Cupric thallic chloride,  $\text{CuCl}_2 \cdot 2\text{TiCl}_3$** 

Sol. in  $\text{H}_2\text{O}$ . (Willm, A. ch (4) 5. 55.)

+ $6\text{H}_2\text{O}$ . Can be cryst. from  $\text{H}_2\text{O}$ . (Gewecke, A 1909, 366. 225)

**Cuprous chloride ammonia,  $\text{Cu}_2\text{Cl}_2 \cdot \text{NH}_3$ .**

(Lloyd, J. phys. Chem. 1908, 12. 399.)

$\text{Cu}_2\text{Cl}_2 \cdot 2\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  or acids, not by alcohol (Ritthausen, J pr 59 369)

$\text{Cu}_2\text{Cl}_2 \cdot 3\text{NH}_3$  (Lloyd, J. phys. Chem. 1908, 12. 399.)

$\text{Cu}_2\text{Cl}_2 \cdot 6\text{NH}_3$ . (Lloyd, J phys Chem. 1908. 12. 399)

**Cupric chloride ammonia,  $\text{CuCl}_2 \cdot 2\text{NH}_3$ .**

Decomp by  $\text{H}_2\text{O}$ . (Kane, A. ch. 72. 273)

$\text{CuCl}_2 \cdot 4\text{NH}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Bouzat, C. R 1902, 135. 294)

+ $\text{H}_2\text{O}$  (*Cuprammonium chloride*) Sol. in  $\text{H}_2\text{O}$  and hot  $\text{NH}_4\text{OH}$ +Aq

+ $2\text{H}_2\text{O}$ . Sol. in small amt. of  $\text{H}_2\text{O}$ .

$\text{Cu}(\text{OH})_2$  is pptd by dilution. (Bouzat, A ch. 1903, (7) 29. 350)

$\text{CuCl}_2 \cdot 5\text{NH}_3$ . (Bouzat, A ch. 1903, (7) 29. 350.)

+ $1\frac{1}{2}\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . On dilution  $\text{Cu}(\text{OH})_2$  is pptd Sol in  $\text{NH}_4\text{OH}$ +Aq,

solubility decreases as  $\text{NH}_3$  concentration increases. (Bouzat, A. ch. 1903, (7) 29. 350.)

$\text{CuCl}_2 \cdot 6\text{NH}_3$ . Completely sol in  $\text{H}_2\text{O}$ . (Rose, Pogg. 20. 55.)

Sol. in  $\text{H}_2\text{O}$  but decomp. by great dilution with pptn. of  $\text{Cu}(\text{OH})_2$

Sol in liquid  $\text{NH}_3$  (Bouzat, A ch. 1903, (7) 29. 350.)

**Cuprocupric chloride ammonia,  $\text{Cu}_2\text{Cl}_2 \cdot \text{CuCl}_2 \cdot 4\text{NH}_3 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  or alcohol. Abundantly sol. in  $\text{NH}_4\text{Cl}$ +Aq, but with partial decomposition (Ritthausen.)

**Cupric chloride ammonia platinous chloride,  $\text{CuCl}_2 \cdot 4\text{NH}_3 \cdot \text{PtCl}_2$ .**

See Platodiamine cupric chloride.

**Cuprous chloride carbon monoxide,**

$\text{Cu}_2\text{Cl}_2 \cdot 2\text{CO} + 4\text{H}_2\text{O}$ .

Very sol. in HCl (sp. gr. 1.19) with evolution of CO. Sol. in  $\text{NH}_4\text{OH}$ +Aq. (Manchot and Friend, A. 1908, 359. 110)

$2\text{Cu}_2\text{Cl}_2 \cdot \text{CO} + 2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  (Berthelot, A. ch. 1856, (3) 46. 488.)

$4\text{Cu}_2\text{Cl}_2 \cdot 3\text{CO} + 7\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , but decomp. therewith very quickly. Sol. in  $\text{Cu}_2\text{Cl}_2 + \text{HCl}$ .

**Cupric chloride hydrazine,  $\text{CuCl}_2 \cdot 2\text{N}_2\text{H}_4$ .**

Easily decomp (Hofmann and Marburg, A. 1899, 305. 222)

**Cuprous chloride mercuric sulphide,  $\text{Cu}_2\text{Cl}_2 \cdot 2\text{HgS}$** 

Insol. in  $\text{H}_2\text{O}$ , sol in conc. hot  $\text{HCl}$ +Aq, not decomp by boiling dil  $\text{H}_2\text{SO}_4$ +Aq, but decomp. by conc.  $\text{H}_2\text{SO}_4$ . (Heumann, B. 7. 1390.)

**Cuprous fluoride,  $\text{Cu}_2\text{F}_2$ .**

Insol. in  $\text{H}_2\text{O}$  or HF Sol in conc.  $\text{HCl}$ +Aq, from which it is precipitated by  $\text{H}_2\text{O}$ .

Insol in alcohol (Berzelius, Pogg. 1. 28.)

Decomp. by  $\text{H}_2\text{O}$  into sol  $\text{CuF}_2$  Sol in boiling  $\text{HCl}$ +Aq and in  $\text{HNO}_3$ +Aq. Only sl attacked by warm  $\text{H}_2\text{SO}_4$  (Poulenc, C. R 116. 1447.)

**Cupric fluoride,  $\text{CuF}_2$** 

Easily takes up  $\text{H}_2\text{O}$  to form  $\text{CuF}_2 \cdot 2\text{H}_2\text{O}$ .

Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or HF+Aq. (Poulenc, C R. 116. 1448)

**Solubility at 25° in HF+Aq**

Normality of HF+Aq	g atoms Cu in 1000 c c of solution
0.12	0.0307
0.28	0.1164
0.57	0.2494
1.08	0.358
2.28	0.463

Solubility is decreased by presence of KF (Jaeger, Z. anorg. 1901, 27. 29.)

Insol. in liquid  $\text{NH}_3$  (Gore, Am. Ch. J. 1898, 20. 827.)

Insol in methyl acetate (Naumann, B. 1909, 42. 3790), ethyl acetate. (Naumann, B 1910, 43. 314.)

Insol in acetone (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

+ $2\text{H}_2\text{O}$ . Sl sol in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Berzelius.)

**Cupric hydrogen fluoride,  $\text{CuF}_2 \cdot 5\text{HF} + 5\text{H}_2\text{O}$ .**

Deliquescent.

Easily sol. in  $\text{H}_2\text{O}$  and dil acids.

Sol in  $\text{NH}_4\text{OH}$ +Aq with decomp (Bohm, Z. anorg. 1905, 43. 329)

**Cupric potassium fluoride,  $\text{CuF}_2 \cdot 2\text{KF}$ .**

Easily sol in  $\text{H}_2\text{O}$ .

$\text{CuF}_2 \cdot \text{KF}$ . Very sl. sol in  $\text{H}_2\text{O}$ ; sl. sol. in dil. acids (Helmholtz, Z. anorg. 3. 115.)

**Cupric rubidium fluoride,  $\text{CuF}_2 \cdot \text{RbF}$ .**

As the K salt. (Helmholtz.)

**Cupric silicon fluoride.**

See Fluosilicate, cupric.

Copper stannic fluoride.  
See Fluostannate, copper.

Copper tantalum fluoride.  
See Fluotantalate, copper.

Copper titanium fluoride.  
See Fluotitanate, copper.

Copper tungstyl fluoride.  
See Fluoxytungstate, copper.

Copper zirconium fluoride.  
See Fluozirconate, copper.

Cupric fluoride ammonia,  $\text{CuF}_2 \cdot 4\text{NH}_3 + 5\text{H}_2\text{O}$ .

Decomp. rapidly in the air.

Easily sol. in  $\text{H}_2\text{O}$

Decomp. by boiling with  $\text{H}_2\text{O}$  with evolution of  $\text{NH}_3$ .

Easily sol. in dil. acids. (Bohm, Z. anorg. 1905, 43, 333.)

Cuprous hydride,  $\text{CuH}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . (Wurtz, C. R. 18, 102.)

Sol. in warm conc.  $\text{HCl}$  with decomp. (Bartlett, Am. Ch. J. 1895, 17, 187.)

Cupric hydride,  $\text{CuH}_2$ .

Sol. in  $\text{HCl}$  with decomp. (Bartlett, Am. Ch. J. 1895, 17, 187.)

Copper hydrosulphide,  $7\text{CuS} \cdot \text{H}_2\text{S}$ .

(Lander and Picton, Chem. Soc. 1892, 61, 120.)

$9\text{CuS} \cdot \text{H}_2\text{S}$ . (Lander and Picton.)

$22\text{CuS} \cdot \text{H}_2\text{S}$ . (Lander and Picton.)

Cuprous hydroxide,  $\text{Cu}_2\text{O} \cdot x\text{H}_2\text{O}$ .

Sol. in acids as cupric salt. Insol. in  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq}$ .

Sol. in  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ ; sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ .

Cuprocupric hydroxide,  $\text{CuOH} \cdot 3\text{Cu}(\text{OH})_2 + 3\text{H}_2\text{O}$ .

Sol. in acids. (Francke, Dissert. 1907.)

Cupric hydroxide,  $3\text{CuO} \cdot \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or dil. alkalis. Easily sol. in warm  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose.)

Much more difficultly sol. than  $\text{CuO} \cdot \text{H}_2\text{O}$  in  $\text{KOH} + \text{Aq}$ . (Chodnew, J. pr. 28, 220.)

True composition is  $6\text{CuO} \cdot \text{H}_2\text{O}$ .

See also Cupric oxide.

$\text{CuO} \cdot \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , but decomp. into  $-\text{CuO}$ ,  $\text{H}_2\text{O}$  by being boiled therewith.

Extremely easily sol. in acids.

Sol. in  $\text{NH}_4\text{OH}$ , and  $\text{NH}_4$  salts +  $\text{Aq}$

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

$\text{NH}_3$ concn.	g. Cu per l	equiv. $\text{CuO} \cdot \text{H}_2\text{O}$ per l
2.03	3.05	0.096
2.00	2.12	0.067
1.32	1.08	0.034
2.540	6.26	0.197
1.905	6.28	0.166
1.280	4.13	0.129
0.973	3.36	0.106
0.870	3.08	0.097
0.540	2.36	0.074
0.391	2.04	0.064
3.176	8.06	0.253
2.070	5.72	0.180
1.272	4.75	0.149
0.451	2.54	0.080
0.320	2.13	0.067

The non-agreement of the results is due to the presence of different modifications of  $\text{CuO} \cdot \text{H}_2\text{O}$ .

(Bonsdorff, Z. anorg. 1904, 41, 182.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $18^\circ$ .

$\text{NH}_3$ mols per l	Cu g atoms per l
0.20	0.00054
0.50	0.0033
1.0	0.0109
1.5	0.0204
2.0	0.0314
2.5	0.0442
3.0	0.0548
4.0	0.0784
5.0	0.1041
6.0	0.1254
8.0	0.1599
9.96	0.1787

(Dawson, Z. phys. Ch. 1909, 69, 111.)

Sol. in cold  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq}$  (Proust); but  $\text{CuO}$  is pptd. on boiling (Berthollet); is not pptd. (Chodnew, J. pr. 28, 220.)

Insol. in  $\text{NaOH}$  or  $\text{KOH} + \text{Aq}$  unless they contain organic matter (Berzelius). This is contradicted by Volcker (A. 59, 34).

Entirely sol. in conc.  $\text{KOH} + \text{Aq}$ , but solution is decomp. by heating (Fremy, A. ch. (3) 12, 510.)

Sol. in  $\text{NaOH} + \text{Aq}$  (70%  $\text{NaOH}$ ). (Lew, Z. anal. 9, 463.)

The solubility in  $\text{NaOH}$  of  $\text{CuO} \cdot \text{H}_2\text{O}$ , prepared either from  $\text{CuSO}_4$  or  $\text{Cu}(\text{NO}_3)_2$ , decreases with decrease in concentration of the base. The solubility of  $\text{CuO} \cdot \text{H}_2\text{O}$  in  $\text{NaOH}$  is only very slightly affected by the addition of sodium or potassium carbonate. (Fischer, Z. anorg. 1904, 40, 41.)

Solubility of crystalline  $\text{CuO}_2\text{H}_2$  in ammoniacal  $\text{Ba}(\text{OH})_2$  and  $\text{NaOH}$  solutions at  $18^\circ$ .

Solvent contains per litre	Cu concentration g atoms per l
1 mol. $\text{NH}_3$ + 0 mol. $\text{Ba}(\text{OH})_2$	0.01090
" + 0.0025 "	0.00907
" + 0.005 "	0.00801
" + 0.01 "	0.00633
" + 0.02 "	0.00526
2 mols. $\text{NH}_3$ + 0 mol. $\text{Ba}(\text{OH})_2$	0.0314
" + 0.01 "	0.0277
4 mols. $\text{NH}_3$ + 0 mol. $\text{Ba}(\text{OH})_2$	0.0784
" + 0.01 "	0.0747
1 mol. $\text{NH}_3$ + 0 mol. $\text{NaOH}$	0.0109
" + 0.01 "	0.00766
" + 0.02 "	0.00655
" + 0.03 "	0.00531
" + 0.05 "	0.00456
" + 0.10 "	0.00410

(Dawson, Chem. Soc. 1909, 95. 377.)

Solubility of crystalline  $\text{CuO}_2\text{H}_2$  in ammoniacal salt solutions at  $18^\circ$ .

Solvent contains per litre	Cone of dissolved Cu g atoms per l
1 mol. $\text{NH}_3$	0.0109
0.05 mol. $\text{NH}_3$ + 0.01 mol. $(\text{NH}_4)_2\text{SO}_4$	0.00129
" + 0.025 "	0.00511
0.1 mol. $\text{NH}_3$ + 0.01 mol. $(\text{NH}_4)_2\text{SO}_4$	0.00326
" + 0.025 "	0.0108
" + 0.05 "	0.0233
0.2 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.00054
" + 0.01 "	0.00649
" + 0.025 "	0.0175
" + 0.05 "	0.0384
" + 0.10 "	0.0690
0.5 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.0033
" + 0.01 "	0.0127
" + 0.025 "	0.0284
" + 0.05 "	0.0536
" + 0.10 "	0.1013
" + 0.20 "	0.1844
1.0 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.0109
" + 0.01 "	0.0210
" + 0.025 "	0.0386
" + 0.05 "	0.0660
" + 0.10 "	0.1185
" + 0.20 "	0.2275
" + 0.40 "	0.4135
2 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.0314
" + 0.01 "	0.0462
" + 0.025 "	0.0605
" + 0.05 "	0.0886
" + 0.10 "	0.1468
" + 0.20 "	0.2591
" + 0.40 "	0.4718
3 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.0548
" + 0.01 "	0.0672
" + 0.025 "	0.0847
" + 0.05 "	0.1156

Solubility of crystalline  $\text{CuO}_2\text{H}_2$  in ammoniacal salt solutions at  $18^\circ$ —Continued

Solvent contains per litre	Cone of dissolved Cu g atoms per l
3 mol. $\text{NH}_3$ + 0.10 mol. $(\text{NH}_4)_2\text{SO}_4$	0.1740
" + 0.20 "	0.2861
" + 0.40 "	0.5044
1 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.0784
" + 0.01 "	0.0922
" + 0.025 "	0.1101
" + 0.05 "	0.1397
" + 0.10 "	0.2002
" + 0.20 "	0.3188
" + 0.40 "	0.5451
5 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.1041
" + 0.01 "	0.1154
" + 0.025 "	0.1320
" + 0.05 "	0.1639
" + 0.10 "	0.2239
" + 0.20 "	0.3415
" + 0.40 "	0.5615
1 mol. $\text{NH}_3$ + 0.00 mol. $\text{Na}_2\text{SO}_4$	0.0109
" + 0.025 "	0.0134
" + 0.10 "	0.0162
" + 0.20 "	0.0192
" + 0.40 "	0.0784
4 mol. $\text{NH}_3$ + 0.10 mol. $\text{Na}_2\text{SO}_4$	0.0994
" + 0.20 "	0.1161

(Dawson, Chem. Soc. 1909, 95. 373.)

Sl. sol. in alkali carbonates + Aq, especially  $\text{KHCO}_3$  and  $\text{NaHCO}_3$ . (Berzelius.)

Sol. in cold  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq, but pptd. on warming. (Field, Chem. Soc. (2) 1. 28.)

Partially sol. when freshly pptd. in  $\text{KCN}$  + Aq. (Rodgers, 1834.)

Sol. in  $(\text{NH}_4)_2\text{S}_2\text{O}_8$  + Aq. (Moreau, Apoth. Ztg. 1901, 16. 383.)

Sol. in  $\text{MSCN}$  + Aq; more difficultly sol. in  $\text{NH}_4\text{SCN}$  + Aq than  $\text{ZnO}_2\text{H}_2$ . (Grossmann, Z. anorg. 1906, 58. 269.)

Very sol. in hydroxylamine. (Jannasch and Cohen, J. pr. 1905, (2), 72. 14.)

Insol. in acetone. (Edmann, C. C. 1899, II. 1014.)

Sol. in large amt. in  $\text{NaC}_2\text{H}_3\text{O}_2$  + Aq. (Mercer, 1844.)

Not pptd. in presence of  $\text{Na citrate}$ . (Spiller.)

Insol. in cane sugar + Aq, unless an alkali or alkaline earth is present. (Peschier.)

Recently pptd.  $\text{CuO}_2\text{H}_2$  is easily sol. in cane sugar with  $\text{NaOH}$ ,  $\text{KOH}$ , or  $\text{CaO}_2\text{H}_2$  + Aq; less sol. in presence of  $\text{SrO}_2\text{H}_2$  or  $\text{BaO}_2\text{H}_2$ . (Bequerel.)

Not pptd. by  $\text{KOH}$  + Aq in solutions containing tartaric acid, cane sugar, and many other non-volatile organic substances.

Sol. in  $\text{Ca}$ ,  $\text{Ba}$ ,  $\text{Sr}$ ,  $\text{K}$  or  $\text{Na}$  succrates + Aq, and ppts. of double succrates form when solutions of the first three bases are heated, but no

ppt forms in the last two cases even at 100°.  
(Hunton)

Insol. in simple Ca, Ba, or K succates + Aq, but immediately sol. when an excess of cane sugar + Aq is present. (Pelouze)

Moderately sol. in amyl amine, easily sol. in methyl, less in ethyl amine (Wurtz.)

Sol. in sorbine + Aq. (Pelouze)

Not pptd. in presence of aromatic oxyacids or phenols of the ortho series. Thus in presence of salicylic acid, pyrocatechin, gallic acid, pyrogallie acid, etc., NaOH + Aq does not ppt.  $\text{CuO}_2\text{H}_2$  from Cu solutions, but pptn. is not prevented by benzoic acid, resorcin, hydroquinone, etc. (Weith, B. 9. 342.)

Sol. in solutions of alkali salts of "spaltungsprodukte" of albumen. (Kalle and Co. Pat 1901.)

Sol. in starch emulsion which has become thin liquid in an alternating magnetic field (Rosenthal, C. C. 1908, 1 593.)

$\text{CuO}$ ,  $2\text{H}_2\text{O}$ . (Rubénovitch, C. R. 1899, 129. 336)

$\text{CuO}$ ,  $3\text{H}_2\text{O}$ . (Kosmann, Z. anorg. 1893, 3. 373.)

$2\text{CuO}$ ,  $3\text{H}_2\text{O}$ . (Cross, Gm.—K 5. 1, 753.)

$4\text{CuO}$ ,  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{OH}$  + Aq. (Mailhe, A. ch. 1902, (7) 27. 393.)

Cupric hydroxide ammonia,  $\text{CuO}_2\text{H}_2$ ,  $4\text{NH}_3$ .

Present in ammoniacal solution of  $\text{CuO}_2\text{H}_2$ . (Dawson, Z. phys. Ch. 1909, 69. 110.)

Cuprous imide,  $\text{Cu}_2\text{NH}$ .

Decomp. at 160° forming  $\text{Cu}_2\text{N}$ .

Readily hydrolysed by  $\text{H}_2\text{O}$ .

Sol. in liquid  $\text{NH}_3$  solutions of  $\text{NH}_4\text{NO}_3$ . (Franklin, J. Am. Chem. Soc. 1912, 34. 1502.)

Cuprous iodide,  $\text{Cu}_2\text{I}_2$ .

Insol. in  $\text{H}_2\text{O}$ , or dil. acids.

Calculated from electrical conductivity of  $\text{Cu}_2\text{I}_2$  + Aq, 1 l.  $\text{H}_2\text{O}$  dissolves about 8 mg.  $\text{Cu}_2\text{I}_2$  at 18° (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Vitali, Gm.—K 5. 1, 947)

Sol. with difficulty in conc.  $\text{HCl}$  + Aq.

Decomp. by conc.  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$ . Insol. in  $\text{NaCl}$ ,  $\text{KNO}_3$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{KBr}$ , or  $\text{NH}_4\text{Cl}$  + Aq. Sol. in  $\text{NH}_4\text{OH}$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{KCN}$ , or  $\text{KI}$  + Aq. (Renault, C. R. 59. 558.)

Appreciably sol. in  $\text{N}/10$   $\text{HCl}$ . Practically insol. in  $\text{N}/10$   $\text{H}_2\text{SO}_4$ . (Moser, Z. anal. 1904, 43. 604.)

Results of experiments on solubility of  $\text{Cu}_2\text{I}_2$  in  $\text{I}_2$  + Aq in presence of acids and salts are given by Bray and MacKay.

$\text{Cu}_2\text{I}_2$  was found to be sl. sol. in  $\text{H}_2\text{O}$  but a considerable amt. dissolves in presence of  $\text{I}_2$ , owing to formation of  $\text{CuI}_2$  and  $\text{CuI}_3$ . (J. Am. Chem. Soc. 1910, 32. 1207.)

### Solubility of $\text{Cu}_2\text{I}_2$ in $\text{I}_2$ + Aq at 20°.

$\mu$ part		Solid Phase
Cu	I	
0.285	0.585	$\text{Cu}_2\text{I}_2$
0.482	1.305	"
0.583	1.922	"
0.678	2.557	"
0.756	3.204	"
0.844	3.954	"
0.898	4.436	"
0.964	5.085	"
1.032	5.685	"
1.000	6.242	"
1.112	6.530	"
1.232	7.653	$\text{Cu}_2\text{I}_2 + \text{I}_2$
1.040	6.449	$\text{I}_2$
0.898	5.594	"
0.748	4.711	"
0.606	3.856	"
0.448	2.919	"
0.300	2.069	"
0.159	1.230	"
0.025*	5.461	$\text{Cu}_2\text{I}_2 + \text{I}_2$
1.658**	11.366	"

\* at 0°. \*\* at 40°.

(Fedotieff, Z. anorg. 1911, 69. 26)

### Solubility in $\text{NH}_4\text{Br}$ + Aq at 20°

$\text{NH}_4\text{Br}$ + Aq	$\mu$ $\text{Cu}_2\text{I}_2$ in 1 l. of the solution
2-N	1.9068
3-N	3.6540
4-N	6.0588

(Kohn and Klein, Z. anorg. 1912, 77. 254)

Sol. in  $\text{FeCl}_3$  + Aq. (Fleischer, C. N. 1869, 19. 206)

### Solubility in $\text{KBr}$ + Aq at t°.

t°	$\text{KBr}$ + Aq.	$\mu$ $\text{Cu}_2\text{I}_2$ in 1 l. of the solution
19.5	2-N	1.4666
24.0	2-N	1.5576
19.5	3-N	3.4004
23.0	3-N	3.5949
22.0	4-N	7.1263
22.0	4-N	6.9768

The solutions undergo change in the course of a few days, iodine being set free; the solubility of the cuprous iodide is not markedly affected thereby.

(Kohn, Z. anorg. 1909, 63. 337.)

1 l. of a 0.2N solution of  $\text{KI}$  dissolves 0.000157 g. mol.  $\text{Cu}_2\text{I}_2$ . (Bodlander, Z. anorg. 1902, 31. 475)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in  $\text{CS}_2$ . (Arctowski, Z anorg. 1894, 6. 257.)

Practically insol. in methylene iodide. (Retgers, Z anorg 1893, 3. 347.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in acetone (Naumann, B. 1904, 37. 4329); (Eidmann, C. C. 1899, II. 1014.)

100 g. acetonitrile dissolve 3.52 g.  $\text{CuI}_2$  at  $18^\circ$  (Naumann and Schier, B. 1914, 47. 249.)

Min. *Marshite*. (Gm.—K 5. 1, 945.)

**Cupric iodide,  $\text{CuI}_2$ .**

Exists only in very dil aqueous solution. (Traube, B. 17. 1064.)

**Copper periodide,  $\text{CuI}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Walker and Dover, Chem. Soc. 1905, 87. 1588.)

**Copper ammonium iodide ammonia.**

See Cupriammonium iodide ammonia.

**Cuprous mercuric iodide,  $\text{Cu}_2\text{I}_2, \text{HgI}_2$ .**

$\text{KI} + \text{Aq}$  dissolves out  $\text{HgI}_2$ .

**Cuprous mercuric iodide ammonia,  $\text{CuI}_2, 2\text{HgI}_2, 4\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  or acids. Sol. in a mixture of acetic acid and alcohol.

$\text{CuI}_2, \text{HgI}_2, 4\text{NH}_3$ . As above. (Jørgensen, J. pr. (2) 2. 347.)

**Cupric nitrogen iodide,  $\text{CuI}_2, \text{N}_2\text{H}_4\text{I}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ ; or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Guyard, C. R. 97. 526.)

**Cupric thallic iodide ammonia,  $\text{CuI}_2, 2\text{TI}_3, 4\text{NH}_3$ .**

Decomp. slowly by  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp. Sol in alcohol.

**Cuprous iodide ammonia,  $\text{Cu}_2\text{I}_2, \text{NH}_3$ .**

Ppt. (Anderline, Gazz. ch. it. 1912, 42. I, 321.)

$+ 4\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$ . Very sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Silberrad, Chem. Soc. 1905, 87. 67.)

$\text{Cu}_2\text{I}_2, 3\text{NH}_3$ . (Lloyd, J. phys. Chem. 1908, 12. 399.)

$\text{Cu}_2\text{I}_2, 4\text{NH}_3$ . (Levol, J. Pharm 4. 328.)

$+ \text{H}_2\text{O}$ . (Saglier, C. R. 104. 1440.)

$\text{Cu}_2\text{I}_2, 6\text{NH}_3$ . (Lloyd)

**Cupric iodide ammonia,  $\text{CuI}_2, 4\text{NH}_3 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp. Not attacked by cold

alcohol or ether. (Berthelmont, J. Pharm. 15. 445.) (Pozza-Escot, C. R. 1900, 130. 90.)

$\text{CuI}_2, 6\text{NH}_3$ . Sol. in liquid  $\text{NH}_3$ . (Horn, Am. Ch. J. 1908, 39. 205.)

$3\text{CuI}_2, 10\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Richards, Am. Ch. J. 1895, 17. 302.)

Sol. in liq.  $\text{NH}_3$ . (Horn, Am. Ch. J. 1908, 39. 204.)

**Cupriammonium iodide ammonia,**

$3\text{Cu}(\text{NH}_3)_2\text{I}_2, 4\text{NH}_3$ .

Decomp. by air and by  $\text{H}_2\text{O}$ . (Richards, Am. Ch. J. 1895, 17. 302.)

**Copper periodide ammonia,  $2\text{CuI}, \text{I}_2, 5\text{NH}_3 + \text{H}_2\text{O}$ .**

Because of its insolubility it cannot be recryst. from any solvent. (Silberrad, Chem. Soc. 1905, 87. 66.)

**Copper tetraiodide, ammonia,  $\text{CuI}_4, 4\text{NH}_3$ .**

(Jørgensen, J. pr. (2) 2. 353.)

**Copper hexaiodide ammonia,  $\text{CuI}_6, 4\text{NH}_3$ .**

Not decomp. in  $\text{H}_2\text{O}$  in closed vessels. (Jørgensen.)

**Copper mercuric iodide ammonia,**

$\text{CuHgI}_4, 5\text{NH}_3$ .

$\text{CuHgI}_2, 2\text{NH}_3$ . Ppt. Decomp. by  $\text{H}_2\text{O}$  and by alcohol.

$\text{CuHgI}_2, 3\text{NH}_3$ . Ppt. Decomp. by long washing with  $\text{H}_2\text{O}$ .

$\text{CuHgI}_2, 4\text{NH}_3$ . Ppt. Decomp. by  $\text{H}_2\text{O}$ . Sl. attacked by abs. alcohol.

$\text{CuI}_2, \text{HgI}_2, 4\text{NH}_3$ . Ppt. (Anderline, Gazz. ch. it. 1912, 42, (1) 321; C. C. 1912, II. 95.)

**Copper nitride,  $\text{Cu}_3\text{N}_2$ .**

Decomp. by dil or conc. acids.

Easily decomp. by  $\text{H}_2\text{O}$  when finely powdered. (Rossel, C. R. 1895, 121. 942.)

**Copper suboxide,  $\text{Cu}_2\text{O}$ .**

Not attacked by  $\text{H}_2\text{O}$ . Decomp. by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  into  $\text{Cu}$  and  $\text{CuSO}_4$ ; dil.  $\text{HCl} + \text{Aq}$  has similar action. Not attacked by  $\text{NH}_4\text{OH} + \text{Aq}$  or  $\text{NH}_4\text{OH} + (\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Rose, Pogg. 120. 1.)

$\text{Cu}_2\text{O}$ . Not attacked by dil. or conc. min. acids, even aqua regia. Slowly sol. in  $\text{HF} + \text{Aq}$ . (Bailey and Hopkins, Chem. Soc. 1890, 57. 272.)

Is a solution of oxide in  $\text{Cu}$ . (Jordis, Zest. angew. Ch. 1908, 21. 51.)

**Cuprous oxide,  $\text{Cu}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{SO}_4 + \text{Aq}$ ,  $\text{H}_3\text{PO}_4 + \text{Aq}$ , or cold very dil.  $\text{HNO}_3 + \text{Aq}$  into a cuprio salt and  $\text{Cu}$ . Converted by  $\text{HCl} + \text{Aq}$  into cuprous chloride.

Solubility of  $\text{Cu}_2\text{O}$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ 

Conc. of total Cu		Conc. of total $\text{NH}_3$	
G. in 1000 g. of solution	G. mol in 1000 g. of solution	G. in 1000 g. of solution	G. mol in 1000 g. of solution
Preparation I			
0.3593	0.00566	3.91	0.23
0.5024	0.00791	12.07	0.71
0.6869	0.01080	13.77	0.81
0.6964	0.01095	16.15	0.95
1.0144	0.01597	27.03	1.59
1.0462	0.01645	32.64	1.92
1.0557	0.01660	36.89	2.17
1.2243	0.01924	45.73	2.69
1.3229	0.02051	63.68	4.04
1.4852	0.02340	74.12	4.36
1.5105	0.02375	81.26	4.78
1.6313	0.02565	98.52	5.56
1.6981	0.02670	122.40	7.20

## Preparation II

0.4229	0.00665	7.82	0.46
0.6678	0.01050	8.16	0.48
0.9890	0.01555	22.61	1.33
1.0494	0.01650	28.39	1.67
1.3528	0.02127	54.15	3.19
1.5047	0.02366	72.08	4.24
1.5963	0.02510	78.20	4.60
1.6555	0.02603	102.05	6.00

(Donnan and Thomas, Chem. Soc. 1911, 99, 1791.)

Sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Rose)  
 Sol. in excess of  $\text{KOH} + \text{Aq.}$  (Chodnew.)  
 Sol. in conc.  $\text{MgCl}_2$  and  $\text{FeCl}_3 + \text{Aq.}$  (Hunt, C. R. 69, 1357.)  
 Sol. attacked by liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 827.)  
 Min. *Cuprite*. Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , and  $\text{NH}_4\text{OH} + \text{Aq.}$

Cupric oxide,  $\text{CuO}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  but dissolves on addition of a few drops of acid or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  Insol. in dil., but sol in warm conc.  $\text{NaOH}$ , and  $\text{KOH} + \text{Aq.}$  (Low, Z. anal. 9, 463.)

$\text{CuO}$  prepared at a low temp. is easily sol in dil. acids, but when ignited is slowly sol in boiling conc. acids, but moderately rapidly in a cold mixture of  $\text{NH}_4\text{I} + \text{HCl}$ . (Joannis, C. R. 1886, 102, 1161.)

Solubility in  $\text{N-HNO}_3$ . 1 l. of the solution contains 0.4802 g. atoms Cu at  $25^\circ$ . (Jaeger, Z. anorg. 1901, 27, 33.)

Solubility of  $\text{CuO}$  in  $\text{HF} + \text{Aq}$  at  $25^\circ$ .

	Time	G. $\text{CuO}$ in 10 ccm. of the solution
0.25N-HF	11 $\frac{1}{2}$ hrs.	0.0431
	33 $\frac{1}{2}$ "	0.0619
	25 $\frac{1}{2}$ "	0.0812
	71 $\frac{1}{2}$ "	0.0823
	170 $\frac{1}{2}$ "	0.0907
N-HF (a)	51 $\frac{1}{2}$ "	0.3018
	21 $\frac{1}{2}$ "	0.2797
	52 "	0.2747
	201 $\frac{1}{2}$ "	0.2330
	226 $\frac{1}{2}$ "	0.2353
N-HF (b)	41 $\frac{1}{2}$ "	0.3220
	44 $\frac{1}{2}$ "	0.2930
	117 $\frac{1}{2}$ "	0.2431
	167 $\frac{1}{2}$ "	0.2210
2.02N-HF	1 $\frac{1}{2}$ "	0.3046
	5 "	0.4533
	71 $\frac{1}{2}$ "	0.3583
	156 $\frac{1}{2}$ "	0.3311

(Deussen, Z. anorg. 1905, 44, 421.)

Solubility of  $\text{CuO}$  in  $\text{HF}$  at  $25^\circ$ .

$\text{Cu} = \text{g-atoms Cu}$  in 1 l. of the solution.

HF normality	Cu
0.12	0.0307
0.28	0.1164
0.57	0.2494
1.08	0.388
2.28	0.463

(Jaeger, Z. anorg. 1901, 27, 29.)

Solubility of  $\text{CuO}$  in  $\text{HF} + \text{KF}$  at  $25^\circ$ .

$\text{Cu} = \text{g-atoms Cu}$  in 1 l. of the solution.

HF normality	Cu
0.12	0.0356
0.28	0.06437
0.57	0.1442
1.11(1.08)	0.2451
2.17(2.28)	0.2517

(Jaeger, l. c.)

Sol. in large excess of  $\text{KOH} + \text{Aq.}$  (de Coninck, C. C. 1904, II, 65.)

Slowly sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq.}$  and less easily in  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Rose)

Sol. in boiling  $\text{H}_2\text{O}$  solutions of  $\text{Al}_2$ ,  $\text{Gl}$ ,  $\text{U}$ ,  $\text{Cr}_2$ ,  $\text{Fe}_2$ , or  $\text{Bi}$  nitrates and chlorides,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{Hg}_2(\text{NO}_3)_2$ ,  $\text{SbCl}_3$ ,  $\text{SnCl}_4$ , and  $\text{SnCl}_2$ , with pptn. of oxides of the bases of those salts. Unacted upon by boiling  $\text{H}_2\text{O}$  solutions of  $\text{Mn}$ ,  $\text{Mg}$ ,  $\text{Ni}$ ,  $\text{Co}$ ,  $\text{Zn}$ ,  $\text{Ce}$ , or

Fe nitrates or chlorides,  $\text{AgNO}_3$ ,  $\text{Pb(NO}_3)_2$ ,  $\text{Cd(NO}_3)_2$ , and  $\text{HgCl}_2$ . (Peisoz.)

Pure  $\text{CuO}$  is very sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  but the solution is greatly increased by the addition of  $\text{NH}_4$  salts (Muthmann, C. C. 1904, II, 410.)

Sol. in hot  $(\text{NH}_4)_2\text{SO}_4$  or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (Juman, Electrochem. Ind. 1908, 6, 258.)

15% dissolves in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  in 24 hrs. (Schmahl, Z. B. H. Sal. 1880, 28, 282.)

Sl. attacked by liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Solubility in N-acetic acid. 1 l. of the solution contains 0.1677 g-atoms Cu at 25° (Jaeger, Z. anorg. 1902, 27, 33.)

Insol in acetone. (Naumann, B. 1904, 37, 4329; Erdmann, C. C. 1899, II, 1014.)

Sl. sol in benzamide (Dessaignes, A. ch. 1852, (3), 34, 146.)

Insol. in piperidine (Cahours, C. R. 1852, 34, 481.)

Sol in acid ammes as asparagin. (Pina, A. ch. 1848, (3), 22, 160.)

Sol. in amines alone or mixed with  $\text{NH}_3$ . (Lancet, Dissert. 1905.)

Slowly sol in Ca or any other alkali saccharate + Aq, but not in cane sugar + Aq. (Tuntun.)

Solubility in (calcium saccharate + sugar) + Aq  
1 l. solution containing 418.6 g. sugar and 34.3 g.  $\text{CuO}$  dissolves 10.26 g.  $\text{CuO}$ .

1 l. solution containing 296.5 g. sugar and 24.2 g.  $\text{CaO}$  dissolves 5.68 g.  $\text{CuO}$

1 l. solution containing 174.4 g. sugar and 14.1 g.  $\text{CaO}$  dissolves 3.47 g.  $\text{CuO}$ . (Bodenbender, J. B. 1885, 600.)

Polypeptides in aqueous solution dissolve  $\text{CuO}$  by short boiling (Fischer, B. 1906, 39, 576.)

$+1/2\text{H}_2\text{O} = 6\text{CuO} + \text{H}_2\text{O}$ . Insol. in dil., but sol. in conc.  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ .

Sol. in volatile oils.

See also Cupric hydroxide.

Min. *Melaconite*. Sol. in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$

Cuprocupric oxide,  $\text{Cu}_2\text{O}_3 = 2\text{Cu}_2\text{O}$ ,  $\text{CuO}$ .

(Favre and Maumené.)

$\text{Cu}_2\text{O}_3 + \text{H}_2\text{O} = \text{Cu}_2\text{O}$ ,  $\text{CuO} + \text{H}_2\text{O}$ . When freshly pptd., sol in  $\text{HCl} + \text{Aq}$ , but insol after drying (Siewert, J. B. 1866, 257.)

$\text{Cu}_2\text{O}_3 = \text{Cu}_2\text{O}$ ,  $2\text{CuO}$ . (Siewert.)

All oxides of Cu except  $\text{Cu}_2\text{O}$ ,  $\text{Cu}_2\text{O}_3$ ,  $\text{CuO}$ , and  $\text{Cu}_2\text{O}_2$  are mixtures (Osborne, Sil. Am. J. (3) 32, 33; Debray, C. R. 99, 583.)

Copper dioxide,  $\text{CuO}_2 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids with formation of cupric salt and  $\text{H}_2\text{O}_2$ . (Weltzien, A. 140, 207.)

Cuprous oxide ammonia (cuprosammonium oxide).

Known only in solution. (Wagner, C. C. 1863, 239.)

Cupric oxide ammonia (cuprammonium hydroxide),  $3\text{CuO}$ ,  $4\text{NH}_3 + 6\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ . (Kane, A. ch. 72, 283.)

$\text{CuO}$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$ . Very deliquescent. Decomp. in the air and by  $\text{H}_2\text{O}$ . (Malaguti and Sarzeau, A. ch. (3) 9, 438.)

Cuprous oxybromide,  $\text{Cu}_2\text{Br}_2$ ,  $\text{CuO} + \text{H}_2\text{O}$ .

(Spring and Lucion, Bull. Ac. Belg. (3) 24, 21.)

Cupric oxybromide,  $\text{CuBr}_2$ ,  $3\text{CuO} + 3\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ . Easily sol in dil. acids or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Bium, C. R. 109, 66.)

Insol. in  $\text{H}_2\text{O}$  but decomp. by continued boiling. Sol in conc. acetic acid, sl. sol in conc.  $\text{CuBr}_2 + \text{Aq}$ . Insol. in dil.  $\text{KBr} + \text{Aq}$ . (Richards, Proc. Am. Acad. 1890, 25, 215.)

Cupric oxybromide ammonia,  $2\text{CuO}$ ,  $\text{CuBr}_2$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$ .

(Kohlschlatter and Pudsches, B. 1904, 37, 1159.)

Cuprous oxychloride,  $\text{Cu}_2\text{Cl}_2$ ,  $\text{CuO} + 3\text{H}_2\text{O}$ .

(Spring and Lucion, Bull. Ac. Belg. (3) 24, 21.)

Cupric oxychloride,  $\text{CuO}$ ,  $\text{CuCl}_2 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Rousseau, C. R. 1890, 110, 1203.)

$2\text{CuO}$ ,  $\text{CuCl}_2$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ , from which it is reprecipitated by dilution with  $\text{H}_2\text{O}$

$+ \text{H}_2\text{O}$  (Kane, A. ch. 72, 277.)

$+ 4\text{H}_2\text{O}$  (Gladstone, Chem. Soc. 8, 211.)

$3\text{CuO}$ ,  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  (Miller and Kendrick, Trans. Roy. Soc. Can. 1901, (2) 8, III 35.)

$+ 3\text{H}_2\text{O}$ . (Dupont and Jansen, Bull. Soc. 1893, (3), 9, 193.)

$+ 3 1/2\text{H}_2\text{O}$ . Insol. in cold  $\text{H}_2\text{O}$ , sl. decomp. by boiling. (Reindel, J. pr. 108, 378.)

Insol. in boiling  $\text{H}_2\text{O}$ . (Habermann, W. A. B. 90, 2, 268.)

$+ 4\text{H}_2\text{O}$ . Sol. in alkaline solution of  $\text{KNa}$  tartrate. (Groger, Z. anorg. 1902, 31, 327.)

(Brunswick green). Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids.

Min. *Atacamite*. Sol. in acids, and  $\text{NH}_4\text{OH} + \text{Aq}$ .

Sol. in cold sat. citric acid + Aq. (Bolton, B. 1880, 13, 732.)

$4\text{CuO}$ ,  $\text{CuCl}_2 + 6\text{H}_2\text{O}$  (Kane, Gm.—K. 5, 1, 919.)

$+ 8\text{H}_2\text{O}$ . Min. *Talkingite* (Church, Gm.—K. 5, 1, 919.)

$5\text{Cu(OH)}_2$ ,  $\text{Cu}_2\text{Cl}_2\text{Cl(OH)}$ . Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Kuhling, B. 1901, 34, 2852.)

$7\text{CuO}$ ,  $2\text{CuCl}_2 + 9\text{H}_2\text{O}$ . (Reindel.)

$6\text{CuO}$ ,  $\text{CuCl}_2 + 9\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acetic acid. (Neumann, Repert. 37, 304.)

$8\text{CuO}$ ,  $\text{CuCl}_2 + 12\text{H}_2\text{O}$ . Min. *Footite*. (König, Zeit. Kryst. 1891, 19, 601.)

Cupric zinc oxychloride,  $\text{ZnO}$ ,  $2\text{ZnCl}_2$ ,  $5\text{CuO}$  +  $6\text{H}_2\text{O}$ .

(André, C. R. 1888, 106. 855.) -

Cupric oxychloride ammonia,  $2\text{CuO}$ ,  $\text{CuCl}_2$ ,  $2\text{NH}_3$  +  $3\text{H}_2\text{O}$ .

(Dehéran, Gm.—K. 5. 1, 932.)

Cupric oxyfluoride,  $\text{CuO}$ ,  $\text{CuF}_2$  +  $\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  (Berzelius) (Balbiano, Gazz. ch. it. 14. 74)

Cupric oxyfluoride ammonia (cuprammonium oxyfluoride),  $\text{Cu}(\text{OH})\text{F}$ ,  $2\text{NH}_3$

(Balbiano, Gazz. ch. it. 14. 74.)

$3\text{CuO}$ ,  $\text{CuI}_2$  +  $x\text{H}_2\text{O}$ . (Tschirwinski, Gm.—K. 5. 1, 1584)

Cuprous oxyiodide,  $\text{Cu}_2\text{I}_2$ ,  $\text{CuO}$  +  $\text{H}_2\text{O}$ .

(Spring and Lucion, Bull. Ac. Belg. (3) 24. 21.)

Cupric oxyiodide,  $2\text{CuI}_2$ ,  $\text{CuO}$  +  $4\text{H}_2\text{O}$ .

Easily decomp. by  $\text{H}_2\text{O}$ . (Carnegie, Watts' Dict. II, 257.)

Copper oxysulphide,  $2\text{Cu}_2\text{S}$ ,  $\text{CuO}$ .

Insol. in  $\text{H}_2\text{O}$ . (Maumené, A. ch. (3) 18. 311.)

$5\text{CuS}$ ,  $\text{CuO}$ . Ppt. (Pelouze)

$2\text{CuS}$ ,  $\text{CuO}$ . Insol. in  $\text{H}_2\text{O}$ .

$\text{CuS}$ ,  $\text{CuO}$ . Insol. in  $\text{H}_2\text{O}$ .

Above comps. do not exist. (Pickering, Chem. Soc. 33. 136.)

Copper phosphide,  $\text{Cu}_3\text{P}_2$ .

Easily sol. in  $\text{HNO}_3$  or aqua regia; insol. in  $\text{HCl}$  + Aq. (Rose, Pogg. 6. 209.)

Sol. in  $\text{HNO}_3$  and  $\text{Br}_2$  + Aq. Decomp. by hot conc.  $\text{H}_2\text{SO}_4$ . (Rubénovitch, C. R. 1899, 128. 1399.)

$\text{Cu}_3\text{P}$ . Sol. in  $\text{HNO}_3$  + Aq. (Granger, A. ch. 1898, (7), 14. 64)

Crystallised. Completely sol. in hot  $\text{HNO}_3$ , aqua regia and  $\text{HF}$  +  $\text{HNO}_3$ . Slowly sol. in hot  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . Not attacked by hot or cold  $\text{HF}$  or acetic acid (Maronneau, C. R. 1899, 128. 939.)

$\text{Cu}_2\text{P}_2$ . Easily sol. in  $\text{HNO}_3$ . Sol. in hot conc.  $\text{H}_2\text{SO}_4$ . Sol. in conc.  $\text{HCl}$  + Aq. before the phosphide has been heated. (Rose, Pogg. 4. 110.)

$\text{Cu}_2\text{P}_2$ . Easily sol. in  $\text{HNO}_3$  or  $\text{HCl}$  + Aq. Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Granger, Bull. Soc. (3) 9. 661.)

$\text{CuP}_2$ . Decomp. by  $\text{HNO}_3$ ; not readily sol. in  $\text{HCl}$ . Easily attacked by  $\text{Cl}_2$  or  $\text{Br}_2$  + Aq. (Granger, C. R. 1895, 120. 924.)

$\text{Cu}_2\text{P}_2$ . (Granger, C. R. N 1898, 77. 220.)

Very sol. in  $\text{HNO}_3$  and  $\text{Br}_2$  + Aq. Decomp. by hot conc.  $\text{H}_2\text{SO}_4$ . (Rubénovitch, C. R. 1899, 129. 338.)

Cupric zinc phosphide,  $10\text{Cu}_2\text{P}_2$ ,  $\text{Zn}_3\text{P}_2$  +  $\text{H}_2\text{O}$ . (Hvoslef, A. 100. 90.)

Copper phosphoselenide,  $\text{Cu}_2\text{Se}$ ,  $\text{P}_2\text{Se}_3$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl}$  + Aq, sol. in  $\text{HNO}_3$  + Aq. Insol. in cold alkalis, but decomp. slowly when heated therewith (Hahn, J. p. 93. 436)

$2\text{CuSe}$ ,  $\text{P}_2\text{Se}_2$ . Attacked only by fuming  $\text{HNO}_3$ . (Hahn.)

$2\text{CuSe}$ ,  $\text{P}_2\text{Se}_2$ . Sol. only in  $\text{HNO}_3$  + Aq. (Hahn.)

Copper phosphosulphide,  $2\text{Cu}_2\text{S}$ ,  $\text{P}_2\text{S}_5$ .

$\text{Cu}_2\text{S}$ ,  $\text{P}_2\text{S}_5$ . (Berzelius)

$2\text{Cu}_2\text{S}$ ,  $\text{P}_2\text{S}_5$ . (Berzelius)

$\text{CuS}$ ,  $\text{P}_2\text{S}_5$ . Insol. in  $\text{H}_2\text{O}$  and dil.  $\text{HCl}$  + Aq. Sol. in conc.  $\text{HCl}$  + Aq, from which it is precipitated by  $\text{H}_2\text{O}$ . (Berzelius, A. 46. 252.)

$8\text{CuS}$ ,  $\text{P}_2\text{S}_5$ . (Berzelius.)

$\text{Cu}_2\text{P}_2\text{S}_5$ . Sol. in conc.  $\text{HNO}_3$  and in aqua regia. Insol. in  $\text{HCl}$ . Not attacked by hot  $\text{H}_2\text{SO}_4$  or conc.  $\text{NaOH}$  + Aq. (Ferland, A. ch. 1899, (7), 17. 407)

Cuprous selenide,  $\text{Cu}_2\text{Se}$ .

Ppt. Sol. in  $\text{HCl}$  and in  $\text{H}_2\text{SO}_4$ .

Decomp. by  $\text{HNO}_3$ . Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Fonzes-Diacon, C. R. 1900, 131. 1207.)

Sol. in  $\text{KCN}$  + Aq. (Heyn and Bauer, Metall 1903, 3. 84)

Mun. Berzelianite

Cupric selenide,  $\text{CuSe}$ .

(Little, A. 112. 211.)

Ppt. Sol. in  $\text{HCl}$  and in  $\text{H}_2\text{SO}_4$ . Decomp. by  $\text{HNO}_3$ . (Fonzes-Diacon, C. R. 1900, 131. 1207.)

Cuprocupric selenide,  $\text{Cu}_2\text{Se}_2$ .

Mun. Umangite. Sol. in  $\text{HNO}_3$ . (Klockmann, Zeit. Kryst. 1891. 19, 270)

Cuprous lead selenide,  $3\text{Cu}_2\text{Se}$ ,  $\text{PbSe}$ .

Mun. Zogite. Sol. in cold conc.  $\text{HNO}_3$  + Aq. with separation of Se.

Cupric lead selenide,  $\text{CuSe}$ ,  $\text{PbSe}$ .

Sol. in cold conc.  $\text{HNO}_3$  with separation of Se. (Karsten.)

$\text{CuSe}$ ,  $2\text{PbSe}$ . As above.

$\text{CuSe}$ ,  $4\text{PbSe}$ . As above.

Cuprous silver selenide,  $\text{Cu}_2\text{Se}$ ,  $\text{Ag}_2\text{Se}$

Mun. Eucaimite. Sol. in hot  $\text{HNO}_3$  with decomp. (Berzelius.)

Cuprous silicide,  $\text{Cu}_2\text{Si}$ .

Sol. in warm dil. or conc.  $\text{HNO}_3$ . Only sl. sol. in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HF}$ . Sol. in a mixture of  $\text{HNO}_3$  and  $\text{HF}$ . Not attacked by solutions of alkalis (Vigouroux, C. R. 1906, 142. 88.)

$\text{Cu}_2\text{Si}_2$ . Sol. in aqua regia and fused sodium potassium carbonate. (de Chalmot, Am. Ch. J. 1896, 18, 95.)

$\text{Cu}_2\text{Si}$  Decomp. by water and moist air, and by acids and fused alkali. (Vigouroux, C. R. 1898, 122, 319.)

Cuprous sulphide,  $\text{Cu}_2\text{S}$ .

More sol. in  $\text{H}_2\text{O}$  than  $\text{Ag}_2\text{S}$ , but much less than  $\text{PbS}$  (Bodlander, Z. phys. Ch. 1898, 27, 64.)

1 l  $\text{H}_2\text{O}$  dissolves  $3.1 \times 10^{-6}$  moles  $\text{Cu}_2\text{S}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58, 294.)

Very slowly decomp. by dil  $\text{H}_2\text{SO}_4$  in presence of oxygen. (Thompson, Electrochem. Ind. 1904, 2, 225.)

Decomp. by conc  $\text{H}_2\text{SO}_4$ . (Picketing, C. N. 1878, 37, 37.)

Cold  $\text{HNO}_3 + \text{Aq}$  dissolves out Cu and leaves  $\text{CuS}$ , hot  $\text{HNO}_3$  dissolves with separation of S. Sl. sol. in boiling conc.  $\text{HCl} + \text{Aq}$ . Insol. in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ .

5N- $\text{HCl}$  dissolves  $\text{Cu}_2\text{S}$  very slightly (0.0038 g Cu in  $7\frac{1}{2}$  hrs) but it is more sol. in presence of Cl, when 0.672 g. are dissolved in  $7\frac{1}{2}$  hours. (Egh, Z. anorg. 1902, 30, 46.)

Sol with exclusion of air in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Malzac, Pat. 1904.)

Insol. in acetone (Naumann, B. 1904, 37, 4329, Eidmann, C. C. 1899, II, 1014.)

Min *Chalcocite*. Completely sol. in warm  $\text{HNO}_3$  with separation of S.

Cupric sulphide,  $\text{CuS}$ .

Almost absolutely insol in  $\text{H}_2\text{O}$ , sol. in 950,000 pts  $\text{H}_2\text{O}$ . When exposed to the air, dissolves in  $\text{H}_2\text{O}$  as  $\text{CuSO}_4$ . Easily sol. in boiling  $\text{HNO}_3$  with separation of S. Difficultly sol. in hot conc.  $\text{HCl} + \text{Aq}$ . Insol in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  (1.6). (Hoffmann, A. 115, 288.)

Pptd. by  $\text{H}_2\text{S}$  or  $(\text{NH}_4)_2\text{S} + \text{Aq}$  in presence of 100,000 pts  $\text{H}_2\text{O}$  (Pfaff), 200,000 pts.  $\text{H}_2\text{O}$  (Lassaigne), 15,000 pts.  $\text{H}_2\text{O}$  and 7500 pts  $\text{HCl}$ , but with 40,000 pts  $\text{H}_2\text{O}$  and 20,000 pts.  $\text{HCl}$  no colour is visible (Reinsch).

1 l  $\text{H}_2\text{O}$  dissolves  $3.51 \times 10^{-6}$  moles  $\text{CuS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58, 294.) Insol in  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Guerout, C. R. 1872, 75, 1276.)

Decomp. by conc.  $\text{H}_2\text{SO}_4$ . (Kliche, J. B. 1890, 593.)

Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Berzelius) Sol in alkali bicarbonates +  $\text{Aq}$ .

Insol in  $\text{NH}_4\text{NO}_3$  or  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Bött) Insol. in acidified conc. alkali chlorides +  $\text{Aq}$ . (Cushman, Am. Ch. J. 1896, 17, 382.)

Sol. in  $\text{FeCl}_3 + \text{Aq}$  with separation of S. (Cumenge and Wimmer, Dingl. 1883, 260, 123.)

Decomp. by boiling  $\text{CuCl}_2 + \text{Aq}$  in presence of  $\text{HCl}$  or  $\text{NaCl}$ . (Raschig, Gm.-K. 6, 1, 819.)

Sol in  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  in presence of large excess of air. (Thompson, Electrochem. Ind. 1904, 2, 228.)

Insol in  $\text{KOH}$ , or  $\text{K}_2\text{S} + \text{Aq}$ , especially if boiling, appreciably sol in colourless and even more readily in hot yellow  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Sl sol in  $\text{Na}_2\text{S} + \text{Aq}$ , more easily in  $\text{NaSH} + \text{Aq}$  (Becker, Sill. Am. J. (3) 33, 199.)

100 cc sat.  $\text{Na}_2\text{S} + \text{Aq}$  (sp gr = 1.225) dissolve 0.0032 g  $\text{CuS}$ . (Holland, Ann. Chem. Anal. 1897, 2, 243.)

Sol. in K polysulphides (3-64%). (Prost, Bull. Soc. Belg Chim 1897, 103.)

Appreciably sol in alkali polysulphides +  $\text{Aq}$ . (Rossing, Z. anal. 1902, 41, 1.)

Sol. in considerable quantity in alkali sulpharsenates, sulphantimonates, and sulphostannates +  $\text{Aq}$ . Therefore when a mixed ppt. of  $\text{CuS}$  and  $\text{As}_2\text{S}_3$ ,  $\text{Sb}_2\text{S}_3$ , or  $\text{SnS}$  is treated with  $\text{K}_2\text{S}$ , a portion of the  $\text{CuS}$  is dissolved. (Wöhler, A. 34, 236.)

Sol in alkali sulphovanadates, or sulphotungstates +  $\text{Aq}$  (Storch, B. 16, 2015.)

Sol. in alkali sulphomolybdates +  $\text{Aq}$  (Debray, C. R. 96, 1618.)

Insol in K thiocarbonate +  $\text{Aq}$ . (Rosenblatt, Z. anal. 26, 15.)

Sol. in  $\text{KCN} + \text{Aq}$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate (Naumann, B. 1910, 43, 314.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329, Eidmann, C. C. 1899, II, 1014.)

Insol. in Na xanthogenate (Ragg, Ch. Z. 1908, 32, 677.)

Solubility of  $\text{CuS}$  in sugar +  $\text{Aq}$  at  $t^\circ$   
g  $\text{CuS}$  per l. of solution

$t^\circ$	10% sugar	30% sugar	50% sugar
17.5	0.5672	0.8632	0.9076
45	0.3659	0.7220	1.0589
75	1.1345	1.2033	1.2809

(Stolle, Z. Ver. Zuckerind. 1900, 50, 331.)

Min. *Covellite*.

*Colloidal*. Aqueous solution is stable when it contains 5 g.  $\text{CuS}$  in a litre; when it contains 4 or 5 times that amount it is decomposed in an hour.

Solutions of salts of the following concentration cause a precipitate in the above solution. Salts of univalent elements—

Salts of univalent elements—

$\text{K}_2\text{Fe}(\text{CN})_6$	1 : 62
$\text{K}_2\text{Fe}(\text{CN})_6$	1 : 127
$\text{Na}_2\text{S}_2\text{O}_3$	1 : 157
$\text{Na}_2\text{CO}_3$	1 : 200
$\text{Na}_2\text{HPO}_4$	1 : 252
$\text{Na}_2\text{SO}_4$	1 : 333
$\text{K}_2\text{Cr}_2\text{O}_7$	1 : 2083
$\text{KI}$	1 : 80
$\text{KBr}$	1 : 133
$\text{KClO}_3$	1 : 166

Salts of univalent elements—*Continued*

$\text{NaC}_2\text{H}_3\text{O}_2$	1: 221
$(\text{NH}_4)_2\text{C}_2\text{O}_4$	1: 255
$\text{NaCl}$	1: 400
$\text{NaHCO}_3$	1: 2500
$\text{K}_2\text{SO}_4$	1: 117
$\text{K}_2\text{CrO}_4$	1: 133
$\text{NaC}_2\text{H}_3\text{O}_2$	1: 166
$\text{K}_2\text{S}_2\text{O}_8$	1: 222
$\text{KCl}$	1: 333
$\text{KNO}_3$	1: 500

## Salts of bivalent metals—

$\text{BaS}_2\text{O}_8$	1: 2242
$\text{Cd}(\text{NO}_3)_2$	1: 3483
$\text{MgSO}_4$	1: 6830
$\text{Ba}(\text{NO}_3)_2$	1: 2677
$\text{BaCl}_2$	1: 3921
$\text{Pb}(\text{ClO}_4)_2$	1: 6988
$\text{CdSO}_4$	1: 3442
$\text{MnSO}_4$	1: 5518

## Salts of trivalent metals—

Ammonia alum	1: 31,896
Chrome alum	1: 55,889
$\text{Al}_2(\text{SO}_4)_3$	1: 90,909

## Acids—

Succinic	1: 100
Oxalic	1: 162
HCl	1: 733
$\text{H}_2\text{SO}_4$	1: 208
Citric	1: 20
Acetic	Not at all
Tartaric	" "

(Spring and de Boeck, Bull. Soc. (2) 58. 165.)

Copper polysulphide,  $\text{Cu}_2\text{S}_x$ .*Amorphous.* Ppt. Decomp. by boiling alcohol. (Rössing, Z. anorg. 1900, 25. 413.) $\text{Cu}_2\text{S}_x$  *Amorphous.* Ppt. can be boiled with  $\text{H}_2\text{O}$  without decomposition. (Rössing, Z. anorg. 1900, 25. 4, 11.) $\text{Cu}_2\text{S}_x$ . Ppt; insol in alkali sulphides; decomp. by conc.  $\text{HNO}_3$ . (Bodroux, C. R. 1900, 130. 1398.)

Could not be obtained. (Rössing, Z. anorg. 1900, 25. 414.)

 $\text{Cu}_2\text{S}_x$ . Ppt. Decomp. by  $\text{H}_2\text{O}$ . Sol. in alkali and barium polysulphides + Aq. Decomp. by colorless alkali sulphides + Aq. (Rössing, Z. anorg. 1900, 25. 407.)Cuprous iron (ferric) sulphide,  $\text{Cu}_2\text{S}$ ,  $\text{Fe}_2\text{S}_3$ .Decomp. by conc.  $\text{HCl}$  + Aq. Sol. in boiling  $\text{HNO}_3$  + Aq. of 1.2 sp. gr. (Schnneider, J. pr. (2) 38. 569.)Min. *Chalcocopyrite*. Insol. in  $\text{HCl}$  + Aq. When heated in a sealed tube with  $\text{H}_2\text{S}$  + Aq, a portion of it dissolves with difficulty and subsequent deposition of S. (Senarmont, A. ch. (3) 32. 168.)Cuprocupric iron (ferric) sulphide,  $\text{Cu}_2\text{S}$ ,  $\text{CuS}$ ,  $\text{FeS}$ .Min. *Bohmite*. Sol. in  $\text{HCl}$  + Aq with a residue of S.Cupric iron (ferric) sulphide,  $\text{CuS}$ ,  $\text{Fe}_2\text{S}_3$ .Min. *Cubanite*.Copper iron potassium sulphide,  $\text{K}_2\text{FeCu}_2\text{S}_4$ .Sl. attacked by cold dil.  $\text{HCl}$  + Aq. Decomp. by warming. (Schnneider, Pogg. 138. 318.)Copper iron sodium sulphide,  $\text{Na}_2\text{FeCu}_2\text{S}_4$ .Sl. attacked by cold dil., easily decomp. by hot  $\text{HCl}$  + Aq. (Schnneider, Pogg. 138. 318.)Cuprous lead sulphide,  $9\text{Cu}_2\text{S}$ ,  $2\text{PbS}$ . $3\text{Cu}_2\text{S}$ ,  $2\text{PbS}$ . $2\text{Cu}_2\text{S}$ ,  $2\text{PbS}$ . Min. *Cuproplumbite*.

## Copper phosphorus sulphide.

See Copper phosphosulphide.

## Cupric platinum sulphide.

See Sulphoplatinate, cupric.

Cuprous potassium sulphide,  $4\text{Cu}_2\text{S}$ ,  $\text{K}_2\text{S}$ .

(Ditte, C. R. 98. 1429.)

Cuprocupric potassium sulphide,  $3\text{Cu}_2\text{S}$ ,  $2\text{CuS}$ ,  $\text{K}_2\text{S}$ .Not decomp. by very dil.  $\text{HCl}$  + Aq, but easily by conc.  $\text{HCl}$  + Aq on warming. (Schnneider, Pogg. 138. 311.)Copper potassium polysulphide,  $\text{KCuS}_x$ .Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Decomp. by conc. and dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3$ . Sl. sol. in alcohol. (Biltz and Herms, B. 1907, 40. 977.) $2\text{CuS}_x$ ,  $\text{K}_2\text{S}$ . Decomp. by  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4\text{SH}$  + Aq. (Priwoznik, B. 5. 1291.) $\text{K}_2\text{Cu}_2\text{S}_{10}$ . Easily sol. in  $\text{H}_2\text{O}$ . 1 g is sol. in less than 5 ccm.  $\text{H}_2\text{O}$ . Rapidly decomp. by dil. acids, slowly by conc. acids. Sl. sol. in alcohol. (Biltz and Herms, B. 1907, 40. 983.)Cupric rubidium polysulphide,  $\text{RbCuS}_x$ .

As K salt. (Biltz and Herms, B. 1907, 40. 978.)

 $\text{Rb}_2\text{Cu}_2\text{S}_{10}$ . Easily sol. in  $\text{H}_2\text{O}$ . Decomp. by acids. Sl. sol. in alcohol (Biltz and Herms, B. 1907, 40. 985.)Cuprous silver sulphide,  $\text{Cu}_2\text{S}$ ,  $\text{Ag}_2\text{S}$ .Min. *Stromeyerite*. Sol. in  $\text{HNO}_3$  + Aq with separation of S. $\text{Cu}_2\text{S}$ ,  $3\text{Ag}_2\text{S}$ . Min. *Jalpaite*. As above.Cuprous sodium sulphide,  $\text{Na}_2\text{S}$ ,  $\text{Cu}_2\text{S}$ .

(Bodländer, Z. Elektrochem. 1905, 11. 181.)

 $\text{Na}_2\text{S}$ ,  $2\text{Cu}_2\text{S}$ . (Bodländer, Z. Elektrochem. 1905, 11. 181.)

Cuprocupric sodium sulphide,  $\text{Cu}_2\text{S}$ ,  $\text{CuS}$ ,  $\text{Na}_2\text{S}$ .

Scarcely decomp. by cold dil.  $\text{HCl} + \text{Aq}$ ; conc.  $\text{HCl} + \text{Aq}$  decomp. easily on warming, without, however, dissolving all the  $\text{Cu}_2\text{S}$ . Completely decomp. by warm  $\text{HNO}_3 + \text{Aq}$  (Schneider, Pogg. 138. 315.)

Copper zinc sulphide,  $\text{CuS}$ ,  $3\text{ZnS}$ .

Copper sulphophosphide.

See Copper phosphosulphide.

Cupric telluride,  $\text{CuTe}$ .

$\text{Cu}_2\text{Te}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Parkmann, Sill. Am. J. (2) 3. 335.)

$\text{Cu}_2\text{Te}$ . (Brauner, M. 1889. 423.)

Croceocobaltic bromide,

$\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Br}$ .

Very sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$  (Gibbs, Proc. Am. Acad. 10. 1.)

— chloraurate,  $2\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Cl}$ ,  $\text{AuCl}_3$ .  
Difficultly sol. in  $\text{H}_2\text{O}$ .

— chloride,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Cl}$ .

Very sl. sol. in cold easily in hot  $\text{H}_2\text{O}$ , but more sol. than the sulphate. (Gibbs.)

— chloroplatinate,  $2\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Cl}$ ,  $\text{PtCl}_4$ .

Can be recrystallised without decomp. with difficulty. (Gibbs and Genth, Sill. Am. J. (2) 24. 91.)

— chromate,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]\text{CrO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— dichromate,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]\text{Cr}_2\text{O}_7$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— periodide,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{I}$ ,  $\text{I}_2$ .

Difficultly sol. in cold  $\text{H}_2\text{O}$  and alcohol. Decomp. by hot  $\text{H}_2\text{O}$ . (Gibbs.)

— nitrate,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{NO}_3$ .

Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$  or dil. acids. Much more sol. than the sulphate. (Gibbs.)

Sol. in about 400 pts. cold  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. 5. 163.)

— nitrite cobaltic nitrite,  $3\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2$ ,  $\text{Co}(\text{NO}_2)_3$ .

Somewhat sol. in  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. 5. 178.)

— nitrite diamine cobaltic nitrite,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2$ ,  $(\text{NO}_2)_2(\text{NH}_3)_2\text{Co}(\text{NO}_2)_2$ .

Nearly insol. in cold, very sl. sol. in boiling  $\text{H}_2\text{O}$ . (Jørgensen.)

Croceocobaltic phosphomolybdate,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]_2\text{O}$ ,  $24\text{MoO}_3$ ,  $\text{P}_2\text{O}_5$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 3. 317.)

— sulphate,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]_2\text{SO}_4$ .

Very sl. sol. in cold or hot  $\text{H}_2\text{O}$ , more easily in hot dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Cuprammonium compounds.

See Copper compounds, ammonia.

Cupro(eti) ammonium tetraiodide.

See Cupric tetraiodide ammonia.

Cupric acid.

Known only in solution (Kruger, Pogg. 62. 445.)

Calcium cuprate.

Decomp. by  $\text{H}_2\text{O}$  with evolution of oxygen. (Kruger and Crum, A. 55. 213.)

Cyanhydric acid,  $\text{HCN}$ .

Miscible with  $\text{H}_2\text{O}$ , alcohol, and ether with absorption of heat

Sp. gr. of  $\text{HCN} + \text{Aq}$ .

% HCN	Sp. gr.	% HCN	Sp. gr.
1.60	0.9979	4.0	0.9940
1.68	0.9978	4.6	0.9930
1.77	0.9975	5.0	0.9923
2.0	0.9974	5.3	0.9914
2.1	0.9973	5.8	0.9900
2.3	0.9970	6.4	0.9890
2.5	0.9967	7.3	0.9870
2.7	0.9964	8.0	0.9840
3.0	0.9958	9.1	0.9815
3.2	0.9952	10.6	0.9788
3.6	0.9945	16.0	0.9570

(Ure, Quar. J. Sci. 13. 321.)

$2\text{HCN}$  mixed with  $3\text{H}_2\text{O}$  causes a diminution of temp. of  $9.75^\circ$ . (Bussy and Bugnet, A. ch. (4) 3. 231.)

Miscible with volatile oils and other organic compounds.

Cyanhydric iodhydric acid,  $\text{HI}$ ,  $\text{HCN}$ .

Easily sol. in  $\text{H}_2\text{O}$  or alcohol, with rapid decomp. Sl. sol. in ether. (Gal, A. 138. 38.)

Cyanides.

The alkali cyanides are easily sol. in  $\text{H}_2\text{O}$ ; those of the alkali-carths are less sol., while all others are insol. with the exception of  $\text{Hg}(\text{CN})_2$ . All cyanides are sol. in  $\text{KCN} + \text{Aq}$ .

Ammonium cyanide,  $\text{NH}_4\text{CN}$ .

Unstable; easily sol. in  $\text{H}_2\text{O}$  and alcohol.

**Ammonium cobaltic mercuric cyanide.***See* Cobalticyanide, ammonium mercuric.**Ammonium cuprous cyanide,  $\text{NH}_4\text{CN}$ ,  $\text{Cu}_2(\text{CN})_2$** 

Ppt. Decomp. by acids

+ $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , less sol. in alcohol. Decomp. by acids and alkalis. (Treadwell and Giese, *Z. anorg. 1904*, 39, 90.)  
 $2\text{NH}_4\text{CN}$ ,  $\text{Cu}_2(\text{CN})_2$ . Sl. sol. in  $\text{H}_2\text{O}$ , but decomp. by long boiling therewith. Sol. in  $\text{HCN}$ +Aq. (Dufau, *A. 88*, 278.)

**Ammonium cuprous cyanide ammonia,  $\text{NH}_4\text{CN}$ ,  $2\text{Cu}_2(\text{CN})_2$ ,  $\text{NH}_3$** Easily decomp. (Treadwell and Giese, *Z. anorg. 1904*, 39, 90.)

+ $2\text{H}_2\text{O}$ . Insol. in cold, decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$ +Aq. (Fleurent, *C. R.* 1893, 116, 191.)

$\text{NH}_4\text{CN}$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $3\text{NH}_3$ . Insol. in cold, sl. sol. in boiling  $\text{H}_2\text{O}$  without decomp. Sol. in  $\text{NH}_4\text{OH}$ +Aq. (Fleurent, *C. R.* 1891, 113, 1046.)

$\text{NH}_4\text{CN}$ ,  $2\text{Cu}_2(\text{CN})_2$ ,  $2\text{NH}_3$ + $2\text{H}_2\text{O}$ . (Fleurent, *B.* 25, 498R.)

**Ammonium gold (aurous) cyanide  $\text{NH}_4\text{CN}$ ,  $\text{AuCN}$ .**Easily sol. in cold or warm  $\text{H}_2\text{O}$  or in alcohol. Insol. in ether.**Ammonium gold (auric) mercuric cyanide, basic,  $3\text{NH}_4\text{CN}$ ,  $2\text{Au}_2\text{O}$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgO}$ . (Schmidt, *Ch. Z.* 1896, 20, 633.)****Ammonium mercuric silver cyanide, basic,  $\text{NH}_4\text{CN}$ ,  $2\text{Ag}_2\text{O}$ ,  $3\text{AgCN}$ ,  $4\text{Hg}(\text{OH})\text{CN}$ + $\frac{1}{2}\text{H}_2\text{O}$  (Schmidt, *Z. anorg.* 1895, 9, 431.)****Ammonium nickel cyanide,  $2\text{NH}_4\text{CN}$ ,  $\text{Ni}(\text{CN})_2$ .**

Easily decomposed.

**Ammonium tungsten cyanide.***See* Tungstocyanide, ammonium.**Ammonium zinc cyanide,  $2\text{NH}_4\text{CN}$ ,  $\text{Zn}(\text{CN})_2$ . Sol. in  $\text{H}_2\text{O}$ .****Ammonium cyanide mercuric nitrate silver cyanide basic,  $2\text{Hg}(\text{OH})\text{NO}_2$ ,  $3\text{NH}_4\text{CN}$ ,  $4\text{AgCN}$ . (Schmidt, *Z. anorg.* 1895, 9, 431.)****Arsenic tricyanide,  $\text{As}(\text{CN})_3$ .**Decomp. by  $\text{H}_2\text{O}$ . Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ . Decomp. on heating. (Guenez, *C. R.* 1892, 114, 1188.)**Barium cyanide,  $\text{Ba}(\text{CN})_2$** Rather sl. sol. in  $\text{H}_2\text{O}$ , more easily in  $\text{KCN}$ +Aq. (Schulz, *J. pr.* 68, 257.)

10 pts.  $\text{H}_2\text{O}$  dissolve 8 pts., and 10 pts. 70% alcohol dissolve 18 pts.  $\text{Ba}(\text{CN})_2$  at 14° (Joannis, *A. ch.* (5) 26, 489.)

Insol. in methyl acetate. (Naumann, *B.* 1900, 42, 3790.)

+ $2\text{H}_2\text{O}$ . Very deliquescent  
 $\text{Ba}(\text{CN})_2$ ,  $\text{BaO}$  (Drechsel, *J. pr.* (2) 21, 84.)

**Barium cadmium cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Cd}(\text{CN})_2$ + $\text{H}_2\text{O}$ .**Easily sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH}$ +Aq.Sl. sol. in alcohol (Loeb, *Dissert.* 1902.)

$2\text{Ba}(\text{CN})_2$ ,  $3\text{Cd}(\text{CN})_2$ + $10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Weselsky, *B.* 2, 590.)

**Barium cobaltous cobaltic cyanide.***See* Cobaltocobalticyanide, barium.**Barium cuprous cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ .**Sol. in  $\text{H}_2\text{O}$  without decomp. (Traube, *Z. anorg.* 1894, 8, 21.)

+ $\text{H}_2\text{O}$ . (Weselsky, *B.* 2, 590.)

Could not be obtained (Grossmann, *Z. anorg.* 1905, 43, 101.)

+ $4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Grossmann, *Z. anorg.* 1905, 43, 101.)

$2\text{Ba}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ + $6\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Grossmann, *Z. anorg.* 1905, 43, 105.)

**Barium gold (aurous) cyanide,  $\text{Ba}(\text{CN})_2$ ,  $2\text{AuCN}$ + $2\text{H}_2\text{O}$ .**Sl. sol. in cold but easily sol. in hot  $\text{H}_2\text{O}$ .Sl. sol. in alcohol. (Lundbom, *Lund Univ. Arsk.* 12, No.6.)**Barium iridium cyanide.***See* Iridicyanide, barium.**Barium manganous cyanide,  $\text{Ba}(\text{CN})_2$ ,  $2\text{Mn}(\text{CN})_2$ .**

Ppt. (Descamps.)

*See also* Manganocyanide and Manganicyanide, barium.**Barium mercuric cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Hg}(\text{CN})_2$ + $3\text{H}_2\text{O}$ .**Very hygroscopic. Very sol. in  $\text{H}_2\text{O}$  (Grossmann, *B.* 1904, 37, 4112.)**Barium mercuric cyanide iodide,  $\text{Ba}(\text{CN})_2$ ,  $\text{HgI}_2$ + $6\text{H}_2\text{O}$ .**(Varet, *C. R.* 1895, 121, 499.)**Barium palladium cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Pd}(\text{CN})_2$ + $4\text{H}_2\text{O}$ .***See* Palladocyanide, barium.**Barium nickel cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Ni}(\text{CN})_2$ + $3\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ , decomp. by acids with pptn. of  $\text{Ni}(\text{CN})_2$ . (Weselsky, *B.* 2, 590.)

- Barium silver cyanide,  $\text{Ba(CN)}_2$ ,  $2\text{AgCN} + \text{H}_2\text{O}$   
Sol. in  $\text{H}_2\text{O}$ . (Weselsky, B. 2. 589)
- Barium zinc cyanide,  $\text{Ba(CN)}_2$ ,  $\text{Zn(CN)}_2 + 2\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ .
- Cadmium cyanide, basic,  $\text{CdO}_2\text{H}_2$ ,  $2\text{Cd(CN)}_2 + 4\text{H}_2\text{O}$   
Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol (Loebe, Dissert, 1902.)
- Cadmium cyanide,  $\text{Cd(CN)}_2$ .  
Sl. sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 17 pts  $\text{Cd(CN)}_2$  at  $15^\circ$ . (Joannis)  
Easily sol. in acids; sol. in  $\text{KCN} + \text{Aq}$ . Sol. in warm  $\text{NH}_4\text{OH} + \text{Aq}$ , but insol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Wittstein.)  
Insol. in benzonitrile (Naumann, B. 1914, 47. 1370.)
- Cadmium calcium cyanide,  $\text{Cd(CN)}_2$ ,  $4\text{Ca(CN)}_2 + 20\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Loebe, Dissert, 1902.)
- Cadmium chromic cyanide.  
See Chromicyanide, cadmium.
- Cadmium cobaltic cyanide.  
See Cobalticyanide, cadmium.
- Cadmium cuprous cyanide,  $2\text{Cd(CN)}_2$ ,  $\text{Cu}_2(\text{CN})_2$ .  
Permanent. Insol. in  $\text{H}_2\text{O}$ . Sl. sol in cold, easily in warm  $\text{HCl} + \text{Aq}$  without decomp., except by long boiling. Insol. in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_3$  salts +  $\text{Aq}$ . (Schüler)
- Cadmium cupric cyanide,  $\text{Cd(CN)}_2$ ,  $\text{Cu(CN)}_2$ .  
Very unstable.
- Cadmium gold (aurous) cyanide,  $\text{Cd(CN)}_2$ ,  $2\text{AuCN}$   
Nearly insol in cold  $\text{H}_2\text{O}$ . Sl. sol. in boiling  $\text{H}_2\text{O}$ . Insol in alcohol (Landbom)
- Cadmium mercuric cyanide,  $2\text{Cd(CN)}_2$ ,  $3\text{Hg(CN)}_2$ .  
Permanent. Readily sol. in cold  $\text{H}_2\text{O}$ . (Schüler.)
- Cadmium mercuric cyanide mercuric iodide,  $\text{Cd(CN)}_2$ ,  $\text{Hg(CN)}_2$ ,  $\text{HgI}_2 + 8\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$ . (Varet, Bull. Soc. (3) 5. S.)  
 $+ 7\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1890, 111. 679.)
- Cadmium mercuric cyanide mercuric iodide,  $\text{Cd(CN)}_2$ ,  $\text{Hg(CN)}_2$ ,  $\text{HgI}_2 + 8\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$ . (Varet, Bull. Soc. (3) 5. S.)
- +  $7\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1890, 111. 679.)
- Cadmium mercuric cyanide mercuric iodide ammonia,  $\text{Cd(CN)}_2$ ,  $\text{Hg(CN)}_2$ ,  $\text{HgI}_2$ ,  $4\text{NH}_3$ .  
Very easily decomp. (Varet, Bull. Soc. (3) 6. 22.)
- Cadmium molybdenum cyanide.  
See Molybdocyanide, cadmium.
- Cadmium potassium cyanide,  $\text{Cd(CN)}_2$ ,  $2\text{KCN}$ .  
Sol. in 3 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . Insol. in absolute alcohol. (Rammelsberg.)
- Cadmium sodium cyanide,  $\text{Na}_2\text{Cd}_2(\text{CN})_2$ ,  $+ 3\text{H}_2\text{O}$   
Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Loebe, Dissert, 1902.)
- Cadmium strontium cyanide,  $\text{Cd(CN)}_2$ ,  $2\text{Sr(CN)}_2 + 3\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Loebe, Dissert. 1902.)
- Cadmium tungsten cyanide,  $\text{Cd}_2\text{W(CN)}_2 + 8\text{H}_2\text{O}$ .  
Nearly insol. in  $\text{H}_2\text{O}$ .  
Sl. sol in dil  $\text{HCl}$  Sol. in conc  $\text{NH}_4\text{OH} + \text{Aq}$ .  
Insol. in organic solvents. (Olsson, Z. anorg. 1914, 88. 68)
- Cadmium cyanide dihydrazine,  $\text{Cd(CN)}_2$ ,  $(\text{N}_2\text{H}_4)_2$ .  
Easily sol in dil. acids. (Franzen, Z. anorg. 1911, 70. 152.)
- Cæsium cuprous cyanide,  $\text{CsCN}$ ,  $\text{CuCN} + 1\frac{1}{2}\text{H}_2\text{O}$ .  
 $\text{H}_2\text{O}$  separates  $\text{CuCN}$ . (Grossmann, Z. anorg 1905, 43. 98.)  
 $2\text{CsCN}$ ,  $\text{CuCN} + \text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg 1905, 43. 98.)  
 $2\text{CsCN}$ ,  $3\text{CuCN}$ . Insol. in, and not decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg 1905, 43. 98)
- Cæsium tungsten cyanide.  
See Tungstocyanide, cæsium.
- Calcium cyanide,  $\text{Ca(CN)}_2$ .  
Sol. in  $\text{H}_2\text{O}$ , but the solution is very unstable. (Schulz.)  
 $\text{Ca(CN)}_2$ ,  $3\text{CaO} + 15\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Joannis, A. ch. (5) 26. 496.)
- Calcium cuprous cyanide,  $\text{Ca(CN)}_2$ ,  $\text{CuCN} + 4\text{H}_2\text{O}$ .  
Easily decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 106.)  
 $\text{Ca(CN)}_2$ ,  $3\text{CuCN} + 8\text{H}_2\text{O}$ . Immediately

decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 96.)

Calcium gold (aurous) cyanide,  $\text{Ca}(\text{CN})_2$ ,  $2\text{AuCN} + 3\text{H}_2\text{O}$ .

Easily sol. in hot or cold  $\text{H}_2\text{O}$  or in alcohol. (Lindbom)

Calcium manganous cyanide,  $\text{Ca}(\text{CN})_2$ ,  $2\text{Mn}(\text{CN})_2$ .

Ppt. (Descamps)

See also Manganocyanide, calcium.

Calcium mercuric cyanide,  $\text{Ca}(\text{CN})_2$ ,  $2\text{Hg}(\text{CN})_2 + 8\text{H}_2\text{O}$ .

Very deliquescent (Grossmann, B. 1904, 37. 4143.)  
 $2\text{Ca}(\text{CN})_2$ ,  $3\text{Hg}(\text{CN})_2 + 6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Grossmann, B. 1904, 37. 4143.)

Calcium mercuric cyanide iodide,  $\text{Ca}(\text{CN})_2$ ,  $\text{HgI}_2$ ,  $\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$ .

(Varet, C. R. 1895, 121. 499)

Calcium nickel cyanide,  $\text{Ca}(\text{CN})_2$ ,  $\text{Ni}(\text{CN})_2 + 7\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ .

Calcium tungsten cyanide.

See Tungstocyanide, calcium.

Calcium zinc cyanide,  $(\text{Ca}(\text{CN})_2)_2$ ,  $\text{Zn}(\text{CN})_2 + 3\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and in alcohol (Loebe, Dissert. 1902.)

Cerous cyanide (?).

Ppt. Very easily decomp. (Behringer, A. 42. 139.)

Chromic cyanide, with  $\text{MCN}$ .

See Chromicyanide, M.

Chromous potassium cyanide.

See Chromocyanide, potassium.

Cobaltous cyanide,  $\text{Co}(\text{CN})_2 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . and  $\text{KCN} + \text{Aq}$ ; also in  $(\text{NH}_4)_2\text{CO}_3$  or  $\text{NH}_4$  succinate +  $\text{Aq}$ ; insol. in  $\text{NH}_4\text{NO}_3$  or  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Wittstein.)

Cobaltous cyanide with  $4\text{MCN}$ .

See Cobaltocyanide, M.

Cobaltic cyanide with  $3\text{MCN}$ .

See Cobaltocyanide, M.

Cobalt gold (aurous) cyanide,  $\text{Co}(\text{CN})_2$ ,  $2\text{AuCN}$ .

Insol. in  $\text{H}_2\text{O}$  or cold  $\text{HCl} + \text{Aq}$ .

Cobalt hydrazine cyanide,  $(\text{N}_2\text{H}_4)_2\text{Co}(\text{CN})_2$ .  
Deliquescent (Franzen, Z. anorg. 1911, 70. 155.)

Cobaltous cyanide ammonia,  $\text{Co}(\text{CN})_2$ ,  $2\text{NH}_3$ .

Unstable. (Peters, B. 1908, 41. 3178.)

Cuprous cyanide,  $\text{Cu}_2(\text{CN})_2$ .

Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sol. in  $\text{NH}_4\text{OH}$ ,  $(\text{NH}_4)_2\text{SO}_4$  or  $\text{NH}_4$  succinate +  $\text{Aq}$ . and in hot  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . Sol. in conc.  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ .

Easily sol. in conc.  $\text{NH}_4\text{SCN}$  or  $\text{KSCN} + \text{Aq}$ . Sl. sol. in  $\text{NaSCN} + \text{Aq}$ . (Grossmann, Z. anorg. 1903, 37. 408.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Very sl. sol. in pyridine. (Schroeder, Dissert. 1902.)

Mol weight determined in pyridine. (Werner, Z. anorg. 1897, 15. 20.)

Cupric cyanide,  $\text{Cu}(\text{CN})_2$ .

Easily decomp. Insol. in  $\text{H}_2\text{O}$

Sol. in pyridine. (Schroeder, Dissert. 1901.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Cuprocupric cyanide,  $\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2 + 5\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. Sol. in cold conc.  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . and in hot  $\text{NH}_4$  salts +  $\text{Aq}$ .

Easily sol. in  $\text{KCN} + \text{Aq}$ . +  $\text{H}_2\text{O}$ . Ppt. (Dufau.)  
+  $\text{Cu}(\text{CN})_2$ ,  $2\text{Cu}_2(\text{CN})_2 + \text{H}_2\text{O}$ . Ppt.

Cuprous hydrazine cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{N}_2\text{H}_4\text{CN}$ .

Insol. in alcohol and  $\text{H}_2\text{O}$ . (Ferrattini, C. C. 1912, I. 1281.)

Cupric iridium cyanide.

See Iridicyanide, cupric.

Cuprous lithium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{LiCN} + \text{H}_2\text{O}$ .

Gradually decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 97.)

Cuprous magnesium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{Mg}(\text{CN})_2 + 11\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 103.)

Cuprous mercuric cyanide bromide,  $\text{Cu}(\text{CN})_2$ ,  $2\text{Hg}(\text{CN})_2$ ,  $\text{HgBr}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Varet, C. R. 1890, 110. 148.)

Cupric molybdenum cyanide ammonia.

See Molybdocyanide ammonia, cupric.

**Cuprous potassium cyanide,  $\text{Cu}_2(\text{CN})_2$ , 2KCN**

Sl sol in  $\text{H}_2\text{O}$ , with partial decomp. Decomp. by acids, but not by alkalis.

Decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Fleurent, C. R. 1893, 116, 191.)

Sol. without decomp. in conc.  $\text{KSCN}$ . (Grossmann, Z. anorg. 1903, 37, 407.)

Sol. without decomp. in  $\text{KCN} + \text{Aq}$ . (Treadwell and Girsfeld, Z. anorg. 1904, 38, 94.)

$\text{Cu}_2(\text{CN})_2$ ,  $\text{KCN} + \text{H}_2\text{O}$ . Almost insol. in cold  $\text{H}_2\text{O}$ . 100 cc  $\text{H}_2\text{O}$  dissolve 0.0591 g. at  $15^\circ$ . Decomp. by much hot  $\text{H}_2\text{O}$  with separation of  $\text{Cu}_2(\text{CN})_2$ . Sol. in  $\text{KCN} + \text{Aq}$  or in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Treadwell and Girsfeld, Z. anorg. 1904, 38, 93.)

$3\text{Cu}_2(\text{CN})_2$ ,  $4\text{KCN}$ . Sol. in  $\text{H}_2\text{O}$ .

$\text{Cu}_2(\text{CN})_2$ ,  $6\text{KCN}$ . Sol. in  $\text{H}_2\text{O}$ .

**Cuprous potassium cyanide ammonia,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{KCN}$ ,  $\text{NH}_3$** 

(Treadwell and Girsfeld, Z. anorg. 1904, 39, 88.)

**Cuprous potassium cyanide potassium sulphocyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $4\text{KCN}$ ,  $2\text{KSCN}$ ,  $\text{H}_2\text{O}$** 

Easily sol. in cold  $\text{H}_2\text{O}$ . (Itzig, B. 1902, 35, 108.)

**Cupric potassium cyanide,  $\text{Cu}(\text{CN})_2$ ,  $2\text{KCN}$** 

Sol. in  $\frac{3}{4}$  pt.  $\text{H}_2\text{O}$  at  $16^\circ$  and  $\frac{1}{2}$  pt. at  $100^\circ$ . (Baiguet, J. Pharm. 1859, (3), 36, 168.)

**Cuprocupric potassium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{Cu}(\text{CN})_2$ ,  $2\text{KCN}$** 

(Straus, Z. anorg. 1895, 9, 15.)

**Cuprous rubidium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{RbCN}$** 

Sl. sol. in  $\text{H}_2\text{O}$ . Pure  $\text{H}_2\text{O}$  separates  $\text{CuCN}$ . (Grossmann, Z. anorg. 1905, 43, 100.)

$3\text{Cu}_2(\text{CN})_2$ ,  $4\text{RbCN}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Pure  $\text{H}_2\text{O}$  separates  $\text{CuCN}$ . (Grossmann, Z. anorg. 1905, 43, 98.)

**Cuprous silver cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{AgCN}$** 

Ppt.  $\text{Cu}_2(\text{CN})_2$ ,  $6\text{AgCN}$ . Sol. in excess of  $\text{Cu}_2(\text{CN})_2$ ,  $\text{KCN} + \text{Aq}$ . (Rammelsberg.)

**Cuprous sodium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{NaCN}$** 

(Traube, Z. anorg. 1894, 8, 21.)  
+  $4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in excess of  $\text{NaCN} + \text{Aq}$ . (Grossmann, Z. anorg. 1905, 43, 96.)

$\text{Cu}_2(\text{CN})_2$ ,  $\text{NaCN} + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43, 96.)

$\text{Cu}_2(\text{CN})_2$ ,  $4\text{NaCN} + 6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  without decomp. (Grossmann, Z. anorg. 1905, 43, 96.)

$\text{Cu}_2(\text{CN})_2$ ,  $6\text{NaCN} + 6\text{H}_2\text{O}$ . Very sol. in

$\text{H}_2\text{O}$  without decomp. (Grossmann, Z. anorg. 1905, 43, 96.)

**Cuprous strontium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{Sr}(\text{CN})_2 + 8\text{H}_2\text{O}$** 

$\text{H}_2\text{O}$  separates  $\text{Cu}_2(\text{CN})_2$ . (Grossmann, Z. anorg. 1905, 43, 103.)

**Cuprous cyanide ammonia,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{NH}_3$** 

Nearly insol. in cold  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  in absence of oxygen. Insol. in alcohol and ether. Decomp. by hot  $\text{H}_2\text{O}$  and acids. (Treadwell and Girsfeld, Z. anorg. 1904, 39, 87.)

**Cuprocupric cyanide ammonia,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{Cu}(\text{CN})_2$ ,  $2\text{NH}_3$** 

(Malmberg, Arch. Pharm. 1898, 236, 256.)  
+  $\text{H}_2\text{O}$ . Sl. sol. in cold, decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Dufau, A. 88, 278.)

$\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $3\text{NH}_3$ . (Mills, Z. Ch. 1867, 545.)

Sl. decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  and can be recryst. therefrom. Insol. in alcohol and ether. Decomp. by alkalis and acids. (Treadwell and Girsfeld, Z. anorg. 1904, 39, 96.)

$\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $4\text{NH}_3$ . Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Treadwell and Girsfeld, Z. anorg. 1904, 39, 92.)

$2\text{Cu}_2(\text{CN})_2$ ,  $\text{Cu}(\text{CN})_2$ ,  $2\text{NH}_3$ . Insol. in  $\text{H}_2\text{O}$ , alcohol and ether. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by boiling acids and alkalis. (Treadwell and Girsfeld, Z. anorg. 1904, 39, 92.)

+  $\text{H}_2\text{O}$ . (Menthner, J. Pharm. 11, 257.)

$\text{Cu}(\text{CN})_2$ ,  $2\text{Cu}_2(\text{CN})_2$ ,  $4\text{NH}_3$ . (Hüllenkamp, A. 97, 218.)

$\text{Cu}(\text{CN})_2$ ,  $2\text{Cu}_2(\text{CN})_2$ ,  $6\text{NH}_3$ . (Schiff and Becchi, A. 134, 33.)

$2\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$ .

(Fleurent, C. R. 114, 1060.)

$2\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $4\text{NH}_3 + \text{H}_2\text{O}$ . Correct formula for  $\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $4\text{NH}_3$ . (Bouvcault, Bull. Soc. (3) 4, 641.)

**Cuprous cyanide ammonium sulphocyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $3\text{NH}_4\text{SCN}$** 

Decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1903, 37, 409.)

**Cupric cyanide hydrazine,  $\text{Cu}(\text{CN})_2(\text{N}_2\text{H}_4)$** 

Insol. in  $\text{H}_2\text{O}$  and cold dil. acids.

Sol. in warm dil. acids. (Franzen, Z. anorg. 1911, 70, 154.)

**Cuprous cyanide mercuric iodide,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{HgI}_2$** 

Sol. in  $\text{H}_2\text{O}$ . (Varet, Bull. Soc. (3) 4, 484.)

Cuprous cyanide potassium sulphocyanide,  
 $\text{Cu}_2(\text{CN})_2, 3\text{KSCN}$

Decomp by  $\text{H}_2\text{O}$ . (Grossmann, Z anorg  
 1903, 37. 409.)

Gold (aurous) cyanide,  $\text{AuCN}$ .

Insol in  $\text{H}_2\text{O}$ , alcohol, or ether. Not at-  
 tacked by dil., or conc. acids, even boiling  
 aqua regia

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in soluble cy-  
 anides +  $\text{Aq}$

Slowly decomp. by boiling  $\text{KOH} + \text{Aq}$ , also  
 by  $(\text{NH}_4)_2\text{S} + \text{Aq}$

Sol. in  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$  (Bentel, Z.  
 anorg. 1912, 78. 152.)

Gold (auric) cyanide with  $\text{MCN}$ .

See Auricyanide, M.

Gold (auroauric) mercuric cyanide auric  
 mercuric chloride,  $4\text{AuCN}$ ,  $\text{Au}(\text{CN})_3$ ,  
 $5\text{Hg}(\text{CN})_2$ ,  $7\text{AuCl}_3$ ,  $5\text{HgCl}_2$ .

(Schmidt, Ch. Z 1896, 20. 633.)

Gold (aurous) potassium cyanide,  $\text{AuCN}$ ,  
 $\text{KCN}$ .

Sol in 7 pts cold, and less than 0.5 pt. boil-  
 ing  $\text{H}_2\text{O}$ . Sl. sol in cold, and somewhat more  
 sol in boiling alcohol Insol. in ether  
 (Hinley, A 42. 160)

Decomp by warm acids, even tartaric, and  
 acetic acids.

Gold (aurous) sodium cyanide,  $\text{AuCN}$ ,  $\text{NaCN}$ .

Sl. sol in cold, more easily in hot  $\text{H}_2\text{O}$ .  
 Sl. sol. in alcohol. (Lindbom)

Gold (aurous) strontium cyanide,  $2\text{AuCN}$ ,  
 $\text{Sr}(\text{CN})_2 + 3\text{H}_2\text{O}$ .

As the Na salt.

Gold (aurous) zinc cyanide,  $2\text{AuCN}$ ,  $\text{Zn}(\text{CN})_2$ .

Nearly insol. in hot or cold  $\text{H}_2\text{O}$

Insol in cold  $\text{HCl} + \text{Aq}$ .

Gold (auric) cyanide auric mercuric chloride,  
 $\text{Au}(\text{CN})_3$ ,  $\text{AuCl}_3$ ,  $2\text{HgCl}_2$

(Schmidt, Ch. Z. 1896, 20. 633)

Gold (auroauric) cyanide aurous mercuric  
 chloride,  $12\text{AuCN}$ ,  $3\text{Au}(\text{CN})_3$ ,  $4\text{AuCl}_3$ ,  
 $2\text{HgCl}_2$ .

(Schmidt, Ch. Z 1896, 20. 633.)

Gold (auroauric) cyanide mercuric chloride.  
 $15\text{AuCN}$ ,  $2\text{Au}(\text{CN})_3$ ,  $5\text{HgCl}_2$ .

(Schmidt, Ch. Z. 1896, 20. 633.)

Iridium cyanide,  $\text{Ir}(\text{CN})_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCN} + \text{Aq}$ .

Iridium cyanide with  $\text{MCN}$ .

See Indicyanide, M

Lanthanum cyanide,  $\text{La}(\text{CN})_3$ .

Ppt. (Friedrichs and Smith, B. 11. 910,  
 1151.)

Lead cyanide,  $\text{Pb}(\text{CN})_2$ .

Sl. sol in cold, more in hot  $\text{H}_2\text{O}$ . Sol. in  
 $\text{HNO}_3 + \text{Aq}$ , and  $\text{KCN} + \text{Aq}$  Partially sol. in  
 $\text{NH}_4\text{OH} + \text{Aq}$ , and  $\text{NH}_4$  salts +  $\text{Aq}$ . Not  
 pptd in presence of Na citrate

Above compound is  $2\text{PbO}$ ,  $\text{Pb}(\text{CN})_2 +$   
 $\text{H}_2\text{O}$  (Joannis, A. ch. (5) 26. 201.)

$2\text{PbO}$ ,  $\text{Pb}(\text{CN})_2 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .

Lead tungsten cyanide.

See Tungstocyanide, lead.

Lead zinc cyanide,  $\text{Pb}(\text{CN})_2$ ,  $2\text{Zn}(\text{CN})_2$ .

Ppt. (Rammelsberg)

Lead cyanide chloride,  $2\text{Pb}(\text{CN})_2$ ,  $\text{PbCl}_2$ .

Insol. in  $\text{H}_2\text{O}$ . (Grissom and Thorp, Am.  
 Ch J 10. 229)

Lithium mercuric cyanide mercuric iodide,  
 $2\text{Li}(\text{CN})_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgI}_2 + 7\text{H}_2\text{O}$

Deliquescent; sol. in  $\text{H}_2\text{O}$ . (Varet, C. R.  
 111. 526.)

Magnesium cyanide,  $\text{Mg}(\text{CN})_2$

Known only in aqueous solution which de-  
 composes on evaporation. (Schulz)

Magnesium mercuric cyanide,  $2\text{Mg}(\text{CN})_2$ ,  
 $3\text{Hg}(\text{CN})_2 + 5\text{H}_2\text{O}$

(Grossmann, B 1904, 37. 4143)

Magnesium mercuric cyanide mercuric  
 bromide,  $\text{Mg}(\text{CN})_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgBr}_2 +$   
 $8\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ . (Varet, Bull. Soc. (3)  
 7. 170.)

Magnesium mercuric cyanide mercuric  
 iodide,  $\text{Mg}(\text{CN})_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgI}_2 +$   
 $8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Varet, Bull. Soc. (3) 7. 170.)

Magnesium platinum cyanide.

See Platnocyamide, magnesium.

Magnesium tungsten cyanide.

See Tungstocyanide, magnesium.

Manganous and manganic cyanides.

See Manganocyanhydric, and Mangani-  
 cyanhydric acids.

Manganous strontium cyanide,  $2\text{Mn}(\text{CN})_2$ ,  
 $\text{Sr}(\text{CN})_2$ .

Ppt. (Descamps)

See also Manganocyanide, strontium.

**Manganous tungsten cyanide.***See Tungstocyanide, manganous.***Manganic cyanide, with MCN.***See Manganicyanide, M.***Manganous cyanide with MCN.***See Manganocyanide, M.***Mercuric cyanide, basic,  $\text{Hg}(\text{CN})_2 \cdot \text{HgO}$** Sl sol. in cold, moderately sol. in hot  $\text{H}_2\text{O}$ . Sol. with decomp. in  $\text{KOH}$ ,  $\text{KCN}$ , or  $\text{KCl} + \text{Aq.}$  (Johnston.)Decomp. by  $\text{H}_2\text{O}$  over  $80^\circ$  (Holdermann, Arch. Pharm. 1903, 244, 135.)Cold  $\text{H}_2\text{O}$  dissolves about 1%, boiling  $\text{H}_2\text{O}$  about 5% (Borelli, Gazz. ch. it. 1908, 38, (1), 361.)1.1% dissolves in  $\text{H}_2\text{O}$  at ord. temp. (Richard, J. Chim. Phys. (6) 18, 555.)At  $0^\circ$  1/100 mol dissolve in 1 l  $\text{H}_2\text{O}$ .At  $25^\circ$  1/32 " " " " "At  $90^\circ$  1/10 " " " " "

(Borelli, Gazz. ch. it. 1908, 38, (1), 361.)

1000 cc. cold  $\text{H}_2\text{O}$  dissolve 1.35g (Holdermann, Arch. Pharm. 1903, 244, 135.)Less sol. in cold  $\text{H}_2\text{O}$  than  $\text{Hg}(\text{CN})_2$ . (Pieverling, J. B. 1899, 783.)

Somewhat sol. in dil. alcohol.

Practically insol. in alcohol, ether,  $\text{C}_2\text{H}_5$  and all organic solvents. (Borelli, Gazz. ch. it. 1908, 38, (1), 361.)Sol. in 110 pt alcohol of  $90^\circ$  B $\acute{e}$ . (Richard, J. Chim. Phys. (6), 18, 555.) $3\text{Hg}(\text{CN})_2 \cdot \text{HgO}$ . (Joannus, A. ch. (5) 26, 469.)Moderately sol. in  $\text{H}_2\text{O}$ . (Barthe, J. Pharm. 1896, (6), 8, 186.)Very sol. in hot, less sol. in cold  $\text{H}_2\text{O}$  (Holdermann, Arch. Pharm. 1904, 242, 32.)Easily sol. in  $\text{HCl}$ . (Joannus, A. ch. 1882, (5) 26, 511.) $\text{Hg}(\text{CN})_2 \cdot 3\text{HgO}$  More sol. in  $\text{H}_2\text{O}$  than  $\text{Hg}(\text{CN})_2 \cdot \text{HgO}$ .**Mercuric cyanide,  $\text{Hg}(\text{CN})_2$** Moderately sol. in  $\text{H}_2\text{O}$ .100 pts.  $\text{Hg}(\text{CN})_2 + \text{Aq}$  sat at  $101.1^\circ$  contain 35 pts.  $\text{Hg}(\text{CN})_2$ , or 100 pts.  $\text{H}_2\text{O}$  dissolve 53.85 pts  $\text{Hg}(\text{CN})_2$  at  $101.1^\circ$ . (Griffiths.)Sol. in 8 pts  $\text{H}_2\text{O}$  at  $15^\circ$ . (Abl.)Sol. in 11 pts cold, and 2.5 pts. boiling  $\text{H}_2\text{O}$ . (Wittstein.)8 g. are sol. in 100 g.  $\text{H}_2\text{O}$  at  $-0.45^\circ$  (Guthrie, Phil. Mag. 1878, (5) 6, 40.)100 g.  $\text{H}_2\text{O}$  dissolve 9.3 g at  $13.5^\circ$  (Timofeev, Dissert. 1894.)100 cc sat solution contain 9.3 g at  $20^\circ$  (Konowalow, J. russ. Soc. 1898, (4) 30, 367.)Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 0.44$  mol. l. (Sherrill, Z. phys. Ch. 1903, 43, 735.)1 l  $\text{H}_2\text{O}$  dissolves 0.3956 mol (Hofmann and Wagner, Z. Elektrochem. 1909, 15, 444.)100 g.  $\text{H}_2\text{O}$  dissolve 12.5 g. at  $15^\circ$  (Marsh and Struthers, Chem. Soc. 1905, 87, 1879.)100 g.  $\text{H}_2\text{O}$  dissolve 11.27 g. at  $25^\circ$  Sp. gr. of solution = 1.0813 (Herz and Anders, Z. anorg. 1907, 52, 164.) $\text{Hg}(\text{CN})_2 + \text{Aq}$  containing 7.23%  $\text{Hg}(\text{CN})_2$  has sp. gr.  $20^\circ/20^\circ = 1.0572$ . $\text{Hg}(\text{CN})_2 + \text{Aq}$  containing 9.07%  $\text{Hg}(\text{CN})_2$  has sp. gr.  $20^\circ/20^\circ = 1.0743$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 282.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{Hg}(\text{CN})_2 + \text{Aq}$  containing 7.8921%  $\text{Hg}(\text{CN})_2 = 1.06376$ ; containing 5.4037% = 1.04246; containing 7.5009% = 1.06049. (Schäferrock, Z. phys. Ch. 1893, 11, 770.)Not decomp. by acids except hot conc.  $\text{H}_2\text{SO}_4$ .Sol without decomp. in  $\text{HNO}_3 + \text{Aq}$ . (Berzelius.)1 l.  $\text{NH}_4\text{OH} + \text{Aq}$  (5.2%  $\text{NH}_3$ ) dissolves 204.3 g at about  $25^\circ$ . (Konowalow.)

Solubility in bases.

1 l.  $\text{H}_2\text{O}$  containing 0.3286 mols  $\text{KOH}$  dissolves 0.5179 mols  $\text{Hg}(\text{CN})_2$ .1 l.  $\text{H}_2\text{O}$  containing 0.2350 mols.  $\text{NaOH}$  dissolves 0.4840 mols  $\text{Hg}(\text{CN})_2$ .1 l.  $\text{H}_2\text{O}$  containing 0.4775 mols.  $\text{NaOH}$  dissolves 0.5977 mols.  $\text{Hg}(\text{CN})_2$ .1 l.  $\text{H}_2\text{O}$  containing 0.9475 mols.  $\text{NaOH}$  dissolves 0.79603 mols.  $\text{Hg}(\text{CN})_2$ .1 l.  $\text{H}_2\text{O}$  containing 0.970 mols.  $\text{LiOH}$  dissolves 0.6743 mols.  $\text{Hg}(\text{CN})_2$ .1 l.  $\text{H}_2\text{O}$  containing 0.480 mols.  $\text{LiOH}$  dissolves 0.5500 mols.  $\text{Hg}(\text{CN})_2$ .1 l.  $\text{H}_2\text{O}$  containing 0.243 mols  $\text{LiOH}$  dissolves 0.4840 mols.  $\text{Hg}(\text{CN})_2$ .

(Hofmann and Wagner, Z. Elektrochem. 1909, 15, 444.)

**Solubility in  $\text{KCN} + \text{Aq}$  at  $25^\circ$ .**

Concentration of $\text{KCN}$ Mols per litre	Solubility of $\text{Hg}(\text{CN})_2$ Mols. per litre
0.0493	0.4855
0.0985	0.5350
0.1970	0.627.

(Sherrill, Z. phys. Ch. 1903, 43, 719.)

**Solubility in  $\text{Na}_2\text{CO}_3 + \text{Aq}$ .**1 l.  $\text{H}_2\text{O}$  containing 0.4923 mols.  $\text{Na}_2\text{CO}_3$  dissolves 0.4956 mols.  $\text{Hg}(\text{CN})_2$ .1 l.  $\text{H}_2\text{O}$  containing 0.2443 mols.  $\text{Na}_2\text{CO}_3$  dissolves 0.4464 mols.  $\text{Hg}(\text{CN})_2$ .1 l.  $\text{H}_2\text{O}$  containing 0.1250 mols.  $\text{Na}_2\text{CO}_3$  dissolves 0.4147 mols.  $\text{Hg}(\text{CN})_2$ .1 l.  $\text{H}_2\text{O}$  containing 0.0000 mols.  $\text{Na}_2\text{CO}_3$  dissolves 0.3952 mols  $\text{Hg}(\text{CN})_2$ .

(Hofmann and Wagner, Z. Elektrochem. 1909, 15, 444.)

Solubility in  $\text{KNO}_3 + \text{Aq}$  at  $25^\circ$ .

1 l  $\text{H}_2\text{O}$  containing 0.9574 mols.  $\text{KNO}_3$  dissolves 0.5383 mols.  $\text{Hg}(\text{CN})_2$   
 1.1.  $\text{H}_2\text{O}$  containing 0.4614 mols.  $\text{KNO}_3$  dissolves 0.4619 mols.  $\text{Hg}(\text{CN})_2$ .  
 1 l.  $\text{H}_2\text{O}$  containing 0.0000 mols.  $\text{KNO}_3$  dissolves 0.3956 mols.  $\text{Hg}(\text{CN})_2$   
 (Hofmann and Wagner, Z. Elektrochem. 1909, 15. 444.)

Insol. in liquid  $\text{CO}_2$  (Büchner, Z. phys. Ch. 1906, 54. 674.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Solubility of  $\text{Hg}(\text{CN})_2$  in ethyl alcohol at  $t^\circ$ 

$t^\circ$	% $\text{Hg}(\text{CN})_2$
0	8.3
10	8.8
20	9.25
30	9.8
40	10.3

(Timofeev, Dissert. 1894.)

Solubility of  $\text{Hg}(\text{CN})_2$  in methyl alcohol at  $t^\circ$ .

$\text{Hg}(\text{CN})_2 = g.$   $\text{Hg}(\text{CN})_2$  in 100 g. of the solution.

$t^\circ$	$\text{Hg}(\text{CN})_2$
0.0	26.10
14.7	29.17
23.4	32.01
27.4	31.77
31.7	32.53
38.1	33.20
44.5	34.05

(Dukelski, Z. anorg. 1907, 53. 337.)

100 pts. methyl alcohol dissolve 44.2 pts.  $\text{Hg}(\text{CN})_2$  at  $19.5^\circ$ ; 100 pts. ethyl alcohol dissolve 2.09 pts. at  $19.5^\circ$ . (de Bruyn, Z. phys. Ch. 1892, 10. 784.)

Sol. in 2.5 pts. methyl alcohol at  $14^\circ$ ; in 20 pts. ethyl alcohol at  $15^\circ$ . (Marsh, Chem. Soc. 1905, 87. 1878.)

Solubility of  $\text{Hg}(\text{CN})_2$  in methyl alcohol + Aq at  $25^\circ$ .

$P = g.$  alcohol in 100 g. alcohol + Aq  
 $\text{Hg}(\text{CN})_2 = g.$  millimols.  $\text{Hg}(\text{CN})_2$  in 10 cc. of the solution

P	$\text{Hg}(\text{CN})_2$	Sp. gr.
0	4.34	1.0813
10.60	4.37	1.0642
30.77	4.94	1.0484
37.21	5.40	1.0430
47.06	6.49	1.0426
64.00	8.13	1.0441
78.05	9.75	1.0484
100	13.60	1.0762

(Herz and Anders, Z. anorg. 1907, 52. 165.)

Solubility of  $\text{Hg}(\text{CN})_2$  in ethyl alcohol + Aq at  $25^\circ$ .

$P = g.$  alcohol in 100 g. alcohol + Aq  
 $\text{Hg}(\text{CN})_2 = g.$  millimols.  $\text{Hg}(\text{CN})_2$  in 10 cc. of the solution

P	$\text{Hg}(\text{CN})_2$	Sp. gr.
0	4.34	1.0813
20.18	3.47	1.0339
40.69	3.58	1.0006
70.01	3.80	0.9419
100	3.25	0.8552

(Herz and Anders, 1 c.)

Solubility of  $\text{Hg}(\text{CN})_2$  in mixtures of methyl and ethyl alcohol at  $25^\circ$ .

$P = \%$  methyl alcohol in the solvent.  
 $\text{Hg}(\text{CN})_2 = g.$   $\text{Hg}(\text{CN})_2$  in 10 cc. of the solution.

 $S$   $25^\circ/4^\circ = \text{Sp. gr. of the sat. solution.}$ 

P	$\text{Hg}(\text{CN})_2$	$S$ $25^\circ/4^\circ$
0	0.819	0.8552
4.37	0.902	0.8618
10.4	1.01	0.8707
41.02	1.67	0.9267
80.69	2.82	1.024
84.77	2.96	1.034
91.25	3.09	1.052
100	3.43	1.076

(Herz and Kuhn, Z. anorg. 1908, 58. 186.)

100 g. propyl alcohol dissolve 3.79 g.  $\text{Hg}(\text{CN})_2$  at  $13.5^\circ$ . (Timofeev, Dissert. 1894.)

Solubility in mixtures of propyl and methyl alcohol at  $25^\circ$ .

$P = \%$  propyl alcohol in the solvent  
 $G = g.$   $\text{Hg}(\text{CN})_2$  in 10 cc. of the solution.  
 $S = \text{Sp. gr. of the sat. solution.}$

P	G	$S$ $25^\circ/4^\circ$
0	3.43	1.0760
11.11	2.952	1.0327
23.8	2.448	0.9891
65.2	1.048	0.8800
91.8	0.504	0.8376
93.97	0.423	0.8335
96.6	0.398	0.8322
100	0.344	0.8283

(Herz and Kuhn, Z. anorg. 1908, 60. 158.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent

G = g.  $\text{Hg}(\text{CN})_2$  in 10 ccm. of the solution

S = Sp gr. of the sat. solution.

P	G	S 25°/4°
0	0.819	0.8552
8.1	0.790	0.8549
17.85	0.730	0.8527
56.0	0.521	0.8386
88.6	0.387	0.8311
91.2	0.384	0.8306
95.2	0.364	0.8293
100	0.341	0.8283

(Herz and Kuhn, l. c.)

Sp. gr. at 16°/4° of  $\text{Hg}(\text{CN})_2$  + alcohol, containing 8.2206 %  $\text{Hg}(\text{CN})_2$  = 0.85273, containing 5.8652 % = 0.8348 +

Sp. gr. of 16°/4° of  $\text{Hg}(\text{CN})_2$  + pyridine containing 29.6018 %  $\text{Hg}(\text{CN})_2$  = 1.28155, containing 23.2275 % = 1.20198

(Schönrock, Z. phys. Ch. 1893, 11. 771)

1 l. ether dissolves 0.01 mol at 25° (Sherill, Z. phys. Ch. 1903, 43. 735.)

Easily sol. in acetone. (Krug and McElroy, J. Anal. Ch. 6. 84.)

100 g. glycerol dissolve 27 g.  $\text{Hg}(\text{CN})_2$  at 15.5°. (Ossendowski, Pharm. J. 1907, 79. 575.)

Nearly insol. in  $\text{C}_6\text{H}_6$ . (Sherill, Z. phys. Ch. 1903, 43. 735.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

100 g. boiling methyl acetate dissolve 3.2 g. (Steiner, Dissert. 1906.)

Solubility of  $\text{Hg}(\text{CN})_2$  in ethyl acetate + Aq at 25°.

P = g. ethyl acetate in 100 g. ethyl acetate + Aq.

$\text{Hg}(\text{CN})_2$  = millimols  $\text{Hg}(\text{CN})_2$  in 10 cc. of the solution.

P	$\text{Hg}(\text{CN})_2$	Sp. gr.
0	4.34	1.0810
4.39	4.295	1.0797
96.76	1.056	1.0374
100	0.714	0.09097

(Herz and Anders, Z. anorg. 1907, 52. 165.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Solubility in organic solvents at 18-20°

100 g. tetrachloromethane dissolve 0.001 g.  $\text{Hg}(\text{CN})_2$

100 g. bromoform dissolve 0.005 g.  $\text{Hg}(\text{CN})_2$ .

100 g. ethyl bromide dissolve 0.013 g.  $\text{Hg}(\text{CN})_2$

100 g. ethylene dibromide dissolve 0.001 g.  $\text{Hg}(\text{CN})_2$ .

(Sule, Z. anorg. 1900, 25. 401.)

100 g. acetonitrile dissolve 9.58 g.  $\text{Hg}(\text{CN})_2$  at 18°. (Naumann and Schier, B. 1914, 47. 249.)

Solubility in benzonitrile at 18° = 1.093 g. in 100 g. (Naumann, B. 1914, 47. 1370.)

Sl. sol. in ethyl amine (Shunn, J. phys. Chem. 1907, 11. 538.)

Very sol. in liquid methyl amine (Gibbs, J. Am. Chem. Soc. 1906, 28. 1410.)

Sol. in puratoluidine. (Weiner, Z. anorg. 1897, 15. 7.)

Mol. weight determined in pyridine and benzonitrile. (Werner, Z. anorg. 1897, 15. 30 and 32.)

100 g. pyridine dissolve 64.8 g.  $\text{Hg}(\text{CN})_2$  at 18°. (Schroeder, Z. anorg. 1905, 44. 6.)

Solubility in pyridine.

Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification	Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification
7.1	0	22.9	45
8.7	11	23.7	46
10.1	12.3	25.3	53
10.4	12.3	26.0	54.5
11.3	13	26.6	56.6
12.9	13.5	27.5	68
13.8	14.5	27.7	70
15.8	16.5	29.0	86
15.9	20.5	32.0	111
17.3	22.5	33.8	122.5
18.4	28.5	34.4	125
19.3	32	38.3	141
20.6	38		
22.3	42		

(Staronka, Anz. Ak. Wiss. Krakau, 1910. 372.)

Solubility in quinoline.

Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification	Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification
4.2	45°	13.2	137°
6.0	54	17.4	161
8.2	89(61)	22.5	180
9.2	99(61)	27.1	192

(Staronka, l. c.)

Solubility in aniline

Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification	Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification
3.7		14.2	77° (?)
4.9	26° (?)	18.2	83.5° (?)
5.7	30.5° (?)	19.7	84° (?)
7.7	35° (?)	23.4	88.5° (?)
9.2	38.5° (?)		

(Staronka, l. c.)

Mercuric nickel cyanide ammonia,  $2\text{Hg}(\text{CN})_2$ ,  $4\text{Ni}(\text{CN})_2$ ,  $5\text{NH}_3 + 2\text{H}_2\text{O}$ .

(Papiermeister, Dissert. 1898.)

$5\text{Hg}(\text{CN})_2$ ,  $18\text{Ni}(\text{CN})_2$ ,  $8\text{NH}_3 + 15\text{H}_2\text{O}$ . (Papiermeister, Dissert. 1898.)

- Mercuric potassium cyanide**,  $\text{Hg}(\text{CN})_2$ ,  $2\text{KCN}$ .  
Sol. in 4.4 pts cold  $\text{H}_2\text{O}$ ; sl sol. in alcohol; decomp. by acids.  
100 g.  $\text{H}_2\text{O}$  dissolve 22.7 g. (Fronmüller, B. 1878, 11. 92.)  
Abundantly sol. in liquid  $\text{NH}_3$ . (Franklin, Z. phys. Ch. 1909, 69. 295.)
- Mercuric silver cyanide**, basic,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgO}$ ,  $7\text{AgCN}$ .  
Ppt. (Bloxam, B. 16. 2669.)
- Mercuric silver cyanide mercuric sulphate**,  $\text{Hg}(\text{CN})_2$ ,  $2\text{AgCN}$ ,  $\text{HgSO}_4 + \text{H}_2\text{O}$ .
- Mercuric sodium cyanide**,  $\text{Hg}(\text{CN})_2$ ,  $\text{NaCN} + 1\frac{1}{2}\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$  (Grossmann, B. 1904, 37. 4141)
- Mercuric strontium cyanide**,  $\text{Hg}(\text{CN})_2$ ,  $\text{Sr}(\text{CN})_2 + 5\text{H}_2\text{O}$ .  
Very hygroscopic. Sol in  $\text{H}_2\text{O}$ . (Grossmann, B. 1904, 37. 4142)
- Mercuric strontium cyanide iodide**,  $\text{Sr}(\text{CN})_2$ ,  $\text{HgI}_2$ ,  $\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$ .  
(Varet, C. R. 1895, 121. 499)
- Mercuric thallium cyanide**,  $\text{Hg}(\text{CN})_2$ ,  $2\text{TlCN}$ .  
Easily sol. in  $\text{H}_2\text{O}$ . 100 pts  $\text{H}_2\text{O}$  dissolve 7.9 pts at  $1^\circ$ , and 10.3 pts. at  $10^\circ$ . (Fronmüller, B. 11. 92)
- Mercuric zinc cyanide**,  $4\text{Zn}(\text{CN})_2$ ,  $\text{Hg}(\text{CN})_2$ .  
Insol. in  $\text{H}_2\text{O}$ . (Dunstan, Chem Soc. 6. 666)
- Mercuric zinc cyanide mercuric bromide ammonia**,  $\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{CN})_2$ ,  $\text{HgBr}_2$ ,  $4\text{NH}_3$ .  
Decomp by  $\text{H}_2\text{O}$  Sl sol. in cold  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1889, 109. 810.)
- Mercuric cyanide ammonia**,  $\text{Hg}(\text{CN})_2$ ,  $\text{NH}_3$ .  
Very sol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , and alcohol. (Varet, C. R. 1889, 109. 903)  
Sl. sol. in  $\text{H}_2\text{O}$  (Schmidt, B. 1894, 27. 232)  
 $8\text{Hg}(\text{CN})_2$ ,  $2\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$  Easily decomp. (Varet, Bull Soc (3) 6. 221)
- Mercuric cyanide bromide**,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgBr}_2$ .  
Very sl. sol. even in boiling  $\text{H}_2\text{O}$ . (Prussas, Gazz. ch. it. 1898, 28, (2), 114)
- Mercuric cyanide barium bromide**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{BaBr}_2 + 6\text{H}_2\text{O}$ .  
Easily sol. especially in hot  $\text{H}_2\text{O}$  and alcohol. (Varet, C. R. 1895, 121. 398.)
- Mercuric cyanide cadmium bromide**,  $\text{Hg}(\text{CN})_2$ ,  $\text{CdBr}_2 + 3\text{H}_2\text{O}$ .  
Sol in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, Bull. Soc. (3) 5. 8)  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{CdBr}_2 + 4.5 \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1890, 111. 680.)
- Mercuric cyanide cadmium bromide ammonia**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{CdBr}_2$ ,  $4\text{NH}_3 + 2\text{H}_2\text{O}$ .  
Decomp by  $\text{H}_2\text{O}$ .  
Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet, C. R. 1891, 112. 535.)
- Mercuric cyanide calcium bromide**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{CaBr}_2 + 5\text{H}_2\text{O}$ .  
Sol in 1 pt. cold, and 0.25 pt. boiling  $\text{H}_2\text{O}$ ; also in 2 pts. cold, and 1 pt boiling 90% alcohol (Custer.)  
 $+ 7\text{H}_2\text{O}$ . (Varet, C. R. 1895, 121. 399.)
- Mercuric cyanide cupric bromide ammonia**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{CuBr}_2$ ,  $4\text{NH}_3$ .  
Decomp. by  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, Bull Soc. (3) 6. 221)
- Mercuric cyanide lithium bromide**,  $2\text{Hg}(\text{CN})_2$ ,  $2\text{LiBr} + 7\text{H}_2\text{O}$ .  
Deliquescent. (Varet, C. R. 111. 526.)
- Mercuric cyanide magnesium bromide**.  
See Magnesium mercuric cyanide mercuric bromide.  
 $\text{Hg}(\text{CN})_2$ ,  $2\text{KBr}$  Very sol. in  $\text{H}_2\text{O}$ . (Harth, Z anorg 1897, 14. 351)
- Mercuric cyanide potassium bromide**,  $\text{Hg}(\text{CN})_2$ ,  $\text{KBr} + 2\text{H}_2\text{O}$ .  
Sol. in 13.34 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and less than 1 pt boiling  $\text{H}_2\text{O}$ . (Brett)  
Sol without decomp. in hot dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ . (Brett.)  
Contains  $1\frac{1}{2}\text{H}_2\text{O}$  (Berthelot, A. ch. (5) 29. 226.)
- Mercuric cyanide sodium bromide**,  $\text{Hg}(\text{CN})_2$ ,  $\text{NaBr} + 1\frac{1}{2}\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$  and alcohol.
- Mercuric cyanide strontium bromide**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{SrBr}_2 + 6\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Varet, C. R. 1895, 121. 399.)
- Mercuric cyanide zinc bromide**,  $\text{HgBr}_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{CN})_2 + 8\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, Bull Soc. (3) 5. 8.)
- Mercuric cyanide zinc bromide ammonia**,  $\text{HgBr}_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{CN})_2$ ,  $4\text{NH}_3$ .  
As the corresponding chloride. (Varet.)

**Mercuric cyanide chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgCl}_2$

Sol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol, which dissolves out  $\text{HgCl}_2$ .

**Mercuric cyanide ammonium chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NH}_4\text{Cl}$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Poggiale)  
 $\text{Hg}(\text{CN})_2$ ,  $4\text{NH}_4\text{Cl}$ .

**Mercuric cyanide barium chloride**,  $2\text{Hg}(\text{CN})_2$ ,  
 $\text{BaCl}_2 + 4\text{H}_2\text{O}$ .

Efflorescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol  
 $+ 6\text{H}_2\text{O}$ . (Dexter.)

**Mercuric cyanide barium chloride ammonia**,  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{BaCl}_2$ ,  $4\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
(Varet, Bull. Soc. (3) 6. 221.)

**Mercuric cyanide cadmium chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $\text{CdCl}_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet,  
Bull. Soc. (3) 5. 8.)

**Mercuric cyanide calcium chloride**,  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{CaCl}_2 + 6\text{H}_2\text{O}$ .

Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Varet,  
C. R. 1895, 121. 349.)

**Mercuric cyanide cerium chloride**,  $3\text{Hg}(\text{CN})_2$ ,  
 $\text{CeCl}_3 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Ahlén, Bull. Soc. (2)  
27. 365.)

**Mercuric cyanide cobaltous chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $2\text{CoCl}_2 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Poggiale.)  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{CoCl}_2 + 7\text{H}_2\text{O}$ . (Dexter.)

**Mercuric cyanide cupric chloride**,  $\text{Hg}(\text{CN})_2$ ,  
 $\text{CuCl}_2 + 6\text{H}_2\text{O}$ .

Efflorescent.  
Sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet,  
C. R. 1888, 107. 1002.)

$2\text{Hg}(\text{CN})_2$ ,  $\text{CuCl}_2 + 6\text{H}_2\text{O}$ . Efflorescent  
Very sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ .

(Varet, C. R. 1888, 107. 1002.)

**Mercuric cyanide cupric chloride ammonia**,  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{CuCl}_2$ ,  $4\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{NH}_4\text{OH}$   
 $+ \text{Aq}$ . (Varet, Bull. Soc. (3) 6. 221.)

**Mercuric cyanide didymium chloride**,  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{DyCl}_3 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Ahlén.)

**Mercuric cyanide erbium chloride**,  $3\text{Hg}(\text{CN})_2$ ,  
 $\text{ErCl}_3 + 8\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Ahlén.)

**Mercuric cyanide hydrazine chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $\text{N}_2\text{H}_4$ ,  $\text{HCl}$ .

Very sol. in  $\text{H}_2\text{O}$ .

Nearly insol. in alcohol and ether. (Fer-  
ratum, Gazz. ch. it 1912, 42. (1), 154.)

**Mercuric cyanide ferric chloride**,  $2\text{Hg}(\text{CN})_2$ ,  
 $\text{FeCl}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ .

(Dexter.)

**Mercuric cyanide lanthanum chloride**,  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{LaCl}_3 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Ahlén.)

**Mercuric cyanide magnesium chloride**,  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{MgCl}_2 + 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and dil. alcohol. (Pog-  
giale.)

**Mercuric cyanide manganous chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $\text{MnCl}_2 + 3\text{H}_2\text{O}$ .

Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Poggiale.)

**Mercuric cyanide nickel chloride**,  $\text{Hg}(\text{CN})_2$ ,  
 $\text{NiCl}_2 + 6\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Poggiale.)  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{NiCl}_2 + 7\text{H}_2\text{O}$ . (Dexter.)

**Mercuric cyanide chloride nickel chloride**  
**oxychloride**,  $11\text{Hg}(\text{CN})_2$ ,  $8\text{HgCl}_2$ ,  $2\text{NiCl}_2$ ,  
 $8\text{Ni}(\text{OH})\text{Cl} + 76\text{H}_2\text{O}$ .

(Papiermeister, Dissert. 1898.)

**Mercuric cyanide potassium chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $\text{KCl} + \text{H}_2\text{O}$ .

Sol. in 6.75 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Brett.)  
Sol. in alcohol.

**Mercuric cyanide sodium chloride**,  $\text{Hg}(\text{CN})_2$ ,  
 $\text{NaCl}$ .

Easily sol. especially in hot  $\text{H}_2\text{O}$ ; insol. in  
alcohol. (Poggiale.)

**Mercuric cyanide strontium chloride**,  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{SrCl}_2 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and dil. alcohol. (Varet,  
C. R. 1895, 121. 349.)

**Mercuric cyanide yttrium chloride**,  $3\text{Hg}(\text{CN})_2$ ,  
 $\text{YCl}_3 + 8\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Ahlén, Bull. Soc. (2)  
27. 365.)

**Mercuric cyanide zinc chloride**,  $2\text{Hg}(\text{CN})_2$ ,  
 $\text{ZnCl}_2 + 6\text{H}_2\text{O}$ .

Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Kane.)  
 $\text{HgCl}_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{CN})_2 + 7\text{H}_2\text{O}$ . Ef-  
florescent. Very sol. in  $\text{H}_2\text{O}$ . (Varet, Bull.  
Soc. (3) 5. 8.)

**Mercuric cyanide zinc chloride ammonia**,  
 $\text{HgCl}_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{ZnCl}_2$ ,  $4\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
(Varet, Bull. Soc. (3) 6. 221.)  
 $\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{CN})_2$ ,  $\text{HgCl}_2$ ,  $6\text{NH}_3$ . (Varet,  
C. R. 106. 1080.)

Mercuric cyanide potassium chromate.

See Chromate mercuric cyanide, potassium.

Mercuric cyanide potassium ferrocyanide,  
 $3\text{Hg}(\text{CN})_2, \text{K}_4\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .

Readily sol. in  $\text{H}_2\text{O}$ .

Mercuric cyanide hydrazine,  $\text{Hg}(\text{CN})_2, \text{N}_2\text{H}_4$ .

Very sol. in  $\text{H}_2\text{O}$  with partial decomp. (Hofmann and Marburg, A. 1899, 305, 215.)  
 $\text{Hg}(\text{CN})_2, \text{N}_2\text{H}_4$  Ppt. (Franzen, Z. anorg. 1911, 70, 154.)

Mercuric cyanide potassium hydroxide,  
 $\text{Hg}(\text{CN})_2, \text{KOH}$ .

(Hofmann and Wagner, B. 1908, 41, 321.)  
 $+1\frac{1}{2}\text{H}_2\text{O}$ . (Hofmann and Wagner, B. 1908, 41, 1630.)

$2\text{Hg}(\text{CN})_2, \text{KOH} + \text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Hofmann and Wagner, B. 1908, 41, 320.)

Mercuric cyanide sodium hydroxide,  
 $\text{Hg}(\text{CN})_2, \text{NaOH} + 1\frac{1}{2}\text{H}_2\text{O}$  or  $\text{H}_2\text{O}$ .

(Hofmann and Wagner, B. 1908, 41, 1631.)

Mercuric cyanide barium iodide,  $2\text{Hg}(\text{CN})_2, \text{BaI}_2 + 4\text{H}_2\text{O}$ .

Slowly deliquescent. Sol. in 16.5 pts cold, and 0.4 pt. boiling  $\text{H}_2\text{O}$ . Sol. in 22.5 pts. cold, and 1.6 pts. hot 90% alcohol. Solution is decomp. on boiling. (Custer.)

Mercuric cyanide cadmium iodide,  $\text{Hg}(\text{CN})_2, \text{Cd}(\text{CN})_2, \text{HgI}_2 + 8\text{H}_2\text{O}$ .

See Cadmium mercuric cyanide mercuric iodide.

Mercuric cyanide caesium iodide,  $\text{Hg}(\text{CN})_2, \text{CsI}$ .

Recryst. from  $\text{H}_2\text{O}$  without decomp. Decomp. by acids. (Mathewson and Wells, Am. Ch. J. 1903, 30, 433.)

Mercuric cyanide calcium iodide,  $2\text{Hg}(\text{CN})_2, \text{CaI}_2 + 6\text{H}_2\text{O}$ .

Sl efflorescent. More sol. in  $\text{H}_2\text{O}$  than corresponding Sr. comp. (Custer.)

Mercuric cyanide lithium iodide,  $\text{Hg}(\text{CN})_2, 2\text{Li}(\text{CN})_2, \text{HgI}_2 + 7\text{H}_2\text{O}$ .

See Cyanide, lithium mercuric mercuric iodide.

Mercuric cyanide magnesium iodide,  
 $\text{Hg}(\text{CN})_2, \text{Mg}(\text{CN})_2, \text{HgI}_2 + 8\text{H}_2\text{O}$ .

See Cyanide, magnesium mercuric mercuric iodide.

Mercuric cyanide potassium iodide,  $\text{Hg}(\text{CN})_2, \text{KI}$ .

Sol. in 16 pts. cold, and less hot  $\text{H}_2\text{O}$ . Sol. in 96 pts. cold alcohol of 34° Baumé. (Caillet.) Sl sol. in ether. Decomp. by acids.

$3\text{Hg}(\text{CN})_2, 2\text{KI} + \frac{1}{2}\text{H}_2\text{O}$ . (Barthelot.)

Mercuric cyanide sodium iodide,  $\text{Hg}(\text{CN})_2, \text{NaI} + 2\text{H}_2\text{O}$ .

Sol. in  $4\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at 18°, and  $\frac{1}{2}$  pt. boiling  $\text{H}_2\text{O}$ .

Sol. in 2 pts. boiling, and  $6\frac{1}{2}$  pts. cold 90% alcohol (Custer.)

Mercuric cyanide strontium iodide,  
 $2\text{Hg}(\text{CN})_2, \text{SrI}_2 + 6\text{H}_2\text{O}$ .

Sol. in 7 pts.  $\text{H}_2\text{O}$  at 18°, and  $\frac{1}{2}$  pt. at b.-pt. Sol. in 4 pts. 90% alcohol at 18°, and  $\frac{1}{2}$  pt. at b.-pt. (Custer.)

Mercuric cyanide zinc iodide,  $2\text{Hg}(\text{CN})_2, \text{ZnI}_2 + 6\text{H}_2\text{O}$ .

Efflorescent; sol. in  $\text{H}_2\text{O}$ .

Mercuric cyanide iodide potassium cyanide,  
 $\text{HgI}_2, \text{Hg}(\text{CN})_2, 2\text{KCN}$

Easily decomp. by dil. acids. (Rupp. Apoth. Ztg., 23, 374.)

Mercuric cyanide cadmium nitrate,  
 $2\text{Hg}(\text{CN})_2, \text{Cd}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol (Nylander, J. B. 1859, 271.)

Mercuric cyanide cobalt nitrate,  $2\text{Hg}(\text{CN})_2, \text{Co}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol (Nylander.)

Mercuric cyanide copper nitrate,  $\text{Hg}(\text{CN})_2, \text{Cu}(\text{NO}_3)_2 + 5\text{H}_2\text{O}$

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Nylander.)

Mercuric cyanide ferrous nitrate,  $2\text{Hg}(\text{CN})_2, \text{Fe}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol (Nylander.)

Mercuric cyanide manganous nitrate,  
 $\text{Hg}(\text{CN})_2, \text{Mn}(\text{NO}_3)_2 + 5\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Nylander.)

$2\text{Hg}(\text{CN})_2, \text{Mn}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$  As above.

Mercuric cyanide nickel nitrate,  $2\text{Hg}(\text{CN})_2, \text{Ni}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Nylander.)

Mercuric cyanide silver nitrate,  $2\text{Hg}(\text{CN})_2, \text{AgNO}_3 + 2\text{H}_2\text{O}$ .

Sl sol. in cold, more readily in hot  $\text{H}_2\text{O}$ . Sol. with decomp. in  $\text{HNO}_3 + \text{Aq}$ .

As sol. in alcohol as in  $\text{H}_2\text{O}$

Mercuric cyanide zinc nitrate,  $2\text{Hg}(\text{CN})_2, \text{Zn}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. Not decomp. by alcohol. (Nylander, J. B. 1859, 271.)

**Mercuric cyanide nitrate silver cyanide, basic,**  
 $\text{Hg}(\text{NO}_3)_2\text{CN}$ ,  $10\text{AgCN}$ ,  $\text{Hg}(\text{OH})\text{NO}_2$ .  
 (Schmidt, Z. anorg. 1895, 9. 431)

**Mercuric cyanide potassium selenocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{KSeCN}$ .

Sl. sol. in cold, much more easily sol. in hot  $\text{H}_2\text{O}$  or alcohol. Traces dissolve in ether.  
 (Cameron and Davy, C. N. 44. 63)

**Mercuric cyanide nickel sulphate,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NiSO}_4 \cdot 9\text{H}_2\text{O}$ .  
 (Papiermeister, Dissert. 1898.)

**Mercuric cyanide ammonium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NH}_4\text{SCN}$ .

Easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 23. 71)

**Mercuric cyanide barium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Ba}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .  
 Permanent. Sol. in hot  $\text{H}_2\text{O}$ . (Cleve)

**Mercuric cyanide cadmium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Cd}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .  
 Permanent. Sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide calcium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Ca}(\text{SCN})_2 \cdot 8\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide cerium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Ce}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$ .  
 Easily sol. in hot  $\text{H}_2\text{O}$ . (John)

**Mercuric cyanide didymium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Dy}(\text{SCN})_3 \cdot 6\text{H}_2\text{O}$ .  
 Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide erbium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $2\text{Er}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$ .  
 Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Cleve)

**Mercuric cyanide lanthanum sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{La}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide magnesium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Mg}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .  
 Permanent. Easily sol. in hot  $\text{H}_2\text{O}$ .  
 (Cleve.)

**Mercuric cyanide potassium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{KSCN}$ .  
 Permanent. Easily sol. in hot  $\text{H}_2\text{O}$ .  
 (Cleve)  
 $+2\text{H}_2\text{O}$ . (Phillip, Z. Ch. 1867. 552.)

**Mercuric cyanide rubidium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{Rb}(\text{SCN})$ .  
 Sol. in hot  $\text{H}_2\text{O}$  without decomp. (Grossmann, B. 1904, 37. 1259.)

**Mercuric cyanide samarium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Sm}(\text{SCN})_2 \cdot 12\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide sodium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NaSCN} \cdot 2\text{H}_2\text{O}$ .  
 Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 23. 71)

**Mercuric cyanide strontium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Sr}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .  
 Efflorescent. (Cleve)

**Mercuric cyanide yttrium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Y}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$ .  
 Sl. sol. in warm, much less in cold  $\text{H}_2\text{O}$ .  
 (Cleve)

**Mercuric cyanide zinc sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .  
 Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide zinc sulphocyanide ammoniac,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{SCN})_2$ ,  $3\text{NH}_3$ .  
 Not efflorescent. Decomp. by  $\text{H}_2\text{O}$ .

**Mercuric cyanide potassium thiosulphate,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{K}_2\text{S}_2\text{O}_3$ .  
 Permanent. Sol. in  $\text{H}_2\text{O}$ . (Kessler.)  
 $+ \text{H}_2\text{O}$ . (Fock and Kluss, B. 24. 1355)

**Molybdenum hydroxyl potassium cyanide,**  
 $\text{K}_3\text{Mo}(\text{OH})_2(\text{CN})_6$ .  
 (Rosenheim and Koss, Z. anorg. 1906, 49. 155)  
 $\text{K}_2\text{Mo}(\text{OH})_2(\text{CN})_6$ . Very sol. in  $\text{H}_2\text{O}$ .  
 (Rosenheim and Koss.)

**Molybdenum cyanide with MCN.**  
 See Molybdocyanide M.

**Molybdenyl potassium cyanide,**  
 $\text{MoO}_2(\text{CN})_2$ ,  $2\text{KCN}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . Aqueous solution is stable in presence of alkalis.  
 Insol. in alcohol (Péchar, C. R. 1894, 118. 805.)  
 $\text{MoO}_3(\text{CN})_2$ ,  $3\text{KCN}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Hofmann, Z. anorg. 1896, 12. 287.)  
 $+ \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Hofmann)  
 $+ 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Hofmann.)

**Nickel cyanide,**  $\text{Ni}(\text{CN})_2 \cdot x\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$ . Insol. in conc.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq}$ , but decomp. by heating there-with. Sol. in  $\text{NH}_4\text{OH}$ , warm  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{NH}_4$  succinate +  $\text{Aq}$ ; also in  $\text{KCN} + \text{Aq}$ . Sl. sol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Wittstein.)  
 Insol. in methyl acetate (Naumann, B. 1909, 42. 3790.)

- +3H<sub>2</sub>O, +3½H<sub>2</sub>O, +3¼ H<sub>2</sub>O, +4¼H<sub>2</sub>O, and +5½H<sub>2</sub>O. (Papiermeister, Dissert. 1898.)  
 +4H<sub>2</sub>O. (Hofmann and Hochtlen, B. 1903, 36, 1149.)
- Nickel potassium cyanide, Ni(CN)<sub>2</sub>, 2KCN + H<sub>2</sub>O.**  
 Sol. in H<sub>2</sub>O. Decomp. by acids with residue of insol. Ni(CN)<sub>2</sub>.  
 +½H<sub>2</sub>O. (Rammelsberg.)
- Nickel sodium cyanide, Ni(CN)<sub>2</sub>, 2NaCN + 3H<sub>2</sub>O.**  
 Sol. in H<sub>2</sub>O; decomp. by acids with residue of Ni(CN)<sub>2</sub>.
- Nickel strontium cyanide, Ni(CN)<sub>2</sub>, Sr(CN)<sub>2</sub> + 7H<sub>2</sub>O.**  
 Sol. in H<sub>2</sub>O. (Handl, J. B. 1859, 273)
- Nickel cyanide ammonia, Ni(CN)<sub>2</sub>, NH<sub>3</sub> + ½H<sub>2</sub>O.**  
 Scarcely attacked by H<sub>2</sub>O or dil. acids.  
 Sol. in conc. H<sub>2</sub>SO<sub>4</sub>. Sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq, conc. NH<sub>4</sub>OH + Aq, (NH<sub>4</sub>)<sub>2</sub>C<sub>2</sub>O<sub>4</sub> + Aq, (NH<sub>4</sub>)<sub>2</sub>S + Aq, and KCN + Aq. Decomp. by boiling with NaOH or KOH. (Bernoulli and Grether, Ch. Z. 1901, 25, 436)
- Nickel cyanide trihydrazine, Ni(CN)<sub>2</sub>, (N<sub>2</sub>H<sub>4</sub>)<sub>3</sub>.**  
 Ppt. (Fianzen, Z. anorg. 1911, 70, 155.)
- Osmium cyanide, Os(CN)<sub>2</sub>(?).**  
 Insol. in H<sub>2</sub>O; not attacked by acids.  
*See also Osmocyanhydric acid.*
- Osmium potassium cyanide.**  
*See Osmocyanide, potassium.*
- Palladous cyanide, Pd(CN)<sub>2</sub>.**  
 Insol. in H<sub>2</sub>O. Insol. in dil. acids. Sol. in KCN or NH<sub>4</sub>OH + Aq, also in conc. HCN + Aq.
- Platinous cyanide, Pt(CN)<sub>2</sub>.**  
 Insol. in H<sub>2</sub>O, alkalis, or acids. Sol. in KCN + Aq. When freshly pptd., sol. in NH<sub>4</sub>OH + Aq.
- Platinous cyanide with MCN.**  
*See Platinocyanide, M.*
- Potassium cyanide, KCN.**  
 Deliquescent. Very sol. in H<sub>2</sub>O.  
 100 pts. KCN + Aq, sat. at b.-pt. 103.3°, contain 55 pts. KCN, i. e. 100 pts. H<sub>2</sub>O dissolve 122.2 pts. KCN at 103.3°. (Griffiths)  
 KCN + Aq containing 3.25% KCN has -sp. gr. = 1.0514; 6.5% KCN, 1.0316. (Kohlrausch, W. Ann. 1879, 1)  
 KCN + Aq containing 9.64% KCN has sp. gr. 20°/20° = 1.0514.
- KCN + Aq containing 14.42% KCN has sp. gr. 20°/20° = 1.0768 (Le Blanc and Rohland, Z. phys. ch. 1896, 19, 278)  
 Moderately sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20, 829.)  
 Almost insol. in absolute alcohol  
 Sol. in 80 pts. 95% alcohol when boiling, and easily sol. in 35% alcohol. (Geiger, A. I. 50)  
 100 pts. absolute methyl alcohol dissolve 4.91 pts. at 19.5°; 100 pts. absolute ethyl alcohol dissolve 0.87 pt. at 19.5°. (de Bruyn, Z. phys. Ch. 10, 783.)  
 Insol. in methyl acetate (Naumann, B. 1909, 42, 3790), ethyl acetate. (Naumann, B. 1904, 37, 3901.)  
 100 g. glycerol dissolve 32 g. KCN at 15.5°. (Ossendowski, Pharm. J. 1907, 79, 575)  
 Sol. in CS<sub>2</sub> when pure (Loughlin, J. B. 1875, 234)  
 Wholly insol. in CS<sub>2</sub>. (Moldenhauer, Z. anal. 16, 199.)  
 Sl. sol. in benzonitrile. (Naumann, B. 1914, 47, 1309.)
- Potassium chromium tetroxide pentacyanide, K<sub>2</sub>(CrO<sub>4</sub>)(CN)<sub>5</sub> + 5H<sub>2</sub>O.**  
 Very hygroscopic.  
 Sol. in H<sub>2</sub>O. (Riesenfeld, B. 1908, 41, 3548)
- Potassium chromium tetroxide dicyanide ammonia, K<sub>2</sub>(CrO<sub>4</sub>)(CN)<sub>2</sub>NH<sub>3</sub> + 5H<sub>2</sub>O.**  
 Hygroscopic in the air.  
 Easily sol. in H<sub>2</sub>O and in NH<sub>4</sub>OH + Aq. (Riesenfeld, B. 1908, 41, 3545.)
- Potassium rhodium cyanide.**  
*See Rhodocyanide, potassium.*
- Potassium ruthenium cyanide.**  
*See Ruthenocyanide, potassium.*
- Potassium silver cyanide, KCN, AgCN.**  
 Sol. in 4.7 pts. H<sub>2</sub>O at 15°, 4 pts. at 20°, and in much less at higher temp. Sol. in 25 pts. 85% alcohol. (Baup, A. ch. (3) 53, 464.)
- Potassium silver sodium cyanide, 2KCN, NaCN, 3AgCN.**  
 Sol. in 4.4 pts. H<sub>2</sub>O at 15°, and 22 pts. 85% alcohol at 17°. (Baup.)
- Potassium tungsten cyanide.**  
*See Tungstocyanide, potassium.*
- Potassium uranyl cyanide, (UO<sub>2</sub>)(CN)<sub>2</sub>, 2KCN.**  
 Ppt. Sol. in H<sub>2</sub>O. Sl. sol. in presence of large excess of KCN (Aloy, A. ch. 1901, (7) 24, 417.)
- Potassium vanadium cyanide, K<sub>3</sub>V(CN)<sub>4</sub>.**  
 Readily sol. in H<sub>2</sub>O; decomp. slowly in neutral aq. solution, rapidly in acid aq. solution;

insol. in alcohol (Locke, Am. Ch. J. 1898, 20. 601.)

$K_4V(CN)_6 \cdot 3H_2O$ . Sol. in  $H_2O$ .

Insol. in alcohol and ether. (Petersen, Z. anorg. 1904, 38. 345.)

Potassium zinc cyanide,  $2KCN, Zn(CN)_2$ .

100 pts.  $H_2O$  dissolve 11 pts at  $20^\circ$ . (Sharwood, Eng. Min. J. 1904, 77. 845.)

Potassium cyanide molybdenum dioxide,  $4KCN, MoO_3 \cdot 5H_2O$ .

Sol. in  $H_2O$ . Insol. in alcohol. (Hofmann, Z. anorg. 1896, 12. 287)

$+6H_2O$  "Potassium dioxotetracyanomolybdate"

Very sol in  $H_2O$ . (Winkler, Dissert. 1909.)

$+8H_2O$ . (Roseuhelm, Kohn and Garfunkel, Z. anorg. 1910, 65. 174)

$+10H_2O$ . Decomp. by conc.  $HCl, HNO_3$  and  $H_2SO_4$ .

Not acted upon by cold dil. acids (v. der Heide and Hofmann, Z. anorg. 1896, 12. 285)

$5KCN, MoO_3 \cdot 8H_2O$ . Sol. in  $H_2O$  Insol. in alcohol (Kalischer, Dissert. 1902.)

Potassium cyanide molybdenum dioxide hydroxylamine,  $4KCN, MoO_3, NH_4OH + H_2O$

Sol. in  $H_2O$ .  
Decomp. by dil. acids. (v. der Heide and Hofmann, Z. anorg. 1896, 12. 282)

Potassium cyanide molybdenum sulphide,  $6KCN, MoS_2 \cdot 5H_2O$ .

Easily sol in  $H_2O$ . Decomp. by dil. acids (Hofmann, Z. anorg. 1896, 12. 289)

Very sol in  $H_2O$  Slowly decomp. in the cold by dil. mineral acids. (v. der Heide and Hofmann, Z. anorg. 1896, 12. 289.)

Potassium cyanide molybdenum sulphocyanide,  $2KCN, MoS_2(CN)_2$ .

(Péchar, C. R. 1894, 118. 806.)

$5KCN, Mo_3S_2(CN)_3 \cdot 7H_2O$  Sol. in  $H_2O$ . Stable toward dil. acids and alkalis. (Hofmann, Z. anorg. 1896, 12. 289)

Potassium cyanide molybdenum sulphocyanide,  $4KCN, Mo_3SO(CN)_3 \cdot 4H_2O$ .

Sol in  $H_2O$  Stable toward dil. acids. (Hofmann, Z. anorg. 1896, 12. 289)

Potassium cyanide nitrite,  $KCN, KNO_2 + \frac{1}{2}H_2O$ .

Sol. in  $H_2O$ ; decomp. slowly by  $H_2O$ ; explosive. (Hofmann, Z. anorg. 1895, 10. 260-261.)

Potassium cyanide sulphur dioxide,  $KCN, SO_2 + H_2O$ .

Much more sol. in hot than cold  $H_2O$ . (Étard, C. R. 88. 649.)

$KCN, HCN, 2SO_2 + 3H_2O$ . Very sl. sol. in cold  $H_2O$ ; decomp. by hot  $H_2O$ . (Étard.)

Rubidium tungsten cyanide.

See Tungstocyanide, rubidium.

Rhodium cyanide,  $Rh(CN)_3$ .

Ppt. Not decomp. by acids Sol. in  $KCN + Aq$  (Martius, A. 117. 361.)

Rhodium cyanide with  $3KCN$ .

See Rhodicyanide, potassium.

Ruthenium cyanide with  $4MCN$ .

See Ruthenocyanide, M.

Silver cyanide,  $AgCN$ .

Sl. sol in  $H_2O$ .

$2.2 + 10^{-4}$  g sol in 1 liter of  $H_2O$  at  $19.96^\circ$ . (Böttger, Z. phys. ch. 1903, 46. 603.)

1 l. solution in  $H_2O$  contains 0.000043 g.  $AgCN$  at  $17.5^\circ$  (Abegg and Cox, Z. phys. Ch. 1903, 46. 11)

Solubility in  $H_2O$  at  $25^\circ = 2.22 + 10^{-4}$  mol. per l (Lucas, Z. anorg. 1904, 41. 198.)

Insol. in dil. acids Decomp. by conc. acids. Not sol to any extent in  $HCN + Aq$ .

Freshly pptd  $AgCN$  is not dissolved by cold dil.  $HNO_3$ , but is attacked by very dil.  $HNO_3$  on boiling From dry  $AgCN$  is dissolved 5% by boiling 1 hour with 1%  $HNO_3$ .

$+Aq$ . Conc  $HNO_3$  dissolves more (Brunck, B. 1901, 34. 1605.)

Sol. in  $NH_4OH + Aq$  Sol in boiling  $KCl, NaCl, CaCl_2, BaCl_2$ , or  $MgCl_2 + Aq$ , but very slowly sol, therein at ord. temp. Sol in  $Na_2S_2O_3, K_2Fe(CN)_6, (NH_4)_2CO_3, (NH_4)_2SO_4, NH_4NO_3$ , and  $NH_4$  succinate  $+Aq$ , and in large amt. of hot  $NH_4Cl + Aq$  (Wittstein.)

Sol in  $KCN, NaCN, Ba(CN)_2, Ca(CN)_2$ , or  $Sr(CN)_2 + Aq$ . Insol. in  $KOH$ , or  $NaOH + Aq$ . Sol. in conc. boiling  $AgNO_3 + Aq$  (Wöhler.)

Sol. in 431.7 pts. 5%  $NH_4OH + Aq$  (sp. gr. 0.998) at  $12^\circ$ ; in 184.5 pts. 10%  $NH_4OH + Aq$  (sp. gr. 0.96) at  $18^\circ$ . (Longi, Gazz. ch. it. 13. 87)

Sl. sol. in Na citrate  $+Aq$

Sol. in  $Hg(NO_2)_2 + Aq$ .

1 l. of a 3-N solution of  $AgNO_3$  dissolves 1.216 g  $AgCN$  at  $25^\circ$ . (Hellwig, Z. anorg. 1900, 25. 177)

Very sol. in  $(NH_4)_2S_2O_3 + Aq$ . (Roseuhelm and Steinhäuser, Z. anorg. 1900, 25. 105)

Moderately sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sl. sol. in liquid  $HF$  (Franklin, Z. anorg. 1905, 46. 2.)

Abundantly sol. in quinoline at  $60^\circ$ . (Varet, C. R. 1893, 116. 60.)

Sl. sol. in ethyl amine. (Shinn, J. phys. Chem. 1907, 11. 538.)

Insol. in methyl acetate. (Bezold, Dissert. 1906; Naumann, B. 1909, 42. 3790); ethyl

acetate (Hamers, Dissert. 1906; Naumann, B. 1910, 43. 314.)

Silver hydrogen cyanide,  $\text{AgCN}$ ,  $\text{HCN}$ .  
(Euler, B. 1903, 36. 1859.)

Silver sodium cyanide,  $\text{AgCN}$ ,  $\text{NaCN}$ .

Sol. in 5 pts.  $\text{H}_2\text{O}$  at  $20^\circ$  and in much less hot  $\text{H}_2\text{O}$ . Sol. in 24 pts. 85% alcohol at  $20^\circ$ . (Baup, A. ch. (3) 53. 468.)

Silver thallous cyanide,  $\text{AgCN}$ ,  $\text{TlCN}$ .

Easily sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 4.7 pts. at  $0^\circ$ , and 7.4 pts. at  $16^\circ$ . (Fronmüller, B. 11. 92.)

Silver tungsten cyanide.

See Tungstocyanide, silver.

Silver cyanide ammonia,  $\text{AgCN}$ ,  $\text{NH}_3$ .

Efflorescent. Decomp. on air.  
Very sol. in ammonia at  $-10^\circ$ . (Joannis, C. R. 1894, 118. 1151.)

Silver cyanide hydrazine,  $\text{AgCN}$ ,  $\text{N}_2\text{H}_4$ .

Decomp. in the air  
Decomp. by  $\text{H}_2\text{O}$ . (Franzen, Z. anorg. 1911, 70. 153.)

Silver cyanide nitrate,  $2\text{AgCN}$ ,  $\text{AgNO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ .

Sodium cyanide,  $\text{NaCN}$ .

Sol. in  $\text{H}_2\text{O}$  and 75% alcohol.  
 $+\frac{1}{2}\text{H}_2\text{O}$ , and  $2\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ ; al. sol. in alcohol. (Joannis, A. ch. (5) 26. 484.)

Sodium tungsten cyanide.

See Tungstocyanide, sodium.

Sodium zinc cyanide,  $\text{NaCN}$ ,  $\text{Zn}(\text{CN})_2 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Much more sol. in  $\text{H}_2\text{O}$  than the corresponding K Zn salt. (Rammelsberg.)  
 $+8\text{H}_2\text{O}$ . (Loebe, Dissert. 1902.)

Sodium cyanide molybdenum dioxide,  $4\text{NaCN}$ ,  $\text{MoO}_2 + 6\text{H}_2\text{O}$ .

(Winkler, Dissert. 1909.)  
 $+14\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Garfunkel and Kohn, Z. anorg. 1910, 65. 174.)

Sodium cyanide molybdenum dioxide hydroxylamine,  $4\text{NaCN}$ ,  $\text{MoO}_2$ ,  $\text{NH}_2\text{OH} + \text{H}_2\text{O}$ .

As K comp. (Winkler, Dissert. 1909.)

Strontium cyanide,  $\text{Sr}(\text{CN})_2 + 4\text{H}_2\text{O}$ .

Very unstable; very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Joannis, A. ch. (5) 26. 498.)

Strontium tungsten cyanide.

See Tungstocyanide, strontium.

Strontium zinc cyanide,  $2\text{Sr}(\text{CN})_2$ ,  $3\text{Zn}(\text{CN})_2 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Loebe, Dissert. 1902.)

Thallous cyanide,  $\text{TlCN}$

100 pts.  $\text{H}_2\text{O}$  dissolve 16.8 pts. at  $28.5^\circ$ . (Fronmüller, B. 6. 1178.)

Thallothallic cyanide,  $\text{Th}(\text{CN})_4 = \text{TlCN}$ ,  $\text{Th}(\text{CN})_3$ .

Easily sol. in  $\text{H}_2\text{O}$ .  
100 pts.  $\text{H}_2\text{O}$  dissolve 27.3 pts. at  $30^\circ$ , 15.3 pts. at  $12^\circ$ , 9.7 pts. at  $0^\circ$ . (Fronmüller, B. 11. 92.)

Thallous tungsten cyanide.

See Tungstocyanide, thallous.

Thallous zinc cyanide,  $2\text{TlCN}$ ,  $\text{Zn}(\text{CN})_2$ .

Easily sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 8.7 pts. at  $0^\circ$ ; 15.3 pts. at  $14^\circ$ ; and 29.6 pts. at  $31^\circ$ . (Fronmüller, B. 11. 92.)

Tungsten cyanide with  $\text{MCN}$ .

See Tungstocyanide, M.

Zinc cyanide,  $\text{Zn}(\text{CN})_2$ .

Insol. in  $\text{H}_2\text{O}$  and alcohol. Sol. in alkalis.  
Easily sol. in  $\text{KCN} + \text{Aq}$ . Sol. in hot  $\text{NH}_3$  salts +  $\text{Aq}$  (Wittstein.)

Easily sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Gore.)  
Sol. in  $\text{KOH} + \text{Aq}$ . Solution is stable when less than 1 mol  $\text{Zn}(\text{CN})_2$  to 2 mols.  $\text{KOH}$  is present. When proportion is 1:1,  $\text{ZnO}_2\text{H}_2$  soon separates.

Sol. in dil.  $\text{KCN} + \text{Aq}$ . (Sharwood, J. Am. Chem. Soc. 1903, 25. 587.)

Sl. sol. in conc.  $\text{Zn}$  salts +  $\text{Aq}$ . 1 l. conc.  $\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  dissolves 4 g., and 1 l. conc.  $\text{ZnSO}_4 + \text{Aq}$  dissolves 2 g.  $\text{Zn}(\text{CN})_2$ . Insol. in  $\text{HCN} + \text{Aq}$ . Easily sol. in dil. acids. (Joannis.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Zinc cyanide ammonia,  $\text{Zn}(\text{CN})_2$ ,  $2\text{NH}_3$ .

Decomp. on air. (Varet, C. R. 105. 1070)  
 $+ \text{H}_2\text{O}$ . Decomp. on air. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet.)

Zinc cyanide dihydrazine,  $\text{Zn}(\text{CN})_2$ ,  $2\text{N}_2\text{H}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Franzen, Z. anorg. 1911, 70. 153.)

Cyanogen,  $\text{CN}$ .

$\text{H}_2\text{O}$  absorbs  $4\frac{1}{2}$  vols.  $\text{CN}$  gas at  $20^\circ$ . Alcohol absorbs 23 vols., and ether 5 vols. at the same temperature. (Gay-Lussac.)

The solution gradually decomposes, but this is prevented by traces of acids.

0.221 mol. litre are dissolved in  $H_2O$  at  $0^\circ$ . (Naumann, *Z. Electrochem.* 1910, **16**, 177.)

Oil of turpentine absorbs 5 vols. (Gay-Lussac.) Absorbed by many essential oils. Very sol. in  $CuCl_2 + Aq$ .

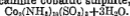
Absorbed with decomp. by  $NH_4OH + Aq$  and other alkaline liquids.

Absorbed by aniline. (Jacquemann, *C. R.* 100, 1006.)

### Cyclotriborene, $B_3H_3$ .

Insol. in  $H_2O$ . (Ramsay and Hatfield, *Proc. Chem. Soc.* 1901, 17, 152.)

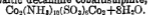
### Decamine cobaltic sulphite,



Sol. in  $H_2O$ . (Vortmann and Magdeburg, *B.* 22, 2636.)

### Decamine cobaltisulphurous acid.

### Cobaltic decamine cobaltisulphite,



Ppt. (Vortmann and Magdeburg, *B.* 22, 2635.)

### Sodium decamine cobaltisulphite,



Sol. in  $H_2O$ . (Vortmann and Magdeburg, *B.* 22, 2635.)

### Diamide, $N_2H_4$ .

See Hydrazine.

### Diamine chromium sulphocyanhydric acid, $Cr(NH_3)_{12}(SCN)_3, HSCN + H_2O$ .

Sol. in  $H_2O$ . (Nordenskiöld, *Z. anorg.* 1, 130.)

### Diamine chromium diaquo sulphocyanide, $Cr(NH_3)_2(SCN)_3 + 2H_2O$

Sol. in  $H_2O$ , from which it is pptd. by con.  $HCl + Aq$ . (Nordenskiöld, *Z. anorg.* 1, 137.)

### Ammonium diamine chromium sulphocyanide, $Cr(NH_3)_2(SCN)_3, NH_4SCN$ .

(Reinecke's salt.) Quite easily sol. in  $H_2O$ , less in alcohol, and insol. in benzene. Slowly decomp. by boiling  $H_2O$  or dil. acids. (Nordenskiöld, *Z. anorg.* 1, 130.)

+  $H_2O$ . Insol. in absolute ether. (Christensen, *J. pr.* (2) 45, 218.)

### Ammonium diamine chromium sulphocyanide iodide, $Cr(NH_3)_2(SCN)_3, NH_4SCN, I$ .

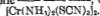
### Barium ———, $[Cr(NH_3)_2(SCN)_3]_2, Ba(SCN)_2$ .

Sol. in  $H_2O$  and alcohol (N.)

### Cadmium diamine chromium sulphocyanide, $Cd(SCN)_2, [Cr(NH_3)_2(SCN)_3]_2 + H_2O$

Nearly insol. in cold, sl. sol. in hot  $H_2O$ . Sl. sol. in boiling alcohol. (Christensen, *J. pr.* (2) 45, 371.)

### Cupric ———, $Cu(SCN)_2$ ,



Insol. in  $H_2O$  or dil. acids. (Reinecke, *A.* 126, 116.)

### Ferric ———, $[Cr(NH_3)_2(SCN)_3]_3, Fe(SCN)_3$ . (N.)

### Luteocobaltic ———,



As good as insol. in cold  $H_2O$ . Sl. sol. in hot  $H_2O$  and alcohol. (Christensen, *J. pr.* (2) 45, 370.)

### Mercuric ———, $[Cr(NH_3)_2(SCN)_3]_2, Hg(SCN)_2$ .

Insol. in  $H_2O$ . (N.)

Insol. in  $H_2O$  and dil. acids. (Reinecke.)

### Potassium ———, $Cr(NH_3)_2(SCN)_3, KSCN$ .

Properties as the  $NH_4$  salt. (N.)  $Cr(NH_3)_2(SCN)_3, KSCN, I$ . As the  $NH_4$  salt. (N.)

### Sodium ———, $NaSCN$ ,



Sol. in  $H_2O$ , alcohol, and ether. (Reinecke.)

### Diamine cobaltic nitrite ammonium nitrite, $Co(NH_3)_2(NO_2)_3, NH_4NO_2$ .

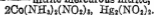
Sol. in  $H_2O$ . (Erdmann.)

### — nitrite lead nitrite,



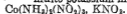
Sol. in hot  $H_2O$  with partial decomp.

### — nitrite mercurous nitrite,



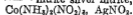
Ppt. Not sol. in hot  $H_2O$  without decomp.

### — nitrite potassium nitrite,



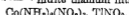
Sol. in  $H_2O$ . (Erdmann, *J. pr.* 97, 385.)

### — nitrite silver nitrite,



Ppt. Crystallises out of hot  $H_2O$ . (Erdmann.)

### — nitrite thallium nitrite,



Crystallises out of hot  $H_2O$  without decomp.

Dichrocoaltic carbonate,  
 $\text{Co}(\text{NH}_3)_2(\text{OH})\text{CO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Vortmann, B. 15. 1901)

Dichrocoaltic chloride,  $\text{Co}(\text{NH}_3)_2\text{Cl}_2 + \text{H}_2\text{O}$ .  
 Quite sol. in cold  $\text{H}_2\text{O}$ , dil. acids, conc.  $\text{H}_2\text{SO}_4$ , or dil. alcohol

From solution in conc.  $\text{H}_2\text{SO}_4$ , the salt is precipitated by much  $\text{HCl} + \text{Ag}$ . Composition is  $\text{Co}(\text{NH}_3)_2(\text{OH}_2)\text{Cl}_2$ . (Jorgensen, Z. anorg. 5. 189.)

— nitrate,  $\text{Co}(\text{NH}_3)_2(\text{NO}_3)_2 + 4\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . More sol. in dil.  $\text{HNO}_3 + \text{Aq}$  than praseoecaltic nitrate (Vortmann, B. 15. 1897)

Anhydrous. Insol. in  $\text{H}_2\text{O}$  as such, but converted into above salt thereby. (Jorgensen, Z. anorg. 5. 186)

— nitrite,  $\text{Co}(\text{NH}_3)_2(\text{NO}_2)_2$ .

Difficultly sol. in cold, but rather easily sol. in hot  $\text{H}_2\text{O}$ .

— sulphate,  $[\text{Co}(\text{NH}_3)_2]_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Vortmann, B. 15. 1900.)

— sulphite,  $[\text{Co}(\text{NH}_3)_2]_2(\text{SO}_3)_3 + \text{H}_2\text{O}$ .

Nearly insol. in cold, slowly decomp. by hot  $\text{H}_2\text{O}$ . Decomp. by acids or  $\text{KOH} + \text{Aq}$ . Insol. in cold, sol. in warm  $\text{NH}_4\text{OH} + \text{Aq}$ . (Kunzel, J. pr. (1) 72. 209) According to Geuther (A. 128. 157), is a double salt—

$[\text{Co}(\text{NH}_3)_2]_2(\text{SO}_3)_3, \text{Co}_2(\text{SO}_3)_3 + 2\text{H}_2\text{O}$

Didymium,  $\text{D}_2$ .

Slowly decomp. by  $\text{H}_2\text{O}$ . Insol. in cold conc.  $\text{H}_2\text{SO}_4$ . Sol. in dil. acids.

Compound of two elements, neodmium and praseodymium. (v. Welsbach, W. A. B. 92. 317.)

Didymium bromide,  $\text{DiBr}_2 + 6\text{H}_2\text{O}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Cleve.)

Didymium nickel bromide,  $2\text{DiBr}_2, 3\text{NiBr}_2 + 18\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Fierichs and Smith, A. 191. 342.)

Didymium zinc bromide,  $\text{DiBr}_2, 3\text{ZnBr}_2 + 12\text{H}_2\text{O}$ .

Extremely deliquescent. (Cleve, Bull. Soc. (3) 43. 361.)

$2\text{DiBr}_2, 3\text{ZnBr}_2 + 36\text{H}_2\text{O}$ . (F. and S.)

Didymium chloride,  $\text{DiCl}_2$ .

Anhydrous. Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Marignac.)

$+ 6\text{H}_2\text{O}$ . Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Marignac.)

Didymium mercuric chloride,  $2\text{DiCl}_2, 9\text{HgCl}_2 + 24\text{H}_2\text{O}$ .

More sol. in  $\text{H}_2\text{O}$  than the corresponding La salt. (Marignac.)

$\text{DiCl}_2, 4\text{HgCl}_2 + 11\text{H}_2\text{O}$ . Not deliquescent. Easily sol. in  $\text{H}_2\text{O}$ .

Didymium stannic chloride.

See Chlorostannate, didymium.

Didymium fluoride,  $\text{DiF}_2 + \frac{1}{2}\text{H}_2\text{O}$

Precipitate. (Cleve.)

Didymium hydrogen fluoride,  $2\text{DiF}_2, 3\text{HF}$ .

Precipitate (Smith.)

Does not exist. (Cleve.)

Didymium potassium fluoride,  $\text{DiF}_2, \text{KF} + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Brauner, B. 15. 114.)

$+ \frac{1}{2}\text{H}_2\text{O}$  As above (B)

$2\text{DiF}_2, 3\text{KF} + \text{H}_2\text{O}$ . As above. (B.)

Didymium hydroxide,  $\text{Di}_2\text{O}_2\text{H}_4$ .

Insol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ , but is al. sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose.)

See also  $\text{Di}_2\text{O}_2$ .

Didymium pentahydroxide,  $\text{DiO}_2\text{H}_3 = \text{Di}_2\text{O}_5, 3\text{H}_2\text{O}$ .

Precipitate (Brauner, B. 15. 113.)

Didymium zinc iodide,  $2\text{DiI}_2, 3\text{ZnI}_2 + 24\text{H}_2\text{O}$ .

Very deliquescent. (Fierichs and Smith)

Didymium oxide,  $\text{Di}_2\text{O}_3$ .

With  $\text{H}_2\text{O}$  slowly forms  $\text{Di}_2\text{O}_2\text{H}_4$ .

Sol. in conc., or dil. mineral acids (Marignac), and in acetic acid (Hermann). Sol. in ammonium salts +  $\text{Aq}$ .

Slightly more slowly sol. in conc.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  than  $\text{La}_2\text{O}_3$ . (Damour and Deville.)

A solution of  $\text{NH}_4\text{NO}_3$  in  $\text{H}_2\text{O}$  that can dissolve 2.9 mols  $\text{La}_2\text{O}_3$  dissolves 1 mol.  $\text{Di}_2\text{O}_3$ . (Brauner, B. 15. 114.)

Insol. in acetone (Naumann, B. 1904, 37. 4329.)

Didymium peroxide,  $\text{Di}_2\text{O}_5$ .

Sol. in acids with decomp. (Fierichs, B. 7. 799)

Not obtained by Cleve. (B. 11. 910)

The contradictory statements concerning the composition of  $\text{Di}$  peroxide are owing to the fact that praseodymium is the only one of the constituents of  $\text{Di}$  which easily forms a peroxide (v. Welsbach.)

Didymium pentoxide,  $\text{Di}_2\text{O}_5$ .

Sol. in dil.  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  in the cold without evolution of gas, but gas is evolved if treated with conc. acids. Insol. in  $\text{HF} + \text{Aq}$ . Sl. sol. in cold  $\text{NH}_4\text{NO}_3 + \text{Aq}$ .  $= \text{Di}_2\text{O}_5$ . (Cleve.)

**Didymium oxybromide,  $D_2OBr$ .**

(Frensch and Smith.)

**Didymium oxychloride,  $D_2OCl$ .**

*Anhydrous.* Insol. in  $H_2O$ . (Smith.)  
 +  $3H_2O$ . Sol. in cold dil.  $HNO_3$  + Aq.  
 (Marignac) Sl. sol. in  $HCl$  + Aq. (Heimann.)

**Didymium oxysulphide,  $D_2O_2S$ .**

Insol. in  $H_2O$ . Sol. in  $HCl$  + Aq without residue. (Marignac)

**Didymium sulphide,  $Di_2S_2$** 

Insol. in  $H_2O$ . Decomp. by dil acids.  
 (Marignac, A. ch. (3) 98. 159.)  
 Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Disulphuric acid,  $H_2S_2O_7$ .***See Disulphuric acid.***Dithionic acid (Hyposulphuric acid),  $H_2S_2O_6$ .**

Known only in aqueous solution, which is stable only when dil. Can be evaporated in vacuo until sp gr = 1.347, but decomp. upon further evaporation. (Welter and Gay-Lussac, A. ch. 10. 312.)

**Dithionates.**All dithionates are sol. in  $H_2O$ .**Aluminum dithionate,  $Al_2(S_2O_6)_3 + 18H_2O$ .**

Extremely deliquescent. Easily sol in  $H_2O$  or absolute alcohol. (Kluss, A. 246. 218.)

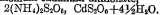
**Aluminum ammonium dithionate,  $Al_2(S_2O_6)_3, (NH_4)_2S_2O_6 + 27H_2O$ .**

Sl. deliquescent. Sol. in  $H_2O$ . (Kluss, A. 246. 303.)

**Ammonium dithionate,  $(NH_4)_2S_2O_6$ .**

Very sol. in  $H_2O$ . Sol. in 0.79 pt.  $H_2O$  at  $10^\circ$ , with reduction of temp. Not decomp. on boiling. Insol. in absolute alcohol. (Heeren, Pogg. 7. 172.)

Contains  $\frac{1}{2}H_2O$ . Sol. in 0.56 pt.  $H_2O$  at  $10^\circ$ . (Kluss, A. 246. 194.)

**Ammonium cadmium dithionate,**

Sol. in  $H_2O$ . (Kluss, A. 246. 298.)

**Ammonium cobalt dithionate,  $9(NH_4)_2S_2O_6, 2CoS_2O_6 + 16\frac{1}{2}H_2O$ .**

Sol. in  $H_2O$ . (Kluss.)

**Ammonium cupric dithionate,  $(NH_4)_2S_2O_6, 2CuS_2O_6 + 8H_2O$ .**

Sol. in  $H_2O$ .

**Ammonium ferrous dithionate,  $3(NH_4)_2S_2O_6, FeS_2O_6 + 6H_2O$ .**

Sol. in  $H_2O$ . (Kluss, A. 246. 300.)

 **$9(NH_4)_2S_2O_6, 2Fe_2S_2O_6 + 16\frac{1}{2}H_2O$ . Sol. in  $H_2O$ . (Kluss.)****Ammonium manganous dithionate,  $9(NH_4)_2S_2O_6, 2MnS_2O_6$ .**

Sol. in  $H_2O$ . (Kluss, A. 246. 301.)

**Ammonium nickel dithionate,  $9(NH_4)_2S_2O_6, 2NiS_2O_6 + 16\frac{1}{2}H_2O$ .**

Sol. in  $H_2O$ . (Kluss.)

**Ammonium zinc dithionate,  $5(NH_4)_2S_2O_6, ZnS_2O_6 + 9H_2O$ .**

Easily sol. in  $H_2O$ . (Kluss, A. 246. 296.)

 **$9(NH_4)_2S_2O_6, 2ZnS_2O_6 + 16\frac{1}{2}H_2O$ . Easily sol in  $H_2O$ . (Kluss.)****Ammonium dithionate chloride,  $(NH_4)_2S_2O_6, NH_4Cl$** 

Sol. in  $H_2O$ . (Fock and Kluss, B. 24. 3017.)

**Barium dithionate,  $BaS_2O_6 + 2H_2O$ .**

Not efflorescent. Sol. in 7.17 pts.  $H_2O$  at  $8^\circ$ , 4.04 pts. at  $18^\circ$ , and 1.1 pts.  $H_2O$  at  $100^\circ$ . Insol. in alcohol. (Gay-Lussac, Heeren.)

Sol. in 0.994 pt.  $H_2O$  at  $102^\circ$ , the boiling-point of the sat. solution. (Baker, Bull. Soc. (2) 44. 166.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+  $4H_2O$ . Very efflorescent. (Heeren.)

**Barium magnesium dithionate,  $BaMg(S_2O_6)_2 + 4H_2O$ .**

Sol. in  $H_2O$ . (Schiff, A. 118. 97.)

**Barium rubidium dithionate,  $BaRb_4(S_2O_6)_2 + H_2O$ .**

Sol. in  $H_2O$ . Solubility is diminished by presence of excess of  $Rb_2SO_4$ , but increased by  $BaS_2O_6$ . (Bodlander, Chem. Ztg. 14. 1140.)

**Barium sodium dithionate,  $BaNa_4(S_2O_6)_2 + 4H_2O$** 

Sol. in  $H_2O$ . Decomp. by recrystallisation. (Kraut, A. 118. 95.)

+  $6H_2O$ . (Schiff.)

**Barium dithionate chloride,  $BaS_2O_6, BaCl_2 + 4H_2O$ .**

(Fock and Kluss, B. 23. 3001.)

**Bismuth dithionate, basic,  $Bi_2O_3, S_2O_6 + 5H_2O$ .**

Efflorescent. Insol. in  $H_2O$ , but decomp. thereby into the following salt. Easily sol. in dil. acids, especially  $HCl$  + Aq. (Kluss, A. 246. 183.)

$4Bi_2O_3, 3S_2O_6 + 5H_2O$ . Insol. in  $H_2O$ . Sol. in dil. acids. (Kluss.)

**Cadmium dithionate.**

Deliquescent in moist air; very sol. in  $\text{H}_2\text{O}$ . (Heeren, Pogg. 7. 183.)

**Cadmium dithionate ammonia,  $\text{CdS}_2\text{O}_6, 4\text{NH}_3$ .**

Decomp. by alcohol; sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  but decomp. on heating. (Rammelsberg, Pogg. 58. 298.)

**Cæsium dithionate,  $\text{Cs}_2\text{S}_2\text{O}_6$ .**

Easily sol. in  $\text{H}_2\text{O}$  (Chabré, C. R. 1901, 133. 297.)

**Calcium dithionate,  $\text{CaS}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Sol. in 246 pts.  $\text{H}_2\text{O}$  at  $19^\circ$ ; 0.8 pt. at  $100^\circ$ . Insol. in alcohol. (Heeren, Pogg. 7. 178.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Cerous dithionate,  $\text{Ce}_2(\text{S}_2\text{O}_6)_3 + 24\text{H}_2\text{O}$** 

Very sol. in  $\text{H}_2\text{O}$ . (Jolin.)  
+3, and  $5\text{H}_2\text{O}$ . (Wyrouboff.)

**Chromic dithionate,  $\text{Cr}_2(\text{S}_2\text{O}_6)_3 + 18\text{H}_2\text{O}$** 

Sol. in  $\text{H}_2\text{O}$  and alcohol (Kluss, A. 246. 189.)

$3\text{Cr}_2\text{O}_3, 4\text{S}_2\text{O}_3 + 24\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  or alcohol. Insol. in ether (Kluss.)

**Cobaltous dithionate,  $\text{CoS}_2\text{O}_6 + 6\text{H}_2\text{O}$ .**

Not deliquescent. Very sol. in  $\text{H}_2\text{O}$  (Heeren.)

+ $8\text{H}_2\text{O}$ . Sol. in 0.49 pt.  $\text{H}_2\text{O}$  at  $19^\circ$ . Sol. in absolute alcohol. (Kluss, A. 246. 203.)

**Cupric dithionate basic,  $4\text{CuO}, \text{S}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . (Heeren, Pogg. 7. 18.)

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Kluss, A. 246. 208.)

+ $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq.}$ ; sol. in traces in conc.  $\text{CuS}_2\text{O}_6 + \text{Aq.}$ . Easily sol. in dil. acids, even  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{S}_2\text{O}_6 + \text{Aq.}$  (Kluss.)

**Cupric dithionate,  $\text{CuS}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Not efflorescent. Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Heeren.)

+ $5\text{H}_2\text{O}$ . Efflorescent. Sol. in 0.64 pt.  $\text{H}_2\text{O}$  at  $18.5^\circ$  (Kluss, A. 246. 204.)

**Cupric dithionate ammonia,  $\text{CuS}_2\text{O}_6, 4\text{NH}_3$ .**

Difficultly sol. in cold  $\text{H}_2\text{O}$ , moderately sol. in  $\text{H}_2\text{O}$  at  $40^\circ$ . Decomp. by much  $\text{H}_2\text{O}$  or by heating the solution above  $60^\circ$ . Decomp. by  $\text{HCl} + \text{Aq.}$  (Heeren.)

Can be recryst. from  $\text{NH}_4\text{OH} + \text{Aq.}$

Sol. in liquid  $\text{NH}_3$  (Horn, Am. Ch. J. 1908, 39. 213.)

-  $\text{CuS}_2\text{O}_6, 9\text{NH}_3$ . Decomp. at ord. temp. in the air.

Insol. in liquid  $\text{NH}_3$ . (Horn, Am. Ch. J. 1908, 39. 213.)

**Didymium dithionate,  $\text{Dy}_2(\text{S}_2\text{O}_6)_3 + 24\text{H}_2\text{O}$ .**

Extremely sol. in  $\text{H}_2\text{O}$  (Cleve.)

**Erbium dithionate,  $\text{Er}_2(\text{S}_2\text{O}_6)_3 + 18\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$  or alcohol, insol. in ether. (Huglund.)

**Glucinum dithionate, basic,  $5\text{GfO}, 2\text{S}_2\text{O}_6 + 14\text{H}_2\text{O}$** 

Easily sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Kluss, A. 246. 196.)

**Iron (ferrous) dithionate,  $\text{FeS}_2\text{O}_6 + 5\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. Decomp. in aqueous solution into  $\text{FeSO}_4$  by boiling (Heeren, Pogg. 7. 181.)

+ $7\text{H}_2\text{O}$ . Sol. in 0.59 pt.  $\text{H}_2\text{O}$  at  $18.5^\circ$ . (Kluss, A. 246. 198.)

**Iron (ferric) dithionate, basic,  $8\text{Fe}_2\text{O}_3, \text{S}_2\text{O}_6 + 20\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  or alcohol. Very sl. sol. in  $\text{H}_2\text{S}_2\text{O}_6 + \text{Aq.}$ ; easily sol. in  $\text{HCl} + \text{Aq}$  (Heeren.)

Contains  $14\text{H}_2\text{O}$ . (Kluss, A. 246. 200.)

$3\text{Fe}_2\text{O}_3, \text{S}_2\text{O}_6 + 8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .

Easily sol. in acids. (Kluss, A. 246. 201.)

**Lanthanum dithionate,  $\text{La}_2(\text{S}_2\text{O}_6)_3 + 16\text{H}_2\text{O}$ , and  $24\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Lead dithionate, basic,  $2\text{PbO}, \text{S}_2\text{O}_6 + 2\text{H}_2\text{O}$ .**

Very difficultly sol. in  $\text{H}_2\text{O}$ . (Heeren, Pogg. 7. 171.)

$10\text{PbO}, \text{S}_2\text{O}_6 + 2\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Heeren.)

**Lead dithionate,  $\text{PbS}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Heeren.)

Sol. in 0.869 pt.  $\text{H}_2\text{O}$  at  $20.5^\circ$ . (Baker, C. N. 36. 203.)

**Lead strontium dithionate,  $(\text{Pb}, \text{Sr})\text{S}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

(Rammelsberg.)

**Lithium dithionate,  $\text{Li}_2\text{S}_2\text{O}_6 + 2\text{H}_2\text{O}$ .**

Sl. deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rammelsberg.)

**Magnesium dithionate,  $\text{MgS}_2\text{O}_6 + 6\text{H}_2\text{O}$ .**

Sol. in 0.85 pt.  $\text{H}_2\text{O}$  at  $13^\circ$ . Solution can be boiled without decomp. (Heeren, Pogg. 7. 179.)

Sol. in 0.692 pt.  $\text{H}_2\text{O}$  at  $17^\circ$ . (Baker, C. N. 36. 203.)

**Manganous dithionate,  $\text{MnS}_2\text{O}_6 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  (Kraut, A. 118. 93.)

+ $6\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Margnag, J. B. 1855. 380.)

**Mercurous dithionate,  $\text{Hg}_2\text{S}_2\text{O}_8$ .**

Sl. sol in cold, decomp. by hot  $\text{H}_2\text{O}$ :  
(Rammelsberg)

**Mercuric dithionate, basic,  $5\text{HgO}$ ,  $2\text{S}_2\text{O}_8$ .**

Sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ .  
Easily sol in  $\text{HNO}_3$  + Aq. (Rammelsberg,  
Pogg. 59. 472)

**Mercuric dithionate,  $\text{HgS}_2\text{O}_6 + 6\text{H}_2\text{O}$** 

Decomp. by  $\text{H}_2\text{O}$  or on standing. (Kluss,  
A. 246. 216.)

**Nickel dithionate,  $\text{NiS}_2\text{O}_6 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  (Topsee.)  
Sol. in 0.897 pt.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Baker, C. N.  
36. 203.)

**Nickel dithionate ammonia,  $\text{NiS}_2\text{O}_6$ ,  $6\text{NH}_3$** 

Can be recryst. from warm  $\text{NH}_4\text{OH}$  + Aq  
Decomp. by  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg  
58. 295.)

**Nickel dithionate hydrazine,  $\text{NiS}_2\text{O}_6$ ,  
 $3\text{N}_2\text{H}_4$ .**

Unstable  
Sol in  $\text{NH}_4\text{OH}$  + Aq (Fauzen, Z anorg  
1908, 60. 267)

**Potassium dithionate,  $\text{K}_2\text{S}_2\text{O}_8$ .**

Not deliquescent Sol. in 16.5 pts.  $\text{H}_2\text{O}$  at  
 $16^\circ$ , and 1.58 pts at  $100^\circ$ . Insol. in alcohol.  
(Heeren.)

Sol in 2.65 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . (Dumas)  
Sol in 16.5 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ ; in 1.58 pts.  
boiling  $\text{H}_2\text{O}$ .

Insol. in alcohol (Heeren, Pogg 1826, 7.  
72.)

**Praseodymium dithionate,  $\text{Pr}_2(\text{S}_2\text{O}_8)_3 + 12\text{H}_2\text{O}$** 

Deliquescent; very sol in  $\text{H}_2\text{O}$ . (von  
Schule, Z. anorg 1898, 18. 361)

**Rubidium dithionate,  $\text{Rb}_2\text{S}_2\text{O}_8$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsee and Christiansen)

**Ruthenium dithionate,  $\text{RuS}_2\text{O}_6$ .**

Ppt. from aq. sol. by alcohol. (Antony,  
Gazz. ch. it. 1898, 28. 139-142.)

**Silver dithionate,  $\text{Ag}_2\text{S}_2\text{O}_8 + 2\text{H}_2\text{O}$ .**

Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . Sol. in  $\text{NH}_4\text{OH}$  +  
Aq. (Heeren, Pogg. 7. 191.)

**Silver sodium dithionate,  $\text{AgS}_2\text{O}_6$ ,  $\text{Na}_2\text{S}_2\text{O}_6$   
 $+ 4\text{H}_2\text{O}$** 

Sol. in  $\text{H}_2\text{O}$ . (Kraut, A. 118. 96.)

**Silver dithionate ammonia,  $\text{AgS}_2\text{O}_6$ ,  $4\text{NH}_3$** 

Sol. in  $\text{H}_2\text{O}$  without decomp. (Rammels-  
berg, Pogg. 58. 298.)

**Sodium dithionate,  $\text{Na}_2\text{S}_2\text{O}_8 + 2\text{H}_2\text{O}$** 

Sol in 2.1 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and in 1.1 pts.  
boiling  $\text{H}_2\text{O}$ . Insol. in alcohol.

Fuming  $\text{HCl}$  + Aq precipitates the salt  
from aqueous solution. (Heeren, Pogg. 7.  
76)  
 $+ 6\text{H}_2\text{O}$ . (Kraut, A. 117. 97.)

**Strontium dithionate,  $\text{SrS}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Sol. in 4.5 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , 1.5 pts boiling  
 $\text{H}_2\text{O}$  Insol. in alcohol (Heeren, Pogg 7.  
177)

**Thallous dithionate,  $\text{Tl}_2\text{S}_2\text{O}_6$ .**

Very easily sol in  $\text{H}_2\text{O}$ . (Weather)

**Thallous dithionate sulphate,  $3\text{Tl}_2\text{S}_2\text{O}_6$ ,  
 $\text{Ti}_2\text{SO}_4$ .**

Sol in  $\text{H}_2\text{O}$ . (Wyrouboff, Ann Phys.  
Bibl. 8. 802.)

**Thorium dithionate,  $\text{Th}(\text{S}_2\text{O}_6)_2 + 4\text{H}_2\text{O}$  (?)**

Very unstable. (Kluss, A. 246. 188.)

**Tin (stannous) dithionate,  $\text{SnS}_2\text{O}_6$ .**

Known only in solution.

$8\text{SnO}$ ,  $\text{S}_2\text{O}_8 + 9\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ . Sol.  
in dil. acids, even dithionic acid + Aq. (Kluss,  
A. 246. 186.)

**Uranous dithionate,  $6\text{UO}_2$ ,  $\text{S}_2\text{O}_8 + 10\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in warm  $\text{HCl}$  + Aq.  
(Kluss, A. 246. 191)

$7\text{UO}_2$ ,  $\text{S}_2\text{O}_8 + 8\text{H}_2\text{O}$ . As above.  
 $8\text{UO}_2$ ,  $\text{S}_2\text{O}_8 + 21\text{H}_2\text{O}$ . As above.

**Divanadyl dithionate,  $(\text{VO}_2)_2\text{S}_2\text{O}_6$** 

Sol. in  $\text{H}_2\text{O}$ . (Bevan, C. N. 38. 294.)

**Yttrium dithionate,  $\text{Y}_2(\text{S}_2\text{O}_6)_3 + 18\text{H}_2\text{O}$ .**

Not deliquescent. Easily sol. in  $\text{H}_2\text{O}$ , but  
difficultly sol. in alcohol. Insol. in ether.  
(Cleve, Bull. Soc. (2) 21. 344.)

**Zinc dithionate,  $\text{ZnS}_2\text{O}_6 + 6\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ ; decomp. on boiling.  
(Heeren, Pogg. 7. 183.)

**Zinc dithionate ammonia,  $\text{ZnS}_2\text{O}_6$ ,  $4\text{NH}_3$ .**

Decomp. with  $\text{H}_2\text{O}$ ; sol. in warm, less sol.  
in cold  $\text{NH}_4\text{OH}$  + Aq. (Rammelsberg, Pogg.  
58. 297.)

$+ \text{H}_2\text{O}$ . Ppt. (Ephraim, B. 1915, 48.  
640.)

**Dysprosium, Dy.**

(Lecoq de Boisbaudran, C. R. 102. 1005.)

**Dysprosium chloride,  $\text{DyCl}_3 + 6\text{H}_2\text{O}$ .**

Deliquescent, sol. in  $\text{H}_2\text{O}$ . (Urbain, C. R.  
1908, 146. 120)

**Europium.**

Europium chloride,  $\text{EuCl}_3$ .

Sol. in  $\text{H}_2\text{O}$ . Stable in very dil. aqueous solution, but decomp. when the solution is concentrated at  $100^\circ$ . (Urban, C. R. 1911, 153. 1157.)

**Erbium, Er**

Decomposes  $\text{H}_2\text{O}$  (Höglund)

The so-called element "erbium" can be further decomp. into simple substances. (Krüss, Z. anorg. 3. 353.)

Erbium bromide,  $\text{ErBr}_3 + 9\text{H}_2\text{O}$ .

Very deliquescent.

Erbium chloride,  $\text{ErCl}_3 + 6\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol (Höglund)

Erbium mercuric chloride,  $\text{ErCl}_3, 5\text{HgCl}_2 + 7\text{H}_2\text{O}$ .

Deliquescent. (Clevs.)

Erbium fluoride,  $\text{ErF}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{HF} + \text{Aq}$ . (Höglund, Bull. Soc. (2) 18. 193.)

Erbium hydroxide,  $\text{Er}_2\text{O}(\text{OH})_4$ .

Insol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ .

Easily sol. in acids. Decomp. ammonium salts by boiling therewith.

Erbium iodide,  $\text{ErI}_3$ .

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol. Insol. in ether. (Höglund.)

Erbium oxide,  $\text{Er}_2\text{O}_3$ .

Difficultly but completely sol. in warm  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq}$ . Decomp.  $\text{NH}_4$  salts by boiling therewith.

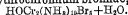
Erbium peroxide,  $\text{Er}_2\text{O}_5$ .

Precipitate. (Cleve, Bull. Soc. (2) 43. 53)

Erbium sulphide.

Decomp. in moist air and with acids.

Erythrochromium bromide,



Very easily sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HBr} + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Jörgensen, J. pr. (2) 25. 398)

— bromide, basic,  $\text{HOCr}_2(\text{NH}_4)_{10}(\text{OH})\text{Br}_4 + \text{H}_2\text{O}$

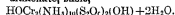
Very sol. in  $\text{H}_2\text{O}$ . (Jörgensen)

— chloroiodide,  $\text{HOCr}_2(\text{NH}_4)_{10}\text{ClI}_4 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Jörgensen.)

Erythrochromium chloroplatinate,  
 $[\text{HOCr}_2(\text{NH}_4)_{10}]_2(\text{PtCl}_6)_5 + 10\text{H}_2\text{O}$ .  
 Nearly insol. in  $\text{H}_2\text{O}$ . (Jörgensen.)

— dithionate, basic,



Insol. in  $\text{H}_2\text{O}$ . Easily sol. in very dil.  $\text{HNO}_3$ ,  $\text{HBr}$ ,  $\text{HCl} + \text{Aq}$ . Sol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Jörgensen.)

— nitrate,  $\text{HOCr}_2(\text{NH}_4)_{10}(\text{NO}_3)_5 + \text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{HNO}_3 + \text{Aq}$ . Sol. in conc.  $\text{HNO}_3$  with decomp. Very sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in alcohol. (Jörgensen)

— nitrate, basic,  $\text{HOCr}_2(\text{NH}_4)_{10}(\text{NO}_3)_4(\text{OH}) + 3\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in cold  $\text{H}_2\text{O}$  (Jörgensen.)

— sulphate,  $[\text{HOCr}_2(\text{NH}_4)_{10}]_2(\text{SO}_4)_5$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Jörgensen)

Tetraferriammonium,  $\text{Fe}_4\text{N}$ .

See Iron nitride.

**Ferric acid.**

Barium ferrate,  $\text{BaFeO}_4 + \text{H}_2\text{O}$ .

Ppt. Can be boiled for some time with  $\text{H}_2\text{O}$  without decomp. Decomp. by mineral acids. Sol. in dil. acetic acid. (Fremy, A. ch. (3) 12. 373)

Insol. in  $\text{H}_2\text{O}$ , not readily acted upon by acids when dry. (Rosen, J. Am. Chem. Soc. 1895, 17. 766)

Ppt. Easily decomp. by acids (Moeser, Arch. Pharm. 1895, 233. 526.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Calcium ferrate,  $\text{CaFeO}_4$

Sol. in  $\text{H}_2\text{O}$ . (Rosell, J. Am. Chem. Soc. 1895, 17. 760-69.)

Potassium ferrate,  $\text{K}_2\text{FeO}_4$ .

Very deliquescent. Easily sol. in cold  $\text{H}_2\text{O}$  with evolution of much heat. Decomp. by standing or warming. Decomp. by acids or alkalis (Fremy, A. ch. (3) 12. 369.)

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Moeser, Arch. Pharm. 1895, 233. 524)

Quickly decomp. by potassium tartrate or racemate, sugar, or albumen without separation of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ , by alcohol with separation of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Potassium oxalate, acetate, formate, and benzoate, also citrate decomp. much more slowly. Insol. in conc.  $\text{KOH} + \text{Aq}$ . (Wackenroder, A. 33. 41.)

Sodium ferrate,  $\text{Na}_2\text{FeO}_4$ .

Sol. in  $\text{H}_2\text{O}$  and in conc.  $\text{NaOH} + \text{Aq}$ . (Fremy, l. c.)

**Strontium ferrate,  $\text{SrFeO}_4$ .**

Sl. sol. in  $\text{H}_2\text{O}$  by which it is decomp.  
Decomp. by acids  
Sol. in aqueous solutions of Na and K salts with partial decomp.  
Insol. in sat.  $\text{SrBr}_2 + \text{Aq.}$ , alcohol and ether. (Eidmann, B. 1903, 36, 2290)

**Ferricomolybdic acid.**

**Ammonium ferricomolybdate,  $3(\text{NH}_4)_2\text{O}$ ,  $\text{Fe}_2\text{O}_3$ ,  $12\text{MoO}_3 + 19\text{H}_2\text{O}$ .**

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29, 697.)

**Ferricyanhydric acid,**

$\text{H}_3\text{Fe}(\text{CN})_3$  (or  $\text{H}_2\text{Fe}_2(\text{CN})_{12}$ ).

Easily sol. in  $\text{H}_2\text{O}$  or alcohol. Solution decomposes slowly by standing, more rapidly by heating. Insol. in ether.

**Ferricyanides.**

The alkali, and alkaline-earth ferricyanides are sol. in  $\text{H}_2\text{O}$ ; the others are insol. The ferricyanides of metals, the oxides of which are sol. in  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq.}$ , are themselves sol. in those reagents

**Ammonium ferricyanide,  $(\text{NH}_4)_3\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$**

Permanent. Readily sol. in  $\text{H}_2\text{O}$  (and alcohol?).

**Ammonium ferrous ferricyanide,  $\text{NH}_4\text{Fe}(\text{CN})_6 + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and not pptd. by alcohol from aqueous solution. More stable than the corresponding K salt.

**Ammonium lead ferricyanide,  $\text{NH}_4\text{PbFe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .**

**Ammonium potassium ferricyanide,  $(\text{NH}_4)_2\text{KFe}(\text{CN})_6$ .**

Sol. in  $\text{H}_2\text{O}$ . (Schaller, Bull. Soc. (2) 1, 275.)

**Barium ferricyanide,  $\text{Ba}_3[\text{Fe}(\text{CN})_6]_2 + 20\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Schuler, W. A. B. 77, 692.)

**Barium potassium ferricyanide,  $\text{BaKFe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .**

Permanent. Easily sol. in  $\text{H}_2\text{O}$ , less in alcohol.

**Barium ferricyanide bromide,  $\text{Ba}_4[\text{Fe}(\text{CN})_6]_3, 2\text{BaBr}_2 + 20\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Boiling alcohol does not dissolve out  $\text{BaBr}_2$ . (Rammelsberg, J. pr. (2) 39, 463.)

**Bismuth ferricyanide,  $\text{Bi}_3[\text{Fe}(\text{CN})_6]_3$ .**

Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling therewith. (Muir, Chem. Soc. 32, 40)

**Cadmium ferricyanide ammonia,  $\text{Cd}_3[\text{Fe}(\text{CN})_6]_2, 6\text{NH}_3 + 3\text{H}_2\text{O}$ .**

Effloresces to form—  
 $\text{Cd}_3[\text{Fe}(\text{CN})_6]_3, 4\text{NH}_3 + 2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Wyrouboff, A. ch. (5) 10, 413.)

**Calcium ferricyanide,  $\text{Ca}_3[\text{Fe}(\text{CN})_6]_2 + 10$ , or  $12\text{H}_2\text{O}$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and dil. alcohol.

**Calcium potassium ferricyanide,  $\text{CaKFe}(\text{CN})_6$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Cerous ferricyanide,  $\text{CeFe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ , easily decomp. (John.)

**Chromic ferricyanide (?)**.

Ppt.

**Cobaltous ferricyanide,  $\text{Co}_3[\text{Fe}(\text{CN})_6]_2$ .**

Insol. in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq.}$  Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$

**Cobaltous ferricyanide ammonia,  $\text{Co}_3[\text{Fe}(\text{CN})_6]_2, 4\text{NH}_3 + 6\text{H}_2\text{O}$ .**

**Cobaltic ferricyanide ammonia.**

See Luteo-, purpureo-, etc. cobaltic ferricyanide.

**Cuprous ferricyanide,  $(\text{Cu}_2)[\text{Fe}(\text{CN})_6]_2$ .**

Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$ ; insol. in  $\text{NH}_4$  salts +  $\text{Aq.}$  (Wittstein)

**Cupric ferricyanide,  $\text{Cu}_2[\text{Fe}(\text{CN})_6]_2$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4$  salts +  $\text{Aq.}$  Sol. in  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Wittstein.)  
Insol. in  $\text{HCl} + \text{Aq.}$

**Iron (ferrous) ferricyanide,  $\text{Fe}_3[\text{Fe}(\text{CN})_6]_2 + x\text{H}_2\text{O}$ .**

(Turnbull's blue) Properties as ferric ferrocyanide (Prussian blue), with which it is perhaps identical. (Gintl, Z. anal. 21, 110.)

**Iron (ferrosoferric) ferricyanide,**

$\text{Fe}_{12}(\text{CN})_{24} = \text{Fe}^{II}_4\text{Fe}^{III}_8[\text{Fe}(\text{CN})_6]_6$ .

(Prussian green) Insol. in  $\text{H}_2\text{O}$  or conc.  $\text{HCl} + \text{Aq.}$ , but slowly decomp. by boiling therewith

$\text{Fe}_2(\text{CN})_6 + 4\text{H}_2\text{O} = \text{Fe}^{II}_4\text{Fe}^{III}_8[\text{Fe}(\text{CN})_6]_4 + 12\text{H}_2\text{O}$  Properties as above. (Reynolds, Chem. Soc. 54, 767.)

**Iron (ferrous) potassium ferricyanide,**

$\text{KFe}(\text{CN})_6 = \text{KFe}(\text{CN})_6 + 4$ , or  $3\text{H}_2\text{O}$ .

(Soluble Prussian blue) Sol. in  $\text{H}_2\text{O}$ , but insol. in salts +  $\text{Aq.}$  or alcohol.

Salt of the same composition, called "Wilhamson's blue," is insol. in  $H_2O$ .

Lead ferricyanide, basic,  $Pb_2[Fe(CN)_6]_2 \cdot 3PbO \cdot H_2 + 11H_2O$ .  
(Schuler.)

Lead ferricyanide,  $Pb_2[Fe(CN)_6]_2 + 16H_2O$   
Sl. sol. in  $H_2O$ ; more sol. in hot, than cold  $H_2O$ , but decomp. on boiling. (Gmelin.)  
 $+4H_2O$ . Easily sol. in  $H_2O$ ; sl. sol. in alcohol. (Schuler, W. A. B. 77. 692.)

Lead potassium ferricyanide,  $PbKFe(CN)_6 + 3H_2O$ .

Sol. in 4.75 pts.  $H_2O$  at  $16^\circ$ , and the solution decomp. on standing. (Schuler.)  
 $+1\frac{1}{2}H_2O$ . Efflorescent. Much more sol. in  $H_2O$  than the Pb salt. Insol. in alcohol (Wyruboff.)

Lead ferricyanide nitrate,  $Pb_2[Fe(CN)_6]_2 \cdot Pb(NO_3)_2 + 12H_2O$ .

Sol. in 13.31 pts.  $H_2O$  at  $16^\circ$ . (Schuler.)  
 $+11H_2O$ . (Joannis, A. ch. (5) 26. 528.)

Magnesium ferricyanide,  $Mg_2[Fe(CN)_6]_2$ .  
Sol. in  $H_2O$ .

Magnesium potassium ferricyanide,  $MgKFe(CN)_6$ .  
(Reindel, J. pr. 103. 166.)

Manganous ferricyanide,  $Mn_2[Fe(CN)_6]_2$ .  
Insol. in  $H_2O$ , acids,  $NH_4OH$ , or  $NH_4$  salts + Aq.

Mercurous ferricyanide,  $Hg_2Fe(CN)_6$ .  
Ppt. (Fernekes, J. Am. Chem. Soc. 1906, 28. 604.)

Mercuric ferricyanide,  $Hg_2[Fe(CN)_6]_2$ .  
Very sol. in  $H_2O$ . Solution quickly decomp. (Fernekes, J. Am. Chem. Soc. 1906, 28. 603.)

Nickel ferricyanide ammonia,  $Ni_2[Fe(CN)_6]_2 \cdot 4NH_3 + H_2O$ .

Sol. in  $NH_4OH$  + Aq. (Reynoso, A. ch. (3) 30. 254.)

Nickel ferricyanide,  $Ni_2[Fe(CN)_6]_2(?)$ .  
Ppt. Insol. in  $HCl$  + Aq.

Potassium ferricyanide,  $K_3Fe(CN)_6$ , (or  $K_4Fe_2(CN)_{12}$ ).

Permanent. Easily sol. in  $H_2O$ .

100 pts.  $H_2O$  dissolve pts.  $K_3Fe(CN)_6$  at  $t^\circ$ .

$t^\circ$	Pts salt	$t^\circ$	Pts salt	$t^\circ$	Pts salt
4 4	33 0	15.6	40 8	100	77 5
10	36 6	37.8	58 8	104.4	82 6

(Wallace, Chem. Soc. 7. 80.)

100 pts.  $H_2O$  at  $13^\circ$  dissolve 38 pts., and the solution has sp. gr. = 1.1630. (Schiff, A. 113. 350.)

1 l sat. solution in  $H_2O$  at  $25^\circ$  contains 385.5 g.  $K_3Fe(CN)_6$ . (Grube, Z. Electrochem. 1914, 20. 342.)

Sp. gr. of  $K_3Fe(CN)_6$  + Aq at  $13^\circ$

$t^\circ$ salt	Sp. gr.	$t^\circ$ salt	Sp. gr.	$t^\circ$ salt	Sp. gr.
1	1.0051	11	1.0595	21	1.1202
2	1.0103	12	1.0653	22	1.1266
3	1.0155	13	1.0712	23	1.1331
4	1.0208	14	1.0771	24	1.1396
5	1.0261	15	1.0831	25	1.1462
6	1.0315	16	1.0891	26	1.1529
7	1.0370	17	1.0952	27	1.1596
8	1.0426	18	1.1014	28	1.1664
9	1.0482	19	1.1076	29	1.1732
10	1.0538	20	1.1039	30	1.1802

(Schiff)

Sp. gr. of  $K_4Fe(CN)_6$  + Aq at  $25^\circ$ .

Concentration of $K_4Fe(CN)_6$ + Aq	Sp. gr.
1—normal	1.0574
$\frac{1}{2}$ —	1.0289
$\frac{1}{4}$ —	1.0143
$\frac{1}{8}$ —	1.0092

(Wagner, Z. phys. Ch. 1890, 5. 37.)

Sat.  $K_3Fe(CN)_6$  + Aq boils at  $104.4^\circ$ . (Wallace)

1 l sat. solution at  $25^\circ$  of  $K_3Fe(CN)_6$  +  $K_4Fe(CN)_6$  contains 338.1 g.  $K_3Fe(CN)_6$  and 79.02 g.  $K_4Fe(CN)_6$  (Grube)

Solubility of  $K_3Fe(CN)_6$  +  $K_4Fe(CN)_6$  in  $KOH$  + Aq at  $25^\circ$

KOH Normality	g. per l	
	$K_3Fe(CN)_6$	$K_4Fe(CN)_6$
0.4687	309	66.64
0.9028	275.3	55.19
1.949	200.8	35.95

(Grube.)

Solubility in  $KOH$  + Aq at  $25^\circ$ .

KOH Normality	g. $K_4Fe(CN)_6$ per l.
0.4687	342.7
0.9028	302.3
1.949	215.1

(Grube, Z. Electrochem. 1914, 20. 342.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in absolute alcohol, and only sl. sol. in dil. alcohol.

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate (Naumann, B. 1910, 43. 314.)

Insol. in benzonitrile (Naumann, B. 1914, 47. 1370.)

**Potassium sodium ferricyanide,**  
 $\text{KNa}_2\text{Fe}(\text{CN})_6$ .

Sol in  $\text{H}_2\text{O}$ .

$\text{K}_2\text{NaFe}(\text{CN})_6$ . Sol in  $\text{H}_2\text{O}$

$\text{K}_2\text{Na}_2[\text{Fe}(\text{CN})_6]$ . Sol in  $\text{H}_2\text{O}$ .  
 $+3\text{H}_2\text{O}$ .

**Potassium ferricyanide iodide,**  $\text{K}_3\text{Fe}(\text{CN})_6$ ,  
 KI.

Very unstable.

**Silver ferricyanide,**  $\text{Ag}_3\text{Fe}(\text{CN})_6$

1 l  $\text{H}_2\text{O}$  dissolves 0.0066 g  $\text{Ag}_3\text{Fe}(\text{CN})_6$  at  $20^\circ$ . (Whitby, Z anorg 1910, 67. 108.)

Sol. in  $\text{NH}_4\text{OH}$ , and hot  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , but insol. in  $\text{NH}_4$  salts +  $\text{Aq}$ .

Insol. in  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ . (Wackenroder, A. 41. 317.)

**Silver ferricyanide ammonia,**  $2\text{Ag}_3\text{Fe}(\text{CN})_6$ ,  
 $3\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Gintl.)

$2\text{Ag}_3\text{Fe}(\text{CN})_6$ ,  $5\text{NH}_3$ . (Carlo, Gazz. ch. it. 1910, 40. (2) 477.)

**Sodium ferricyanide,**  $\text{Na}_3\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$

Deliquescent. Sol. in 5.3 pts. cold, and 1.5 pts. boiling  $\text{H}_2\text{O}$ . Insol. in alcohol, but not pptd. thereby from aqueous solution. (Bette)

**Ferrinitrososulphydric acid.**

See Ferroheptanitrososulphydric acid.

**Ferrocyanhydric acid,**  $\text{H}_4\text{Fe}(\text{CN})_6$ .

Sol in  $\text{H}_2\text{O}$  and alcohol.

100 pts.  $\text{H}_2\text{O}$  dissolve 15 pts. acid at  $14^\circ$ . (Joannis, A. ch. (5) 26. 514.)

Insol. in ether, and much less sol. in ether-alcohol than in alcohol. Insol. in conc.  $\text{HCl} + \text{Aq}$ .

**Ferrocyanides.**

The ferrocyanides of the alkali and alkaline-earth metals are sol. in  $\text{H}_2\text{O}$ ; the others are insol., but sol. in alkalies +  $\text{Aq}$  in case the base is sol. therein.

**Aluminum ferrocyanide,**  $\text{Al}_4[\text{Fe}(\text{CN})_6]_3 + 17\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$

Sl. sol. in  $\text{HCl} + \text{Aq}$  with partial decomp. (Wyruboff, A. ch. (5) 8. 446.)

**Ammonium ferrocyanide,**  $(\text{NH}_4)_4\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol.

$+ \text{H}_2\text{O}$ . (Berzelius.)

**Ammonium cadmium ferrocyanide ammonia,**  
 $(\text{NH}_4)_2\text{Cd}_2[\text{Fe}(\text{CN})_6]_2 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wyruboff, A. ch. (5) 10. 413.)

**Ammonium calcium ferrocyanide,**  
 $(\text{NH}_4)_2\text{CaFe}(\text{CN})_6$ .

Sl. sol. in  $\text{H}_2\text{O}$  (Kunheim and Zimmermann, Dingl. 252. 478.)

100 g. sat. solution in  $\text{H}_2\text{O}$  contain 0.258 g at  $16^\circ$ . (Brown, J. phys. Ch. 1898, 2. 51.)

**Ammonium cuprous ferro cyanide,**  
 $(\text{NH}_4)_2\text{Cu}_2\text{Fe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$  and alcohol.

Decomp. in the air. (Messner, Z. anorg. 1895, 8. 382.)

**Ammonium cupric ferrocyanide,**  
 $(\text{NH}_4)_2\text{CuFe}(\text{CN})_6$ .

Ppt.

$+ x\text{H}_2\text{O}$  Very unstable Insol. in  $\text{H}_2\text{O}$ ; decomp. by boiling  $\text{H}_2\text{O}$  (Messner, Z. anorg. 1895, 8. 384.)

**Ammonium lithium ferrocyanide,**  
 $(\text{NH}_4)_2\text{Li}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Wyruboff, A. ch. (4) 21. 270.)

**Ammonium magnesium ferrocyanide,**  
 $(\text{NH}_4)_2\text{MgFe}(\text{CN})_6$ .

1 l sat. solution at  $17^\circ$  contains 2.48 g  $(\text{NH}_4)_2\text{MgFe}(\text{CN})_6$  (Robinson, Chem. Soc 1909, 96. 1353.)

**Ammonium manganous ferrocyanide,**  
 $(\text{NH}_4)_2\text{MnFe}(\text{CN})_6$ .

Ppt. (Blum, Z. anal. 30. 284.)

**Ammonium potassium ferrocyanide,**  
 $\text{NH}_4\text{K}_3\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Easily sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Insol. in alcohol.

$(\text{NH}_4)_2\text{K}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

**Ammonium potassium ferrocyanide ammonium chloride,**  $(\text{NH}_4)_2\text{KFe}(\text{CN})_6$ ,  
 $2\text{NH}_4\text{Cl}$

Sol in  $\text{H}_2\text{O}$ . (Étard, J. pr. (2) 31. 430.)

**Ammonium ferrocyanide bromide,**  
 $(\text{NH}_4)_4\text{Fe}(\text{CN})_6 \cdot 2\text{NH}_4\text{Br}$ .

Permanent. Very sol. in  $\text{H}_2\text{O}$ .

**Ammonium ferrocyanide chloride,**  
 $(\text{NH}_4)_4\text{Fe}(\text{CN})_6 \cdot 2\text{NH}_4\text{Cl} + 3\text{H}_2\text{O}$ .

Permanent. Very sol. in  $\text{H}_2\text{O}$ , but less so than  $\text{NH}_4\text{Cl}$ . (Bunsen.)

**Antimony ferrocyanide**,  $\text{Sb}_4[\text{Fe}(\text{CN})_6]_3 + 25\text{H}_2\text{O}$ .

Ppt. (Atterberg.)

**Barium ferrocyanide**,  $\text{Ba}_2\text{Fe}(\text{CN})_6 + 6\text{H}_2\text{O}$ .

Permanent. Sl sol in  $\text{H}_2\text{O}$ .

Sol. in 584 pts. cold, and 116 pts. boiling  $\text{H}_2\text{O}$  (Duflos, 1832); sol. in 1800 pts. cold  $\text{H}_2\text{O}$  (Porrett, 1814); sol. in 1920 pts. cold, and about 100 pts. boiling  $\text{H}_2\text{O}$  (Thomson); sol. in 2000 pts. cold, and 100 pts. boiling  $\text{H}_2\text{O}$  (Ure's Dict.)

Sol. in 1000 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 100 pts. at  $75^\circ$ . (Wyruboff, A. ch. (4) 16. 292.)

Sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , or conc.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

**Barium cupric ferrocyanide**,  $\text{BaCuFe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ . (Messner, Z. anorg. 1895, 8. 389.)

**Barium potassium ferrocyanide**,  
 $\text{BaK}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Sol. in 38 pts. cold, and 9.5 pts. boiling  $\text{H}_2\text{O}$  (Duflos, 1832); in 36.4 pts.  $\text{H}_2\text{O}$  at  $14^\circ$ , and 11.9 pts. at b.-pt. (Mosander)

Not more sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . Sol. in dil., insol. in conc.  $\text{HCl} + \text{Aq}$ . (Rose.)  $+ 5\text{H}_2\text{O}$ . Sol. in 300 pts.  $\text{H}_2\text{O}$  at ord. temp. (Wyruboff.)

**Bismuth ferrocyanide**,  $\text{Bi}_2\text{Fe}(\text{CN})_6 + 5\text{H}_2\text{O} (?)$

Sl sol. in pure  $\text{H}_2\text{O}$ . (Wyruboff.)

$\text{Bi}_4[\text{Fe}(\text{CN})_6]_3$ . Ppt. (Murr, Chem. Soc. 31 657.)

**Bismuth potassium ferrocyanide**,  
 $\text{BiKFe}(\text{CN})_6 + 7\text{H}_2\text{O}$ , or  $4\text{H}_2\text{O}$ .

Ppt.

**Cadmium potassium ferrocyanide**,  
 $\text{CdK}_2\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ .

Formula given by Wyruboff is  $\text{Cd}_2\text{K}_4[\text{Fe}(\text{CN})_6]_3 + 11\text{H}_2\text{O} (?)$ .

**Calcium ferrocyanide**,  $\text{Ca}_3\text{Fe}(\text{CN})_6 + 12\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Sol. in 0.66 pt.  $\text{H}_2\text{O}$  at  $90^\circ$  and not pptd. by cooling, and is apparently less sol. in warm than cold  $\text{H}_2\text{O}$ . (Wyruboff, A. ch. (4) 16. 280.)

**Calcium cuprous ferrocyanide**,

$\text{CaCu}_2\text{Fe}(\text{CN})_6$ . (Messner, Z. anorg. 1894, 8. 387.)

**Calcium cupric ferrocyanide**,  $\text{CaCuFe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ . (Messner, Z. anorg. 1895 8. 388.)

**Calcium potassium ferrocyanide**,  
 $\text{CaK}_2\text{Fe}(\text{CN})_6$

Sl. sol. in  $\text{H}_2\text{O}$ . (Kunheim and Zimmerman, Dingl. 252. 478.)

$+ 3\text{H}_2\text{O}$ . Sol. in 795 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 145. pts. at b.-pt., with decomp. in the latter case.

Sol. in dil., insol. in conc.  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{HNO}_3$  of 1.2 sp. gr. (Mosander.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ .

**Calcium sodium ferrocyanide**,

$\text{CaNa}_4[\text{Fe}(\text{CN})_6]_{12}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Calcium strontium ferrocyanide**,

$\text{CaSrFe}(\text{CN})_6 + 10\text{H}_2\text{O}$ .

Efflorescent. Sol. in about 3 pts.  $\text{H}_2\text{O}$ . (Wyruboff, A. ch. (4) 21. 278.)

**Cerium ferrocyanide**,  $\text{Ce}_4[\text{Fe}(\text{CN})_6]_3 + 30\text{H}_2\text{O}$ .

Ppt. (Wyruboff.)

**Cerium potassium ferrocyanide**,

$\text{CeKFe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Ppt. (Jolin.)

$+ 4\text{H}_2\text{O}$ . (Wyruboff.)

**Chromic ferrocyanide**,  $\text{Cr}_2[\text{Fe}(\text{CN})_6]_3 + 20\text{H}_2\text{O}$ .

Ppt.

**Cobaltous ferrocyanide**,  $\text{Co}_2\text{Fe}(\text{CN})_6 + 7\text{H}_2\text{O}$

Wholly insol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{SO}_4$  with decomp. Insol. in  $\text{HCl} + \text{Aq}$ . Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ .

**Cobaltous ferrocyanide ammonia**,

$\text{Co}_2\text{Fe}(\text{CN})_6 \cdot 8\text{NH}_3 + 10\text{H}_2\text{O}$ .

Ppt. Decomp. on standing. (Curda, Z. Ch. 1869. 369.)

$\text{Co}_2\text{Fe}(\text{CN})_6 \cdot 12\text{NH}_3 + 9\text{H}_2\text{O}$ . As above. (Curda.)

**Cobaltous potassium ferrocyanide**,

$\text{CoK}_2\text{Fe}(\text{CN})_6$ .

Ppt. (Wyruboff.)

$\text{Co}_2\text{K}_4[\text{Fe}(\text{CN})_6]_3 (?)$ . Ppt. Insol. only in presence of an excess of  $\text{K}_4\text{Fe}(\text{CN})_6$ . (Wyruboff.)

**Columbium potassium ferrocyanide**,

$\text{Cb}_2\text{K}[\text{Fe}(\text{CN})_6]_2 + 67\text{H}_2\text{O} (?)$ .

Sol. in  $\text{H}_2\text{O}$ . (Wyruboff.)

$\text{Cb}_{11}\text{K}_2\text{Fe}(\text{CN})_6 + 39\text{H}_2\text{O} (?)$ . Sol. in  $\text{H}_2\text{O}$  (W.)

$(\text{CbO})_3\text{K}_9[\text{Fe}(\text{CN})_6]_6 + 10\text{H}_2\text{O} (?)$ . Ppt. (Atterberg.)

**Cuprous ferrocyanide**,  $\text{Cu}_2\text{Fe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ .

**Cupric ferrocyanide, basic**,  $\text{CuFe}(\text{OH})_2(\text{CN})_4$   
Ppt. (Bong, Bull. Soc. 23. 231.)

**Cupric ferrocyanide**,  $\text{Cu}_2\text{Fe}(\text{CN})_6 + 7\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or acids. Insol. in  $\text{NH}_4$  salts + Aq. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol in  $(\text{NH}_4)_2\text{C}_2\text{O}_4 + \text{Aq}$  and in  $\text{KCN} + \text{Aq}$ .

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)  
+  $10\text{H}_2\text{O}$ . Sol. in excess of  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$ , especially if hot. (Wyrouboff.)

**Cupric ferrocyanide ammonia (cuprammonium ferrocyanide)**,  $\text{Cu}_2\text{Fe}(\text{CN})_6 \cdot 4\text{NH}_3 + \text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$  or alcohol Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Bunsen)  
 $\text{Cu}_2\text{Fe}(\text{CN})_6 \cdot 8\text{NH}_3 + \text{H}_2\text{O}$ .

**Cuprous magnesium ferrocyanide**,  
 $\text{Cu}_2\text{MgFe}(\text{CN})_6$ .

Very unstable. Decomp. in air.  
Insol. in  $\text{H}_2\text{O}$  (Messner, Z. anorg. 1895, 8. 385)

**Cupric magnesium ferrocyanide**,  
 $\text{CuMgFe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$   
Very unstable. (Messner, Z. anorg. 1895, 8. 387.)

**Cuprous potassium ferrocyanide**,  
 $\text{Cu}_2\text{K}_2\text{Fe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ .  
Decomp. by acids Insol. in alcohol. (Messner, Z. anorg. 1895, 8. 378)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , alcohol, or ether.  
Decomp. by acids. Sol. in  $\text{KCN} + \text{Aq}$ .  
 $\text{K}_2\text{Cu}_2\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .  
+  $5\text{H}_2\text{O}$ . (Wonfor.)  
+  $6\text{H}_2\text{O}$ . (Wyrouboff.)

**Cupric potassium ferrocyanide**,  $\text{K}_2\text{CuFe}(\text{CN})_6 + \text{H}_2\text{O}$

Insol. in cold, sl. decomp. by boiling  $\text{H}_2\text{O}$   
 $\text{K}_2\text{Cu}_2[\text{Fe}(\text{CN})_6]_2 + 12\text{H}_2\text{O}$ . Ppt.

**Cuprous sodium ferrocyanide**,  
 $\text{Cu}_2\text{Na}_2\text{Fe}(\text{CN})_6$ .

Decomp. by boiling  $\text{H}_2\text{O}$ ; insol. in alcohol,  
insol. in  $\text{H}_2\text{O}$ ; decomp. by acids. (Messner, Z. anorg. 1895, 8. 373)

**Cupric sodium ferrocyanide**,  
 $\text{CuNa}_2\text{Fe}(\text{CN})_6$ .

Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling  
 $\text{H}_2\text{O}$ . (Moissan, Z. anorg. 1895, 8. 376.)

**Cupric strontium ferrocyanide**,  
 $\text{CuSrFe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ . (Messner, Z. anorg 1895, 8. 389.)

**Didymium potassium ferrocyanide**,  
 $\text{D}_2\text{KFe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .

Ppt. (Cleve)  
+  $2\text{H}_2\text{O}$ . (Wyrouboff.)

**Erbium potassium ferrocyanide**,  $\text{ErKFe}(\text{CN})_6 + \text{H}_2\text{O}$ .  
(Höglund.)

**Gallium ferrocyanide**.

Sol in boiling  $\text{HCl} + \text{Aq}$ . (de Boissaudran, C. R. 99. 526.)

**Glucinum ferrocyanide**,  $\text{Gl}_2\text{Fe}(\text{CN})_6 \cdot 4\text{GlO}_2\text{H}_2 + 7\text{H}_2\text{O}$  (?).  
Sol in  $\text{H}_2\text{O}$ . (Atteberg.)

**Iron (ferric) ferrocyanide**,  $\text{Fe}_4(\text{CN})_{12} = \text{Fe}_4[\text{Fe}(\text{CN})_6]_3 + x\text{H}_2\text{O}$ .

(*Prussian blue*) Insol. in  $\text{H}_2\text{O}$ , alcohol, ether, or oils Decomp. slowly by boiling  $\text{H}_2\text{O}$ . Insol. in dil. mineral acids. Sol. in conc.  $\text{HCl} + \text{Aq}$ , and conc.  $\text{H}_2\text{SO}_4$  without decomp Sol. in  $\text{H}_2\text{C}_2\text{O}_4$  or  $\text{NH}_4$  tartrate + Aq. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp. by  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq}$ . Not pptd. in presence of tartrates or citrates

**Iron (ferrous) potassium ferrocyanide**,  
 $\text{FeK}_2\text{Fe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. on air.

**Iron (ferric) potassium ferrocyanide**,  
 $\text{Fe}_3\text{KFe}(\text{CN})_6$ .

Is probably ferrous potassium ferrocyanide, which see.

**Iron (ferric) ferrocyanide ammonia**,  
 $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3 \cdot 6\text{NH}_3 + 9\text{H}_2\text{O}$

Insol. in  $\text{NH}_4$  tartrate + Aq.

**Lanthanum potassium ferrocyanide**,  
 $\text{LaKFe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .

Ppt.

**Lead ferrocyanide**,  $\text{Pb}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , acids, or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Wyrouboff, A. ch. (5) 8. 480.)

Sl. sol. in conc.  $\text{H}_2\text{SO}_4$ , from which it is pptd by  $\text{H}_2\text{O}$ . (Berzelius.)

Sol. in hot  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4$  succinate + Aq; insol. in other  $\text{NH}_4$  salts + Aq (Wittstein.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Brett.)

Not pptd. in presence of Na citrate. (Spiller.)

**Lithium ferrocyanide**,  $\text{Li}_2\text{Fe}(\text{CN})_6 + 9\text{H}_2\text{O}$ .  
Deliquescent. Very sol in  $\text{H}_2\text{O}$ .

**Lithium potassium ferrocyanide**,  
 $\text{Li}_2\text{K}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  Sol. in 1.5 pts  $\text{H}_2\text{O}$  at ord. temp. (Wyrouboff, A. ch. (4) 21. 274)

**Magnesium ferrocyanide**,  $Mg_2Fe(CN)_6 + 6H_2O$ .

Sol. in 3 pts. cold  $H_2O$ . (Bette, A. 22. 148.)

**Magnesium potassium ferrocyanide**,  $MgK_2Fe(CN)_6$ .

Sol. in 1575 pts  $H_2O$  at  $15^\circ$ , and 238 pts. at  $100^\circ$ . Solution is decomp. by boiling. (Storer's Dict.)

1 l sat. solution at  $17^\circ$  contains 1.95 g.  $MgK_2Fe(CN)_6$  (Robinson, Chem. Soc 1909, 75. 1353.)

**Manganous ferrocyanide**,  $Mn_2Fe(CN)_6 + 7H_2O$ .

Insol. in  $H_2O$ . Sol. in  $HCl + Aq$ . Insol. in  $NH_4Cl$ , or  $NH_4NO_3 + Aq$

**Manganic ferrocyanide**,  $Mn_2Fe_3(CN)_{12}$ .

Insol. in  $H_2O$ . Easily decomp. in the air. Sol. in  $HCl$  (Straus, Z. anorg. 1895, 9. 8.)

**Manganous potassium ferrocyanide**,  $MnK_2Fe(CN)_6$ .

Ppt. (Berzelius)  
 $5Mn_2Fe(CN)_6 + 4K_4Fe(CN)_6 + 4H_2O(?)$ .  
Ppt. Sol. in dil  $HCl + Aq$ . (Wyrouboff.)

**Mercuric potassium ferrocyanide**,  $K_2HgFe(CN)_6$ .

Insol. in  $H_2O$ . Appreciably sol. in  $K_4Fe(CN)_6 + Aq$  (Fernekes, J Am Chem. Soc 1906, 28. 87)

**Molybdenum ferrocyanide**,  $Mo_4Fe(CN)_6 + 20H_2O(?)$

Very sol. in  $NH_4OH + Aq$ . (Wyrouboff)  
 $Mo_2Fe(CN)_6 + 8H_2O(?)$ . (W.)  
 $+ 14H_2O(?)$ . Very sol. in  $H_2O$ ; insol. in alcohol. (W.)

**Molybdenum potassium ferrocyanide**,

$K_4Mo_2[Fe(CN)_6]_2 + 40H_2O(?)$ .  
(Wyrouboff)  
 $K_2(MoO_4)_2[Fe(CN)_6]_2 + 2MoO_3 + 20H_2O(?)$ .  
(Atterberg.)  
 $K_4Mo_2[Fe(CN)_6]_2 + 2MoO_3 + 12H_2O(?)$ .  
(Atterberg.)

**Nickel ferrocyanide**,  $Ni_2Fe(CN)_6 + 11H_2O$ , or  $14H_2O$ .

Ppt. Insol. in  $H_2O$  or  $HCl + Aq$ . Sol. in  $NH_4OH + Aq$ , insol. in  $NH_4$  salts +  $Aq$ . Sol. in  $KCN + Aq$ .

**Nickel ferrocyanide ammonia**,  $Ni_2Fe(CN)_6 + 4NH_3 + H_2O$ .

Completely insol. in  $H_2O$  and not attacked thereby, sol. in  $NH_4OH + Aq$  to form—  
 $Ni_2Fe(CN)_6 + 10NH_3 + 4H_2O$ . Decomp. by hot  $H_2O$  (Reynoso, A. ch. (3) 30. 252.)  
 $Ni_2Fe(CN)_6 + 2NH_3 + 4$ , and  $9H_2O$ . Hygro-

scopic. Easily decomp. (Gintl, J. B 1868. 304.)

$Ni_2Fe(CN)_6 + 8NH_3 + 4H_2O$ . Sol. in  $NH_4OH + Aq$  (G)  
 $Ni_2Fe(CN)_6 + 12NH_3 + 9H_2O$  Sol. in  $NH_4OH + Aq$ , but less so than the above compounds. (G.)

**Nickel potassium ferrocyanide**,  $NiK_2Fe(CN)_6 + 3H_2O$ .

Ppt (Wyrouboff)

**Osmium ferrocyanide**,  $Os_2Fe(CN)_6$ .

Ppt. (Marius, A 117. 368.)

**Potassium ferrocyanide**,  $K_4Fe(CN)_6$ .

Permanent. Easily sol. in cold, and more easily in hot  $H_2O$ .

Sol. in 4 23 pts  $H_2O$  at  $15^\circ$ , or 100 pts.  $H_2O$  dissolve 23.6 pts. salt at  $15^\circ$ . (Schiff, A. 113. 350.)

100 pts.  $H_2O$  dissolve 27.8 pts. at  $12^\circ$ ; 65.8 pts. at  $37.7^\circ$ ; 87.6 pts. at  $65.5^\circ$ , and 90.6 pts. at  $96.3^\circ$  (Thomson.)

Sol. in 4 pts cold, and 2 pts. boiling  $H_2O$ . (Wittstein)

100 pts  $H_2O$  dissolve 29.2 pts salt at  $15^\circ$ , and solution has sp. gr. = 1.441. (Michel and Knaft, A. ch. (3) 41. 478.)

Solubility of  $K_4Fe(CN)_6$  in  $H_2O$  at  $t^\circ$ .

$-2^\circ$	$+7^\circ$	$14^\circ$	$30^\circ$	$56^\circ$
10.8	15.4	17.9	23.0	31.7%
60°	75°	89°	98°	157°
34.0	39.1	41.9	42.6	46.8%

(Etard, A. ch. 1894, (7) 2. 546.)

$K_4Fe(CN)_6 + Aq$  sat. at  $8^\circ$  has sp. gr. = 1.13. (Anthon.)

Sp. gr. of  $K_4Fe(CN)_6 + Aq$  at  $15^\circ$ .

°C	hydrous salt	Sp gr	°C	hydrous salt	Sp gr
1	1.0038	8	1.0479	15	1.0932
2	1.0116	9	1.0542	16	1.0999
3	1.0175	10	1.0605	17	1.1067
4	1.0234	11	1.0669	18	1.1136
5	1.0295	12	1.0734	19	1.1205
6	1.0356	13	1.0800	20	1.1275
7	1.0417	14	1.0866	..	...

(Schiff, A 113. 199.)

Sp gr of  $K_4Fe(CN)_6 + Aq$  at  $25^\circ$ .

Concentration of $K_4Fe(CN)_6 + Aq$	Sp gr
1—normal	1.0617
$1/2$ "	1.0300
$1/4$ "	1.0150
$1/8$ "	1.0074
$1/16$ "	1.0037

(Wagner, Z. phys. Ch. 1890, 5. 37.)

## Solubility in KOH + Aq at 25°.

KOH Normalty	g $K_4Fe(CN)_6 + 3H_2O$ per l.
0.00984	308.5
0.2496	283.5
0.4963	247.1
0.7036	217.4
0.9415	184.8
1.395	132.1
1.883	86.12

(Grube, Z. Electrochem., 1914, 20, 342.)

$K_4Fe(CN)_6 + NaCl + Aq$  sat. at 20° contains 26.6 g. NaCl and 17.8 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ ; sat. at 93° it contains 27.4 g. NaCl and 35.9 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$  (Conroy, J. Soc. Chem. Ind., 1898, 17, 105.)

$K_4Fe(CN)_6 + KCl + Aq$  sat. at 21° contains 27.2 g. KCl and 4.2 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ ; sat. at 99° it contains 39.6 g. KCl and 17.0 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ . (Conroy.)

$K_4Fe(CN)_6 + Na_2CO_3 + Aq$  sat. at 22° contains 29.9 g.  $Na_2CO_3$  and 26.7 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ ; sat. at 97° it contains 42.0 g.  $Na_2CO_3$  and 27.5 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ . (Conroy.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J., 1898, 20, 829.)

Insol. in alcohol even when dilute.

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37, 3601.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Sol. in acetone. (Naumann, B. 1904, 37, 4328.)

+3 $H_2O$ . 1 l. sat. solution in  $H_2O$  contains 319 g.  $K_4Fe(CN)_6 + 3H_2O$  (Grube, Electrochem. Z., 1911, 20, 342.)

Two modifications with different solubilities.

25.0 g. of  $\alpha$  modification are contained in 100 g. of solution at 20°.

24.6 g. of  $\beta$  modification are contained in 100 g. of solution at 20°. (Briggs, Chem. Soc. 1911, 99, 1024.)

32.0 g.  $K_4Fe(CN)_6$  (anhydrous) are dissolved in 100 g.  $H_2O$  at 25°. (Wagner, Z. phys. Ch., 1910, 71, 428.)

**Potassium samarium ferrocyanide,**  
 $KSmFe(CN)_6 + 5H_2O$ .

Precipitate. (Cleve.)

**Potassium sodium ferrocyanide,**  
 $KNa_3Fe(CN)_6 + 12H_2O$ .

Sol. in  $H_2O$ .

$K_2Na_2Fe(CN)_6 + 8H_2O$ . Easily sol. in  $H_2O$ .  
 $K_4NaFe(CN)_6 + 3H_2O$ . Permanent. Easily sol. in  $H_2O$ ; insol. in alcohol.

**Potassium sodium ferrocyanide nitrate,**  
 $K_2Na_2Fe(CN)_6 + 4KNO_3$ .

Sol. in  $H_2O$ . (Martius.)

**Potassium strontium ferrocyanide,**  
 $K_2SrFe(CN)_6 + 3H_2O$ .

Easily decomp. Sol. in  $H_2O$ ; sl. sol. in alcohol. (Wyrouboff, A. ch. (4) 21, 276.)

**Potassium stannic ferrocyanide,**  
 $KSn_3[Fe(CN)_6] + 68H_2O$  (?).

Ppt. (Wyrouboff.)

$K_4Sn_{18}[Fe(CN)_6]_{11} + 230H_2O$  (?). (Atterberg.)

**Potassium titanium ferrocyanide,**  
 $K_4Ti_3[Fe(CN)_6] + 11H_2O$  (?).

Ppt. Sol. in  $K_4Fe(CN)_6 + Aq$ . (Wyrouboff.)

$K_4Fe(CN)_6$ , 11 $Ti_3Fe(CN)_6 + 43H_2O$  (?). Ppt. (Wyrouboff.)

$K_2(TiO)_3[Fe(CN)_6] + 23H_2O$  (?) Ppt. (Atterberg.)

$K_2(TiO)_3[Fe(CN)_6] + 110H_2O$  (?). Ppt. (Atterberg.)

**Potassium tungsten ferrocyanide,**  
 $KW_3Fe(CN)_6 + 7H_2O$  (?).

Sol. in  $H_2O$ . (Wyrouboff.)

$K_2W_6Fe(CN)_6 + 20H_2O$  (?) Sol. in  $H_2O$ . (W.)

**Potassium uranium ferrocyanide,**  
 $K_2U_2[Fe(CN)_6] + 6H_2O$  (?).

Ppt. (Wyrouboff.)

$K_2(UO_2)_2[Fe(CN)_6] + 6H_2O$ . Ppt. (Atterberg.)

$K_2(UO_2)_2[Fe(CN)_6] + 12H_2O$ . Sol. in  $H_2O$ . (Atterberg.)

**Potassium vanadium ferrocyanide,**  
 $K_3V[Fe(CN)_6] + 39H_2O$  (?).

Ppt. Sl. sol. in  $H_2O$ . (Wyrouboff.)

$K_4(VO)_2[Fe(CN)_6] + 60H_2O$  (?). Ppt. (Atterberg.)

**Potassium ytterbium ferrocyanide,**  
 $KYbFe(CN)_6 + 3H_2O$ .

Ppt. Sol. in excess  $K_4Fe(CN)_6 + Aq$ . (Cleve, Z. anorg. 1902, 32, 140.)

**Potassium yttrium ferrocyanide,**  
 $KYFe(CN)_6 + 2H_2O$ .

Ppt. (Wyrouboff, A. ch. (5) 8, 444.)

**Potassium zinc ferrocyanide,**  
 $K_2Zn_4[Fe(CN)_6] + 12H_2O$ .

Absolutely insol. in  $H_2O$ . (Wyrouboff, A. ch. (5) 8, 485.)

**Potassium ferrocyanide carbonyl,**  
 $K_2Fe(CN)_6(CO) + 3\frac{1}{2}H_2O$ .

See Carbonyl ferrocyanide, potassium.

**Rubidium ferrocyanide,**  $Rb_4Fe(CN)_6 + 2H_2O$ .

Sol. in less than 1 pt.  $H_2O$  at ord. temp. with great absorption of heat. (Wyrouboff, A. ch. (4) 16, 307.)

**Silver ferrocyanide**,  $\text{Ag}_4\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or dil. acids. Insol. in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts + Aq. Sol. in  $\text{KCN}$  +  $\text{Al}_2$ .

Decomp. by warm  $\text{NH}_4\text{OH}$  + A-. (Weith, Z. Ch. (2) 5. 381.)

**Silver ferrocyanide ammonia**,

$\text{Ag}_4\text{Fe}(\text{CN})_6 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$

(Wyrouboff.)

+  $6\text{H}_2\text{O}$ . (Gintl.)

**Sodium ferrocyanide**,  $\text{Na}_4\text{Fe}(\text{CN})_6 + 12\text{H}_2\text{O}$ .

Efflorescent. Less sol. in  $\text{H}_2\text{O}$  than  $\text{K}_4\text{Fe}(\text{CN})_6$ . Sol. in 4.5 pts.  $\text{H}_2\text{O}$  at  $12^\circ$  (John.)

100 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 22 pts. (Ure's Diet.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$18^\circ$  20° 42° 53°  
16.7 17.875 30.2 37.1 pts.  $\text{Na}_4\text{Fe}(\text{CN})_6$

58° 60° 77° 80°

41.7 42.5 54.8 59.2 pts.  $\text{Na}_4\text{Fe}(\text{CN})_6$

90° 98° 98.5°

62.1 61.6 6.30 pts.  $\text{Na}_4\text{Fe}(\text{CN})_6$

(Conroy, J. Soc. Chem. Ind. 1898, 17. 104.)

+  $10\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$18^\circ$  20° 42°

29.45 31.85 58.5 pts.  $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$

53° 58° 60°

75.9 88.4 90.2 pts.  $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$

77° 80° 96°

129.5 146.0 157.0 pts.  $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$

98° 98.5°

156.5 161.0 pts.  $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$ .

(Conroy.)

**Strontium ferrocyanide**,  $\text{Sr}_2\text{Fe}(\text{CN})_6 + 15\text{H}_2\text{O}$ .

Efflorescent. Sol. in 2 pts. cold, and less than 1 pt. boiling  $\text{H}_2\text{O}$ . (Betta.)

Excessively sol. in  $\text{H}_2\text{O}$ . (Wyrouboff, A. ch. (4) 16. 280.)

+  $8\text{H}_2\text{O}$ . (Wyrouboff.)

**Thallous ferrocyanide**,  $\text{Tl}_4\text{Fe}(\text{CN})_6 + 2\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 0.37 pt. at  $18^\circ$ , and 3.93 pts. at  $101^\circ$ . (Lamy.)

Sol. in  $\text{KCN}$  + Aq. (Kühlmann.)

**Thorium ferrocyanide**,  $\text{ThFe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .

Ppt. (Cleve, Bull. Soc. (2) 24. 355.)

**Tin (stannous) ferrocyanide**,  $\text{Sn}_2\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or acids; sl. sol. in  $\text{NH}_4\text{OH}$  + Aq. (Wyrouboff.)

**Tin (stannic) ferrocyanide**,  $\text{Sn}_3\text{Fe}(\text{CN})_6 + 18\frac{1}{2}\text{H}_2\text{O}$  (?).

(Wyrouboff.)

**Titanium ferrocyanide**,  $\text{Ti}_2[\text{Fe}(\text{CN})_6]_2$  (?).

Ppt. (Wyrouboff.)

**Uranium ferrocyanide**,  $\text{UF}_6(\text{CN})_6 + 10\text{H}_2\text{O}$ .

Ppt. (Wyrouboff.)

**Vanadyl ferrocyanide**,  $(\text{VO})_2\text{Fe}(\text{CN})_6 + 11\text{H}_2\text{O}$

Ppt. (Atterberg.)

**Yttrium ferrocyanide**,  $\text{Y}_4[\text{Fe}(\text{CN})_6]_3$ .

Easily sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Popp, A. 131. 179.)

**Zinc ferrocyanide**,  $\text{Zn}_2\text{Fe}(\text{CN})_6 + 31\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or acids.

Insol. in  $\text{HCl}$  + Aq. (Lea, Sil. Am. J. (2) 31. 191.)

Sol. in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts + Aq. (Wittstein.)

Insol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3$  + Aq. (Brett.)

Sl. sol. in boiling  $\text{K}_4\text{Fe}(\text{CN})_6$ , or  $\text{K}_2\text{Fe}(\text{CN})_6$  + Aq. (Gole.)

$\text{Na}_4\text{Fe}(\text{CN})_6 + \text{NaCl}$  + Aq. sat. at  $21^\circ$  contains 29.0 g.  $\text{NaCl}$  and 5.8 g.  $\text{Na}_4\text{Fe}(\text{CN})_6$  per 100 g.  $\text{H}_2\text{O}$ ; sat. at  $90^\circ$  it contains 24.7 g.  $\text{NaCl}$  and 21.3 g.  $\text{Na}_4\text{Fe}(\text{CN})_6$  per 100 g.  $\text{H}_2\text{O}$ .

(Conroy, J. Soc. Chem. Ind. 1898, 17. 105.)

$\text{Na}_4\text{Fe}(\text{CN})_6 + \text{Na}_2\text{CO}_3$  + Aq. sat. at  $22^\circ$  contains 22.6 g.  $\text{Na}_2\text{CO}_3$  and 6.5 g.  $\text{Na}_4\text{Fe}(\text{CN})_6$  per 100 g.  $\text{H}_2\text{O}$ , sat. at  $95^\circ$  it contains 29.8 g.  $\text{Na}_2\text{CO}_3$  and 36.8 g.  $\text{Na}_4\text{Fe}(\text{CN})_6$  per 100 g.  $\text{H}_2\text{O}$ . (Conroy.)

Very sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Insol. in alcohol

+  $4\text{H}_2\text{O}$ . Absolutely insol. in  $\text{H}_2\text{O}$ . (Wyrouboff, A. ch. (5) 8. 485.)

+  $8\text{H}_2\text{O}$ . (Weith, A. 147. 329.)

+  $10\text{H}_2\text{O}$ . (Pehnl, A. 233. 165.)

**Ferroletranitrososulphydic acid**,

$\text{H}_2\text{S}_2(\text{NO})_2\text{Fe}_2$ .

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol; more easily in ether; very sol. in  $\text{CS}_2$  or  $\text{CHCl}_3$ .

Not obtained in a pure state (Pawel, B. 15. 2600.)

**Ethyl ferroletranitrososulphide**,

$(\text{C}_2\text{H}_5)_2\text{S}_2(\text{NO})_2\text{Fe}_2$ .

Insol. in  $\text{H}_2\text{O}$ , difficultly sol. in alcohol, more easily in ether, and very easily in  $\text{CS}_2$ ,  $\text{CHCl}_3$ ,  $\text{C}_2\text{H}_5\text{I}$ , or  $\text{C}_4\text{H}_6$ . (Pawel, B. 15. 2609.)

**Ferrous** —,  $\text{FeS}_2(\text{NO})_2\text{Fe}_2$ .

More difficultly sol. in  $\text{H}_2\text{O}$  and alcohol than the hepta salt.

Sol. in ether.

**Potassium** —,  $\text{K}_2\text{S}_2(\text{NO})_2\text{Fe}_2 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Easily sol. in alcohol; insol. in ether. (Pawel, B. 15. 2600.)

True composition of "nitrosulphide of

iron and potassium" of Roussin (A. ch. (3) 52. 297.) (Pawel, B. 13. 1949.)

Sodium ferrotetranitrososulphide,  
 $\text{Na}_2\text{S}_2(\text{NO})_4\text{Fe}_3 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , easily sol. in alcohol; insol in ether. (Pawel.)

True composition of "nitrosulphide of iron and sodium" of Roussin. (Pawel)

Thallium —,  $\text{Tl}_2\text{S}_2(\text{NO})_4\text{Fe}_2$ .

Insol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Pawel)

Ferroheptanitrososulphydic acid,  
 $\text{HS}_3(\text{NO})_7\text{Fe}_4$ .

Insol in  $\text{H}_2\text{O}$ , alcohol, and ether Easily sol. in  $\text{CS}_2$  or  $\text{CHCl}_3$  (Pawel, B. 15. 2604.)

May be called Ferrinitrososulphydic acid.

Ammonium ferrotetranitrososulphide,  
 $\text{NH}_4\text{S}_2(\text{NO})_4\text{Fe}_4 + \text{H}_2\text{O}$ .

Less easily sol in  $\text{H}_2\text{O}$  than the K compound. (Pawel, B. 15. 2600.)

"Binitrosulphide of iron" of Roussin. Sol. in about 2 pts boiling  $\text{H}_2\text{O}$ ; very sl sol in cold  $\text{H}_2\text{O}$ . Very sol in alcohols, methyl, ethyl, or amyl, and in  $\text{HC}_2\text{H}_3\text{O}_2$ . Miscible with ether. Insol. in  $\text{CS}_2$  or  $\text{CHCl}_3$ .

Decomp by conc.  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$ .

Not attacked by  $\text{H}_2\text{C}_2\text{O}_4$ , or  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Ag}$ .

Insol. in  $\text{NH}_4\text{OH}$ , and  $\text{KOH} + \text{Aq}$ . (Roussin, A. ch. (3) 52. 286.)

Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Hofmann, Z. anorg. 1895, 9. 299)

Barium —.

Easily sol. in  $\text{H}_2\text{O}$ . (Pawel.)

Cæsium —,  $\text{Fe}_4(\text{NO})_7\text{S}_2\text{Cs} + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Difficultly sol. in alcohol and ether. (Pawel)

Sparingly sol in  $\text{H}_2\text{O}$ . (Hofmann, Z. anorg. 1895, 9. 298.)

Calcium —.

Easily sol. in  $\text{H}_2\text{O}$ . (Pawel.)

Ferrous —,  $\text{Fe}[\text{S}_3(\text{NO})_7\text{Fe}_4] + 8\text{H}_2\text{O}$ .

More easily sol. in  $\text{H}_2\text{O}$  than Na salt. (Pawel.)

Lead —.

Difficultly sol. in  $\text{H}_2\text{O}$ . (Pawel.)

Magnesium —.

Easily sol. in  $\text{H}_2\text{O}$ . (Pawel.)

Potassium —,  $\text{KS}_3(\text{NO})_7\text{Fe}_4$ .

Sol. in  $\text{H}_2\text{O}$ , alcohol, and very sol. in ether with slight decomp. (Pawel, B. 15. 2600.)

Rubidium ferrotetranitrososulphide,  
 $\text{RbS}_3(\text{NO})_7\text{Fe}_4$ .

Less soluble in  $\text{H}_2\text{O}$  than the  $\text{NH}_4$  salt. (Pawel.)

+  $\text{H}_2\text{O}$  Ppt. (Hofmann, Z. anorg. 1895, 9. 298.)

Sodium —,  $\text{NaS}_3(\text{NO})_7\text{Fe}_4 + 2\text{H}_2\text{O}$ .

More sol in  $\text{H}_2\text{O}$  than the potassium salt. (Pawel)

Thallium —,  $\text{TlS}_3(\text{NO})_7\text{Fe}_4 + \text{H}_2\text{O}$ .

Very difficultly sol in  $\text{H}_2\text{O}$ . More easily sol in alcohol. (Pawel) (Hofmann, Z. anorg. 1895, 9. 297.)

Ferrodinitrosothiosulphonic acid.

Ammonium ferrodinitrosothiosulphonate,  
 $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_3\text{NH}_4 + \text{H}_2\text{O}$ .

Can be cryst. from warm  $\text{H}_2\text{O}$  without decomp. (Hofmann, Z. anorg. 1895, 8. 321.)

Cæsium —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_3\text{Cs}$ .

Sparingly sol in  $\text{H}_2\text{O}$ . (Hofmann.)

Potassium —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_3\text{K} + \text{H}_2\text{O}$ .

Sl sol in  $\text{H}_2\text{O}$  without decomp at  $80^\circ$ .

Sol in 50% alcohol.

Sol. in  $\text{H}_2\text{SO}_4$  without decomp (Hofmann)

Rubidium —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_3\text{Rb} + \text{H}_2\text{O}$ .

Less sol. in  $\text{H}_2\text{O}$  than the corresponding Na salt. (Hofmann.)

Sodium —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_3\text{Na} + 2\text{H}_2\text{O}$ .

Closely resembles K salt, but is more sol. in  $\text{H}_2\text{O}$  and alcohol. (Hofmann.)

Ferrotungstic acid.

Sol. in  $\text{H}_2\text{O}$ . (Laurent, C. R. 31. 693)

Ammonium manganous ferrotungstate,  
 $12(\text{NH}_4)_2\text{O}$ ,  $6\text{MnO}$ ,  $2\text{Fe}_2\text{O}_3$ ,  $3\text{H}_2\text{O}$ ,  
 $45\text{WO}_3 + 81\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Laurent.)

Barium ferrotungstate,  $21\text{BaO}$ ,  $2\text{Fe}_2\text{O}_3$ ,  
 $45\text{WO}_3 + 27\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Laurent.)

Potassium ferrotungstate,  $9\text{K}_2\text{O}$ ,  $2\text{Fe}_2\text{O}_3$ ,  
 $12\text{H}_2\text{O}$ ,  $45\text{WO}_3 + 54\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Laurent.)

$18\text{K}_2\text{O}$ ,  $2\text{Fe}_2\text{O}_3$ ,  $3\text{H}_2\text{O}$ ,  $45\text{WO}_3 + 54\text{H}_2\text{O}$ . (Laurent.)

Ferrous acid.

Barium ferrite,  $\text{BaO}$ ,  $\text{Fe}_2\text{O}_3$ .

Ppt. (List, B. 11. 1512.)

**Calcium ferrite,  $4\text{CaO}, \text{Fe}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$ , or sugar +  $\text{H}_2\text{O}$ . Decomp. by the weakest acids, but not by boiling  $\text{KOH} + \text{Aq.}$  (Pelouze, A. ch. (3) 33. 5.)

$\text{CaO}, \text{Fe}_2\text{O}_3$  (List)

$3\text{CaO}, \text{Fe}_2\text{O}_3$ . Much less readily attacked by  $\text{H}_2\text{O}$  and acids than the silicates. (Hilpert, B. 1909, 42. 4581.)

$3\text{CaO}, 2\text{Fe}_2\text{O}_3$ . As above. (Hilpert, B. 1909, 42. 4581.)

**Calcium ferrite chloride,  $\text{CaO}, \text{Fe}_2\text{O}_3, \text{CaCl}_2$ .**

Not decomp. by  $\text{H}_2\text{O}$ . (Chatelier, C. R. 99. 276.)

**Cupric ferrite,  $\text{CuO}, \text{Fe}_2\text{O}_3$ .**

Ppt. (List.)

+  $5\text{H}_2\text{O}$ . (List.)

**Ferrous argentous ferrite,  $2\text{FeO}, \text{Ag}_2\text{O}, \text{Fe}_2\text{O}_3$  (?)**

Easily decomp. by  $\text{HCl} + \text{Aq.}$  Not completely sol. in dil.  $\text{HNO}_3 + \text{Aq.}$  Easily sol. in conc.  $\text{HNO}_3$ . Decomp. by acetic acid. (Rose, Pogg. 10. 323.)

**Magnesium ferrite,  $\text{MgO}, \text{Fe}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Not attacked by boiling conc.  $\text{HNO}_3$ . (Dewille, C. R. 52. 1264.)

Min. *Magnesia ferrite*. Difficultly sol. in  $\text{HCl} + \text{Aq.}$  (Rammelsberg, Pogg. 107. 451.)

+  $4\text{H}_2\text{O}$  Ppt. (List, B. 11. 1512.)

$6\text{MgO}, \text{Fe}_2\text{O}_3 + 9\text{H}_2\text{O}$ . Ppt.

+  $15\text{H}_2\text{O}$  Min. *Pyrourite*.

**Manganous ferrite,  $\text{MnO}, \text{Fe}_2\text{O}_3$ .**

Ppt. (List.)

**Nickel ferrite,  $\text{NiO}, \text{Fe}_2\text{O}_3$ .**

Ppt. (List.)

**Potassium ferrite,  $3\text{K}_2\text{O}, 4\text{Fe}_2\text{O}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq.}$ ,  $\text{NaOH} + \text{Aq.}$ , etc., but only slowly by  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Salm-Horstmar, J. pr. 55. 349.)

$\text{K}_2\text{Fe}_2\text{O}_4$ . Decomp. by  $\text{H}_2\text{O}$ . (Rousseau and Bernheim, C. R. 107. 240.)

**Silver (argentous) ferrite,  $\text{Ag}_2\text{O}, \text{Fe}_2\text{O}_3$  (?)**

Decomp. by dil.  $\text{HNO}_3 + \text{Aq.}$  (Rose, Pogg. 10. 323.)

**Sodium ferrite,  $\text{Na}_2\text{O}, \text{Fe}_2\text{O}_3$ .**

$\text{Na}_2\text{O}$  is dissolved out by  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HCl} + \text{Aq.}$  Not easily decomp. by  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Salm-Horstmar.)

**Zinc ferrite,  $\text{ZnO}, \text{Fe}_2\text{O}_3$ .**

Sol. in boiling conc.  $\text{HCl} + \text{Aq.}$  (Ebelmen, A. ch. (3) 33. 47.)

Min. *Franklinite*.

**Flavocobaltic compounds.**

See also *Xanthocobaltic compounds*.

**Flavocobaltic chloraurate,  $(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4\text{AuCl}$ .**

More easily sol. than the chloroplatinate. Not wholly insol. in absolute alcohol. (Jørgensen, Z. anorg. 5. 159.)

— chloroplatinate,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{PtCl}_6$   
As the chloroplatinite. (Jørgensen.)

— chloroplatinite,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{PtCl}_4$ .  
Somewhat sol. in  $\text{H}_2\text{O}$ , and not insol. in 50% alcohol (Jørgensen.)

— chromate,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{Cr}_2\text{O}_7$   
Ppt. (Jørgensen.)

— nitrate,  $\text{Co}(\text{NO}_2)_2(\text{NH}_3)_4\text{NO}_3$ .

Sol. in about 33 pts. cold  $\text{H}_2\text{O}$ , insol. in  $\text{HNO}_3$ . (Jørgensen.)

$\text{Co}(\text{NO}_2)_2(\text{NH}_3)_4\text{NO}_3$ .  $\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Jørgensen.)

— cobaltic nitrite,  $3(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4$ ,  
 $\text{Co}_2(\text{NO}_2)_6 + 2\text{H}_2\text{O}$

Sl. sol. in  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. 5. 179.)

— diamine cobaltic nitrite,

$(\text{NO}_2)_2\text{Co}(\text{NH}_2)_4$

$(\text{NO}_2)_2(\text{NH}_2)_2\text{Co}(\text{NO}_2)_2$

Very sl. sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

— sulphate,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{SO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ , more easily in  $\text{HCl}_2\text{H}_2\text{O}_2 + \text{Aq.}$  (Jørgensen.)

**Fluoborhydric acid,  $\text{HBF}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  very rapidly. (Landolph, C. R. 86. 603.)

**Aluminum fluoboride,  $2\text{AlF}_3, 3\text{BF}_3$ .**

Sol. in  $\text{H}_2\text{O}$  only when acidulated, sol. in acids. (Berzelius.)

**Ammonium fluoboride,  $\text{NH}_4\text{BF}_4$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Sol. in 4 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and 1 02-1.05 pts. boiling  $\text{H}_2\text{O}$ . (Stolba, Chem. techn. Cont. Anz. 7. 459.) Sl. sol. in alcohol.

**Barium fluoboride,  $\text{Ba}(\text{BF}_4)_2 + 2\text{H}_2\text{O}$ .**

Deliquescent; easily sol. in  $\text{H}_2\text{O}$ , decomp. by alcohol. (Berzelius.)

**Cesium fluoboride,  $\text{CsBF}_4$ .**

100 pts.  $\text{H}_2\text{O}$  dissolve 0.92 pt.  $\text{CsBF}_4$  at  $20^\circ$ , and 0.04 pt. at  $100^\circ$ . (Godeffroy, B. 9. 1367.)  
0.02 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Erdmann, Arch. Pharm. 1894, 232. 21.)

**Calcium fluoboride,  $\text{Ca}(\text{BF}_4)_2$ .**

Decomp. by  $\text{H}_2\text{O}$ , with formation of a sol. acid salt and an insol. basic salt. (Berzelius.)

**Cupric fluoboride,  $\text{Cu}(\text{BF}_4)_2$ .**

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Lead fluoboride,  $\text{Pb}(\text{BF}_4)_2$ .**

Sol. in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$  or alcohol into an acid soluble, and a basic insoluble salt. (Berzelius.)

**Lithium fluoboride,  $\text{LiBF}_4$ .**

Hygroscopic. Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Magnesium fluoboride.**

Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Potassium fluoboride,  $\text{KBF}_4$ .**

Sol. in 223 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Stolba.)

Sol. in 70.4 pts. cold  $\text{H}_2\text{O}$ . (Berzelius.)

Sol. in 15.94 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Stolba.)

1.43 pts. are sol in 100 pts  $\text{H}_2\text{O}$  at  $20^\circ$ . (Erdmann, Arch. Pharm. 1894, 232, 21.)

Not more sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ ; sol. in hot  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{M}_2\text{CO}_3 + \text{Aq}$ . (Berzelius.) More sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose, Pogg. 80, 276.) Insol. in 20%  $\text{KC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Stromeyer.) Insol. in cold, sl. sol. in boiling alcohol.

**Rubidium fluoboride,  $\text{RbBF}_4$ .**

100 pts.  $\text{H}_2\text{O}$  dissolve 0.55 pt. at  $20^\circ$ , and 1.0 pt. at  $100^\circ$ . (Godeffroy, B. 9, 1337.)

0.55 pts. are sol in 100 pts  $\text{H}_2\text{O}$  at  $20^\circ$ . (Erdmann, Arch. Pharm. 1894, 232, 21.)

**Sodium fluoboride,  $\text{NaBF}_4$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in alcohol. (Berzelius.)

**Yttrium fluoboride.**

Sol. in  $\text{H}_2\text{O}$  with excess of acid. (Berzelius.)

**Zinc fluoboride,  $\text{Zn}(\text{BF}_4)_2$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Fluoboric acid,  $\text{HBF}_4$ .**

See Fluoborhydric acid.

$\text{H}_4\text{B}_4\text{O}_7$ ,  $3\text{HF}$  and  $\text{H}_4\text{B}_2\text{O}_5$ ,  $2\text{HF}$  (?). Fume on air, and are decomp. with  $\text{H}_2\text{O}$ . (Landolph, B. 12, 1583.)

$\text{HBO}_2$ ,  $3\text{HF}$ . Decomp. by  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 59, 644.)

Is either a mixture, or a solution of  $\text{HBO}_2$  in  $\text{HF}$ , and is decomp. by distillation, and the salts are decomp. by recrystallisation. (Basson, C. R. 73, 1696.)

**Potassium fluoborate,  $\text{K}_2\text{B}_2\text{O}_5\text{F}_2$  (?).**

Sl. deliquescent. Scarcely sol. in boiling alcohol. (Schiff, A. Suppl. 6, 175.)

See Boron trioxide potassium fluoride,  $\text{B}_2\text{O}_3$ ,  $2\text{KF}$ .

**Fluochromic acid.****Ammonium fluochromate,  $\text{NH}_4\text{CrO}_5\text{F}$** 

Sol. in  $\text{H}_2\text{O}$ . (Varenne, C. R. 91, 989r.)

**Potassium fluochromate,  $\text{KCrO}_5\text{F}$ .**

Efflorescent. Sol. in  $\text{H}_2\text{O}$ , with gradual decomp. (Streng, A. 129, 225.)

**Fluocolumbic acid.**

See also Fluoxycolumbic acid.

**Ammonium fluocolumbate fluoxycolumbate,  $(\text{NH}_4)_2\text{C}_6\text{F}_{11}$ ,  $2\text{C}_6\text{H}_5\text{F}_{11}$ ,  $\text{NH}_4\text{F}$ .****Cadmium fluocolumbate,  $\text{Cd}_2\text{H}_4\text{C}_6\text{F}_{11} + 2\text{SH}_2\text{O}$ .**

Insol. in, and decomp. by  $\text{H}_2\text{O}$ . (Streng.)

**Cobalt fluocolumbate,  $\text{Co}_2\text{H}_4\text{C}_6\text{F}_{11} + 2\text{SH}_2\text{O}$ .**

Insol. in, and decomp. by  $\text{H}_2\text{O}$ . (Streng.)

**Copper fluocolumbate,  $\text{Cu}_2\text{H}_4\text{C}_6\text{F}_{11} + 9\text{H}_2\text{O}$ .**

Insol. in, and decomp. by  $\text{H}_2\text{O}$ .

**Ferrous fluocolumbate,  $\text{Fe}_2\text{H}_4\text{C}_6\text{F}_{11} + 19\text{H}_2\text{O}$ .**

As above

**Manganous fluocolumbate,  $\text{Mn}_2\text{H}_4\text{C}_6\text{F}_{11} + 2\text{SH}_2\text{O}$ .****Mercuric fluocolumbate,  $\text{Hg}_2\text{C}_6\text{F}_{11} + 8\text{H}_2\text{O}$ .**

As above.

**Nickel fluocolumbate,  $\text{Ni}_2\text{H}_4\text{C}_6\text{F}_{11} + 19\text{H}_2\text{O}$ .**

As above.

**Potassium fluocolumbate,  $\text{K}_2\text{C}_6\text{F}_{11}$ .**

Decomp. by solution in  $\text{H}_2\text{O}$ . (Marignac A. ch. (4) 8, 34.)

**Rubidium fluocolumbate,  $\text{Rb}_2\text{C}_6\text{F}_{11}$ .**

Sol. in  $\text{H}_2\text{O}$  and  $\text{HF} + \text{Aq}$ . Insol. in alcohol (Pennington, J. Am. Chem. Soc. 1896, 18, 58.)

**Zinc fluocolumbate,  $\text{Zn}_2\text{H}_4\text{C}_6\text{F}_{11} + 2\text{SH}_2\text{O}$ .**

Insol. in cold  $\text{H}_2\text{O}$ ; decomp. by hot  $\text{H}_2\text{O}$ . (Santesson, Bull. Soc. (2) 24, 52.)

**Fluodithionic acid.****Cæsium monofluodithionate,**

$\text{S}_2\text{O}_4(\text{OH})\text{FCs}_2 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in  $\text{HF}$ ; very unstable. (Weinland, Z. anorg. 1899, 21, 66.)

**Potassium difluodithionate,  $\text{S}_2\text{O}_4\text{F}_2\text{K}_2 + 3\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in  $\text{HF}$ ; very unstable. (Weinland.)

Rubidium difluodithionate,  $\text{S}_2\text{O}_6\text{F}_2\text{Rb}_2 + 3\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$  with decomp.  
Sol. in  $\text{HF}$ ; very unstable. (Weinland.)

Fluogermanic acid,  $\text{H}_2\text{GeF}_4$ .  
Known only in solution. (Winkler, J. pr. (2) 36. 177.)

Potassium fluogermanate,  $\text{K}_2\text{GeF}_6$ .  
Sol. in 173.98 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Winkler.)  
Sol. in 184.61 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Krüss and Nilson, B. 20. 1696.)  
Sol. in 34.07 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Winkler.)  
Sol. in 38.76 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Krüss and Nilson.)  
Insol. in alcohol.

Difluiodic acid.

Ammonium difluiodate,  $\text{NH}_4\text{IO}_3\text{F}_2$ .  
Like K salt  
Sol. in 40%  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 20. 30.)  
Sol. in  $\text{H}_2\text{O}$ . Easily decomp. (Weinland, B. 1897, 30. 868.)

Cæsium difluiodate,  $\text{CsIO}_3\text{F}_2$ .  
(Weinland, Z. anorg. 1899, 20. 36.)

Cæsium hydrogen difluiodate,  $\text{CsIO}_3\text{F}_2, \text{HIO}_3\text{F}_2 + 2\text{H}_2\text{O}$ .  
Efflorescent Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland, Z. anorg. 1899, 22. 257.)

Potassium difluiodate,  $\text{KIO}_3\text{F}_2$ .  
Sol. in  $\text{H}_2\text{O}$ . Decomp. in moist air. (Weinland, B. 1897, 30. 867.)  
Decomp. in air. Sol. in  $\text{H}_2\text{O}$  with decomp.  
Sol. without decomp. in 40%  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 20. 31.)

Rubidium difluiodate,  $\text{RbIO}_3\text{F}_2$ .  
Resembles K salt. Sol. in  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 20. 35.)

Rubidium hydrogen difluiodate,  $\text{RbIO}_3\text{F}_2, \text{HIO}_3\text{F}_2 + 2\text{H}_2\text{O}$ .  
Sol. in 40-60%  $\text{HF} + \text{Aq}$  (Weinland, Z. anorg. 1899, 22. 260.)

Sodium difluiodate,  $\text{NaIO}_3\text{F}_2$ .  
Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1897, 30. 868.)  
Sol. in  $\text{HF}$ . (Weinland, Z. anorg. 1899, 20. 37.)

Fluomanganic acid,  $\text{H}_2\text{MnF}_6$ .  
Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol and ether in absence of  $\text{H}_2\text{O}$ . (Nickles, C. R. 65. 107.)

Ammonium fluomanganate,  $(\text{NH}_4)_2\text{MnF}_6$ .  
More sol. than the K salt. (Nickles, C. R. 65. 107.)  
True composition is  $(\text{NH}_4)_2\text{Mn}_2\text{F}_{10} = 4\text{NH}_4\text{F}, \text{Mn}_2\text{F}_6$ . (Christensen, J. pr. (2) 34. 41.)

Cobalt fluomanganate,  $2\text{CoF}_2, \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Christensen.)

Nickel fluomanganate,  $2\text{NiF}_2, \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Christensen.)

Potassium fluomanganate,  $\text{K}_2\text{MnF}_6$ .  
Difficultly sol. in  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$ . (Nickles, C. R. 65. 107.)  
Composition is  $\text{K}_2\text{Mn}_2\text{F}_{10} = 4\text{KF}, \text{Mn}_2\text{F}_6$ . Also with  $2\text{H}_2\text{O}$ . (Christensen, J. pr. (2) 34. 41.)  
Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}, \text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  with decomp. Can be recryst. from 40%  $\text{HF} + \text{Aq}$ . Insol. in acetic acid. (Weinland and Lauenstein, Z. anorg. 1899, 20. 41.)

Rubidium fluomanganate,  $\text{Rb}_2\text{MnF}_6 + 2\text{H}_2\text{O}$ .  
As the K salt. (Weinland and Lauenstein, Z. anorg. 1899, 20. 44.)

Silver fluomanganate,  $\text{Ag}_2\text{Mn}_2\text{F}_{10} + 14\text{H}_2\text{O}$ .  
(Christensen, J. pr. (2) 34. 41.)

Sodium fluomanganate,  $4\text{NaF}, \text{Mn}_2\text{F}_6$ .  
Decomp. by much  $\text{H}_2\text{O}$ . (Christensen.)

Zinc fluomanganate,  $2\text{ZnF}_2, \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Christensen.)

Fluomolybdic acid.  
See Fluoxyhypomolybdic, and Fluoxymolybdic acids.

Fluopalladous acid.

Potassium fluopalladite,  
Sl. sol. in  $\text{H}_2\text{O}$ .

Sodium fluopalladite.  
Sl. sol. in  $\text{H}_2\text{O}$  (Berzelius.)

Fluoperboric acid.

Ammonium fluoperborate,  
 $\text{NH}_4\text{O}(\text{O}(\text{F})\text{O}(\text{O}(\text{F})\text{O})\text{NH}_4$ .  
Ppt. Insol. in ether. (Petrenko, C. C. 1902, I. 1191.)

Potassium fluoperborate,  $\text{K}_4\text{B}_4\text{F}_{10}\text{O}_{11} + \text{H}_2\text{O}$ .  
Dry salt is rather stable.  
Easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. rapidly when warmed; at ordinary

temp. the decomp. proceeds slowly. Insol. in alcohol. (Mehkoff, B. 1899, 32, 3350.)  
 $\text{KOOb(F)OOb(F)OK} + 1\frac{1}{2}\text{H}_2\text{O}$  Ppt.  
 Insol. in ether. (Petrenko, C. C. 1902, I 1191; J. Russ. phys. chem. Soc 34, 37)

### Fluoperuranic acid.

Potassium fluoperuranate,  $\text{K}_4\text{U}_4\text{F}_8\text{O}_{18} + 4\text{H}_2\text{O} = 3\text{UO}_4\text{KF} + \text{UO}_4\text{K}_2 + \text{KF} + 4\text{H}_2\text{O}$ .  
 Ppt. (Lordkipanidse, C. C. 1900, II. 525)

Sodium fluoperuranate,  $\text{UO}_4\text{NaF} + 5\text{H}_2\text{O}$ .  
 Ppt. (Lordkipanidse, C. C. 1900, II. 525)

### Fluophosphamide, $\text{PF}_3(\text{NH}_2)_2$

Sol. in  $\text{H}_2\text{O}$  (Poulenc, A. ch. (6) 24. 566)

### Fluophosphoric acid.

Monocæsium monofluophosphate,  
 $\text{P}(\text{OH})_2(\text{OCs})\text{F}$ .

Like the K salt. (Weinland, Z anorg. 1899, 21. 48)

Monopotassium monofluophosphate,  
 $\text{P}(\text{OH})_2(\text{OK})\text{F}$ .

Sol. in 40% HF+Aq, decomp. in the air. (Weinland, Z anorg 1899, 21. 44)

Potassium monofluophosphate,  
 $\text{KHF} \cdot \text{PO}_3 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ ; unstable. (Weinland, B. 1898, 31. 124-125.)

Monorubidium monofluophosphate,  
 $\text{P}(\text{OH})_2(\text{ORb})\text{F}$ .

Sol. in 40% HF+Aq. (Weinland, Z. anorg. 1899, 21. 47)

Rubidium monofluophosphate,  
 $\text{RbHFPO}_3 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$ . (Weinland, B. 1898, 31. 124.)

### Fluoplatinic acid.

Ammonium fluoplatinate.

Decomp. by  $\text{H}_2\text{O}$  to a sol. acid, and an insol. basic salt. Insol. in alcohol. (Berzelius.)

Potassium fluoplatinate.

Deliquescent. Insol. in alcohol. Decomp. by  $\text{H}_2\text{O}$ . (Berzelius.)

Sodium fluoplatinate.

Decomp. by  $\text{H}_2\text{O}$ . (Berzelius.)

### Fluor- and Fluoro-.

See Fluor-.

### Fluorhydric (Hydrofluoric) acid, HF or $\text{H}_2\text{F}_2$ .

Attracts  $\text{H}_2\text{O}$  from air with great avidity. Very sol. in  $\text{H}_2\text{O}$  with evolution of much heat. Sat. solution has sp. gr. 1.25. (H. Davy.)

On boiling the aqueous solution an acid of constant composition is obtained, which boils at  $120^\circ$ , has sp. gr. 1.15, and contains 35.37% HF (Bineau, A. ch. (3) 7. 257.) The residual acid after boiling contains 36 to 38% HF, and by standing over  $\text{CaO}$  gives off HF until an acid containing 32.5 to 32.7% HF is formed. Weaker acids increase their strength to 32.2 to 32.4% HF, while an acid containing 32.5% HF remains unchanged (Roscoe, A. 116. 218)

Does not attack gutta-percha. Sol. in  $\text{H}_2\text{SO}_4$ .

Sp. gr. of HF+Aq at  $15^\circ$ .

Sp. gr.	% HF	Sp. gr.	% HF	Sp. gr.	% HF
1.01	2.90	1.10	29.00	1.19	55.10
1.02	5.80	1.11	31.90	1.20	58.00
1.03	8.70	1.12	34.80	1.21	60.90
1.04	11.60	1.13	37.70	1.22	63.80
1.05	14.50	1.14	40.60	1.23	66.70
1.06	17.40	1.15	43.50	1.24	69.60
1.07	20.30	1.16	46.40	1.25	72.50
1.08	23.20	1.17	49.30	...	..
1.09	26.10	1.18	52.20	...	..

(Hart, J. Anal. Ch. 3. 372)

Sp. gr. of HF+Aq at ord. temp.

Deg. Baumé	Sp. gr.	% HF
1	1.0089	2.32
2	1.0139	4.04
3	1.0211	5.76
4	1.0283	7.48
5	1.0356	9.20
6	1.0431	10.92
7	1.0503	12.48
8	1.0583	14.04
9	1.0661	15.59
10	1.074	17.15
11	1.082	18.86
12	1.0901	21.64
13	1.0983	24.42
14	1.1067	27.20
15	1.1152	29.98
16	1.1239	32.78
17	1.1326	35.15
18	1.1415	37.53
19	1.1506	39.91
20	1.1598	42.29
21	1.1691	44.67
22	1.1786	47.04
23	1.1883	49.42
24	1.1981	51.57
25	1.2080	53.72
26	1.2182	55.87
27	1.2285	58.02

Sp. gr. of HF+Aq at ord temp.—*Continued.*

Deg Baumé	Sp gr	% HF
28	1.2390	60.17
29	1.2497	62.32
30	1.2605	64.47
31	1.2716	66.61
32	1.2828	68.76
33	1.2943	70.91
34	1.3059	73.06
35	1.3177	75.21
36	1.3298	77.36
37	1.3421	79.51
38	1.3546	81.66
39	1.3674	83.81
40	1.3804	85.96
41	1.3937	88.10
42	1.4072	90.24
43	1.4211	92.39
44	1.4350	94.54
45	1.4493	96.69

(Eckelt, Ch Z 1898, 22, 225.)

Sp. gr. of HF+Aq at 0°

% HF	Sp gr	% HF	Sp gr
0.484	1.005	71.73	1.262
1.504	1.009	72.21	1.260
2.48	1.012	78.05	1.260
4.80	1.017	84.27	1.235
7.75	1.035	87.72	1.212
15.85	1.065	88.11	1.210
24.47	1.097	88.82	1.207
28.48	1.110	89.02	1.202
29.83	1.120	89.15	1.200
34.23	1.130	89.82	1.190
38.50	1.145	90.20	1.185
41.00	1.155	90.64	1.175
41.15	1.155	91.04	1.165
41.92	1.157	92.09	1.152
47.52	1.182	92.81	1.135
48.49	1.187	92.91	1.130
50.97	1.200	94.26	1.095
55.09	1.217	95.84	1.065
55.39	1.220	97.50	1.035
57.66	1.230	98.22	1.022
61.66	1.245	100.05	1.0005
65.19	1.255		

(Hull, Roy. Soc. Proc. 1909, 83, A 144.)

Sp. gr. of HF+Aq at 18°

% HF	Sp. gr
0.484	1.003
1.504	1.005
2.48	1.009
4.80	1.017
7.75	1.028
15.85	1.058
24.47	1.087
29.83	1.103

(Hull.)

Aq. solution of sp. gr. 1.138 at 18° contains 43.2% HF and has a constant bpt. of 111° at 750 mm (Denssen, Z. anorg. 1906, 49, 297.)

The strongest acid that can be obtained by distillation contains 48.17% HF and boils at 125–125.5° (Gore.)

**Fluorides.**

The alkali fluorides, also AgF and SnF<sub>2</sub>, are sol in H<sub>2</sub>O; the fluorides of Fe, Sr, and Cd are sl sol.; the others are insol. in H<sub>2</sub>O. Most fluorides are sol. in acids, especially HF + Aq.

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J 1898, 20, 822.)

See under each element.

**Fluorine, F<sub>2</sub>.**

Decomposes H<sub>2</sub>O and all organic solvent with great violence. (Moissan, C. R. 103, 202 and 256.)

Liquified at -185° to a yellowish liquid which does not dissolve glass nor ignite cooled Si, B, C, S, P, or Fe. (Moissan, C. R. 1897, 124, 1202–1204.)

**Fluomolybdic acid.**

**Ammonium fluomolybdate**, (NH<sub>4</sub>)MoF<sub>6</sub> + H<sub>2</sub>O.

Somewhat more sol in H<sub>2</sub>O than the K salt. Hydrolysed by H<sub>2</sub>O (Rosenheim, Z. anorg. 1905, 46, 321.)

(NH<sub>4</sub>)<sub>3</sub>Mo<sub>2</sub>F<sub>7</sub> + 2H<sub>2</sub>O. (Rosenheim.)

**Potassium fluomolybdate**, KMoF<sub>6</sub> + H<sub>2</sub>O.

Nearly insol. in H<sub>2</sub>O (Rosenheim.)

**Fluoselenic acid.**

**Ammonium monofluoselenate**,

SeO<sub>3</sub>(OH)F(NH<sub>4</sub>).

Not hygroscopic

Easily sol H<sub>2</sub>O with decomp.

Sol in HF (Weinland, Z. anorg. 1899, 21, 58.)

**Tripotassium difluodiselenate**, Se<sub>2</sub>O<sub>7</sub>F<sub>2</sub>K<sub>3</sub>H + H<sub>2</sub>O

Decomp. in the air; sol. in H<sub>2</sub>O with decomp.; sol. in HF. (Weinland.)

**Trrubidium difluodiselenate**, Se<sub>2</sub>O<sub>7</sub>F<sub>2</sub>Rb<sub>3</sub>H + H<sub>2</sub>O.

Decomp. in the air; sol. in H<sub>2</sub>O with decomp.; sol. in HF (Weinland, Z. anorg. 1899, 21, 57.)

**Fluosilicic acid,  $\text{H}_2\text{SiF}_6$ .**

Sp. gr. of  $\text{H}_2\text{SiF}_6 + \text{Aq}$  at  $17.5^\circ$  ( $\text{H}_2\text{O}$  at  $17.5^\circ = 1.000$ ).

% $\text{H}_2\text{SiF}_6$	Sp gr	% $\text{H}_2\text{SiF}_6$	Sp gr
2	1.0161	20	1.1748
4	1.0324	22	1.1941
6	1.0491	24	1.2136
8	1.0661	26	1.2335
10	1.0834	28	1.2537
12	1.1011	30	1.2742
14	1.1190	32	1.2951
16	1.1373	34	1.3162
18	1.1559		..

(Stolba, J. pr. 90. 193.)

+  $2\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Kessler, C. R. 90. 1285.) Solution decomp. into  $\text{HF}$  and  $\text{SiF}_4$  on evaporation, when it becomes concentrated.

**Fluosilicates.**

Most of the fluosilicates are sol. in  $\text{H}_2\text{O}$ , but the alkali salts (especially K) and the Ba salt are only sl. sol. in  $\text{H}_2\text{O}$ .

**Aluminum fluosilicate,  $\text{Al}_3(\text{SiF}_6)_3$ .**

Easily sol. in  $\text{H}_2\text{O}$ . After evaporating to dryness, the residue is slowly but completely sol. in  $\text{H}_2\text{O}$ . (Deville, A. ch (3) 61. 327.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Aluminum fluosilicate silicate,  $\text{Al}_3\text{SiF}_6\text{Si}_2\text{O}_5$ .**

Min. Topaz. Insol in acids.

**Ammonium fluosilicate,  $(\text{NH}_4)_3\text{SiF}_6$ .**

Sol. in 5.38 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  to form a solution of 1.0961 sp. gr.; sol in 18 pts. hot  $\text{H}_2\text{O}$ ; sol in 45.5 pts alcohol of 31% (Stolba, C. C. 1877. 418.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Erdmann, C. C. 1899, II. 1014.)

$3\text{NH}_4\text{F}, \text{SiF}_6 = (\text{NH}_4)_3\text{SiF}_6, \text{NH}_4\text{F}$ . Sol in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 221.)

**Barium fluosilicate,  $\text{BaSiF}_6$ .**

Sol. in 3802 pts. cold  $\text{H}_2\text{O}$ . (Fresenius, A. 59. 120.)

Sol. in 3731 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$ ; in 3315 pts. at  $21^\circ$ ; in 1175 pts. at  $100^\circ$  (Stolba, J. pr. 96. 22.)

Sol. in 640-733 pts.  $\text{H}_2\text{O}$  containing a little  $\text{HCl}$ . (Fresenius.)

488 pts  $\text{HCl} + \text{Aq}$  containing 4.25%  $\text{HCl}$  dissolve 1 pt. at  $22^\circ$ . (Stolba.)

More sol. in  $\text{HNO}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Fresenius.)

372 pts.  $\text{HNO}_3 + \text{Aq}$ , containing 8%  $\text{N}_2\text{O}_5$ , dissolve 1 pt. at  $22^\circ$ . (Stolba.)

1 pt.  $\text{BaSiF}_6$  dissolves in 428 pts. sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ ; in 589 pts. sat.  $\text{NH}_4\text{Cl} + \text{Aq} + 2$  vols  $\text{H}_2\text{O}$ . (Mallet, Sill. Am. J. (2) 28. 48.)

1 pt.  $\text{BaSiF}_6$  dissolves in 306 pts. sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $22^\circ$ ; in 361 pts. 15% solution of  $\text{NH}_4\text{Cl}$ ; in 563 pts. sat. boiling  $\text{NaCl} + \text{Aq}$ ; in 349 pts. 10% solution of  $\text{NaCl}$  at boiling temp.; in 2185 pts. 10% solution of  $\text{NaCl}$  at  $20^\circ$ ; in 1140 pts. 5% solution of  $\text{NaCl}$  at  $20^\circ$ . (Stolba.)

Nearly absolutely insol. in alcohol. (Fresenius.)

Solubility in a mixture of  $\text{H}_2\text{O}$ , alcohol (96%),  $\text{HCl} + \text{Aq}$  (20%),  $\text{H}_2\text{SiF}_6 + \text{Aq}$  (3.7%).

1 pt  $\text{BaSiF}_6$  is sol. in pts. of solutions of given composition.

$\text{H}_2\text{O}$	Alcohol	$\text{HCl} + \text{Aq}$	$\text{H}_2\text{SiF}_6 + \text{Aq}$	$\text{BaSiF}_6$
50	50	0	0	37,219
74.1	25	0 9	0	5,263
70.8	25	4 2	0	2,860
77 95	20	0 9	1 15	39,061
73 0	25	0 9	1 1	70,679
97.09	0	1.25	1 66	3,247
75.0	25	0	0	16,914

(Fresenius, Z. anal. 29. 143.)

**Cadmium fluosilicate,  $\text{CdSiF}_6 + 6\text{H}_2\text{O}$ .**

Extremely sol. in  $\text{H}_2\text{O}$ . Easily sol. in 50% alcohol. (Engelskirchen, Dissert. 1903.)

**Cæsium fluosilicate,  $\text{Cs}_3\text{SiF}_6$ .**

Sol in 166 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ , and much less hot  $\text{H}_2\text{O}$ . Insol. in alcohol (Press, J. pr 103. 410.)

**Calcium fluosilicate,  $\text{CaSiF}_6 + 2\text{H}_2\text{O}$ .**

Sl. sol. in, and partly decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HF}$  and  $\text{HCl} + \text{Aq}$ . Sol. in fluosilicic acid without decomp. Easily sol. in 60% alcohol. (Fleischer.)

**Cerium fluosilicate.**

Very difficultly sol. in  $\text{H}_2\text{O}$ , acetic, or fluosilicic acids. Insol. in alcohol. (Stolba, C. C. 1874. 130.)

**Chromium fluosilicate.**

Deliquescent. (Berzelius)  
Efflorescent. Sol. in  $\text{H}_2\text{O}$  (Berlin)

**Cobaltous fluosilicate,  $\text{CoSiF}_6 + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Cuprous fluosilicate,  $\text{Cu}_2\text{SiF}_6$ .**

Insol. in  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 1. 199.)

**Cupric fluosilicate,  $\text{CuSiF}_6 + 6\text{H}_2\text{O}$ .**

Deliquescent in moist, efflorescent in dry air.

Sol. in 0.428 pt.  $\text{H}_2\text{O}$  at  $17^\circ$ . Sp. gr. of solution sat. at  $17^\circ = 1.6241$

Sol. in 17 5 pts. alcohol of 62 vol % at  $20^\circ$ , in 150 pts. of 85% at  $20^\circ$ ; in 617 pts. of 92% at  $20^\circ$ . (Stolba, J. pr. 102. 7.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790)  
Contains  $6\frac{1}{2}\text{H}_2\text{O}$  (Stolba.)  
+  $5\frac{1}{2}\text{H}_2\text{O}$ . (Knop and Wolf)

**Cupric fluosilicate phosphate,  $\text{CuSiF}_6$ ,  $\text{Cu}_3(\text{PO}_4)_2$ .**

Insol. in  $\text{H}_2\text{O}$ , but easily sol. in dil.  $\text{HCl}$  + Aq (Thorpe and Rodger, Chem. Soc. 55, 320.)

**Glucinum fluosilicate.**

Known only in solution

**Iron (ferrous) fluosilicate,  $\text{FeSiF}_6 \cdot 6\text{H}_2\text{O}$ .**  
Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Iron (ferric) fluosilicate,  $\text{Fe}_2(\text{SiF}_6)_3$ .**  
Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Lead fluosilicate,  $\text{PbSiF}_6 \cdot 2\text{H}_2\text{O}$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ .  
Insol. in acetone. (Naumann, B. 1904, 37, 4329.)  
+  $4\text{H}_2\text{O}$ . (Marignac)

**Lithium fluosilicate,  $\text{Li}_2\text{SiF}_6 \cdot 2\text{H}_2\text{O}$ .**

100 pts.  $\text{H}_2\text{O}$  at  $17^\circ$  dissolve 73 pts. crystalline salt. (Marignac.)

100 pts. cold  $\text{H}_2\text{O}$  dissolve 52 pts. crystals.  
Sol. in dil. alcohol. (Stolba, J. pr. 91, 456.)

100 pts alcohol of 46 vol. % dissolve about 4 pts., and 100 pts. alcohol of 79 vol. % dissolve about 0.4 pt. crystals (Stolba, Z. anal. 3, 311.)

Insol. in ether or benzene.  
Insol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37, 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790)

Insol. in ethyl acetate. (Naumann, B. 1904, 37, 3601)

**Magnesium fluosilicate,  $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$ .**

Efflorescent. Sol in 1534 pts. cold  $\text{H}_2\text{O}$ , forming a solution of 1.235 sp. gr. at  $17.5^\circ$ . Separates out  $\text{SiO}_2$  on warming, which nearly all redissolves on cooling. (Stolba, C. C. 1877, 578)

**Magnesium fluosilicate silicate,  $\text{Mg}_2\text{Si}_2\text{F}_{10}$ ,  $x\text{Mg}_2\text{Si}_2\text{O}_6$ .**

Min *Humite*, *Chondrodite*. Gelatinises with  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4$  + Aq.

**Manganous fluosilicate,  $\text{MnSiF}_6 \cdot 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Marignac, J. pr. 83, 202.)  
100 pts. dissolve in 71.4 pts  $\text{H}_2\text{O}$  at  $17.5^\circ$ , and sp. gr. of solution = 1.44825. Much more sol. in hot  $\text{H}_2\text{O}$ , and less sol. in alcohol, the stronger the alcohol (Stolba, C. C. 1883, 292.)

**Mercurous fluosilicate,  $\text{Hg}_2\text{SiF}_6$ .**

Sl. sol. in  $\text{H}_2\text{O}$  without decomp (Lemaire, C. C. 1897, I, 1040.)

+  $2\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  More easily sol in acidified  $\text{H}_2\text{O}$ , but precipitated by  $\text{HCl}$  + Aq. (Berzelius)

**Mercuric fluosilicate, basic,  $\text{HgSiF}_6$ ,  $\text{HgO}$  +  $3\text{H}_2\text{O}$**

Decomp. by  $\text{H}_2\text{O}$ , but sol. in weakest acids. (Berzelius, Pogg. 1, 200.)

**Mercuric fluosilicate,  $\text{HgSiF}_6 \cdot 6\text{H}_2\text{O}$ .**

Deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . (Finkener, Pogg. 111, 246.)

**Nickel fluosilicate,  $\text{NiSiF}_6 \cdot 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$  (Maignac, Ann. Min. (5) 15, 262.)

**Potassium fluosilicate,  $\text{K}_2\text{SiF}_6$ .**

Sol. in 833 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$ , and 104.8 pts. at  $100^\circ$ . (Stolba, J. pr. 103, 396.) Sol. in 3800 pts cold, and more easily sol. in hot  $\text{H}_2\text{O}$  (Fresenius.)

More sol. in  $\text{HCl}$  + Aq than in  $\text{H}_2\text{O}$ .

Sol. in 337 pts.  $\text{HCl}$  + Aq of 26.5% at  $14^\circ$ ; in 307 pts. of 25.7% at  $15^\circ$ ; in 340 pts. of 14.1% at  $14^\circ$ ; in 303 pts. of 13.8% at  $15^\circ$ ; in 327 pts. of 9.6% at  $14^\circ$ ; in 313 pts. of 9.2% at  $15^\circ$ ; in 376 pts. of 2.7% at  $14^\circ$ ; in 318 pts. of 2.4% at  $15^\circ$ ; in 400 pts. of 1.8% at  $14^\circ$ . (Stolba, l. c.)

Sol. in 428 pts. sat., and 580 pts. dil.  $\text{NH}_4\text{Cl}$  + Aq (Mallet)

Much less sol. in  $\text{K}_2\text{SO}_4$ ,  $\text{KNO}_3$ , or  $\text{KCl}$  + Aq, but more sol. in  $\text{NH}_4\text{Cl}$  + Aq than in  $\text{H}_2\text{O}$ . (Stolba.)

Sol in 24,066 pts.  $\text{K}_2\text{SO}_4$  + Aq containing 9.92%  $\text{K}_2\text{SO}_4$  at  $17^\circ$ , in 17,858 pts. containing 6% at  $18^\circ$ ; in 19,530 pts. containing 5% at  $17^\circ$ ; in 10,721 pts. containing 1% at  $17^\circ$

Sol in 125,000 pts.  $\text{KNO}_3$  + Aq containing 18.4%  $\text{KNO}_3$  at  $15^\circ$ , in 43,478 pts. containing 8.7% at  $15^\circ$ ; in 1735 pts. containing 8.8% at  $100^\circ$ ; in 35,814 pts. containing 4.3% at  $15^\circ$ ; in 10,203 pts. containing 1.00% at  $15^\circ$

Sol. in 40,070 pts  $\text{KCl}$  + Aq containing 25%  $\text{KCl}$  at  $17^\circ$ ; in 38,352 pts. containing 18.4% at  $17^\circ$ ; in 41,264 pts. containing 13.4% at  $14^\circ$ ; in 24,032 pts. containing 6.7% at  $12^\circ$ ; in 1200 pts. containing 0.65% at  $17^\circ$ ; in 1095 pts. containing 0.45% at  $18^\circ$

Sol. in 358 pts.  $\text{NH}_4\text{Cl}$  + Aq containing 26.3%  $\text{NH}_4\text{Cl}$  at  $17^\circ$ ; in 308 pts. containing 15% at  $15^\circ$ ; in 339 pts. containing 10% at  $15^\circ$ ; in 436 pts. containing 5% at  $15^\circ$ . (Stolba, J. pr. 103, 306)

Insol. in liquid  $\text{CO}_2$ . (Buchner, Z. phys. Ch. 1900, 54, 674.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. ch. J. 1898, 20, 829.)

Completely pptd. from aqueous solution by an equal vol. of alcohol.

Sl. sol in benzonitrile (Naumann, B 1914, 47. 1369.)  
 Insol in methyl acetate (Naumann, B. 1909, 42. 3790.)

#### Rubidium fluosilicate, $\text{Rb}_2\text{SiF}_6$ .

Sol. in 625 pts  $\text{H}_2\text{O}$  at  $20^\circ$ , and 73 05-74 5 pts at  $100^\circ$ . More sol in acidified water  
 Insol. in alcohol. (Stolba, J. pr 101. 1.)  
 Insol. in  $\text{H}_2\text{O}$ . (Eggeling, Z. anorg 1905, 46. 175.)  
 Less sol. in  $\text{H}_2\text{O}$  than  $\text{K}_2\text{SiF}_6$  (Gossner, Zeit. Kryst. 1904, 38. 149.)

#### Silver fluosilicate, $\text{Ag}_2\text{SiF}_6 + 4\text{H}_2\text{O}$

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 221.)

#### Sodium fluosilicate, $\text{Na}_2\text{SiF}_6$

Much more sol in  $\text{H}_2\text{O}$  than  $\text{K}_2\text{SiF}_6$ , especially in hot  $\text{H}_2\text{O}$ . Addition of acid does not increase solubility. (Berzelius)  
 Sol in 153.3 pts  $\text{H}_2\text{O}$  at  $17.5^\circ$ , and 40.66 pts. at  $100^\circ$ . Easily forms supersaturated solutions. (Stolba, Z. anal. 11. 199.)  
 Much less sol. in  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Stolba, J. pr. 1865 (1) 96. 26.)  
 Precipitated completely from aqueous solution by alcohol (Rose)  
 Insol. in methyl acetate (Naumann, B. 1909, 42. 3790.)

#### Strontium fluosilicate, $\text{SrSiF}_6 + 2\text{H}_2\text{O}$

Sol. in cold  $\text{H}_2\text{O}$ , but decomp. somewhat on heating Sol in 31.06 pts  $\text{H}_2\text{O}$ . (Fresenius.)  
 Easily sol. in acidified  $\text{H}_2\text{O}$  without decomp. Sol. in alcohol

Solubility in a mixture of  $\text{H}_2\text{O}$ , alcohol (96%),  $\text{HCl} + \text{Aq}$  (20%),  $\text{H}_2\text{SiF}_6 + \text{Aq}$  (3.7%).  
 1 pt  $\text{SiSiF}_6$  is sol. in pts of solutions of given composition.

$\text{H}_2\text{O}$	Alcohol	$\text{HCl} + \text{Aq}$	$\text{H}_2\text{SiF}_6 + \text{Aq}$	$\text{SrSiF}_6$
50	50	0	0	15.29
74 1	25	0	0	82.93
70 8	25	4 2	0	50 9
77 95	20	0 9	1 15	55 0
73	25	0 9	1 1	82.97
75	25	0	0	147 4
95.24	0	2 04	2 72	7 3

(Fresenius, Z. anal. 29. 143.)

#### Thallous fluosilicate, $\text{Tl}_2\text{SiF}_6 + 2\text{H}_2\text{O}$ .

Very easily sol. in  $\text{H}_2\text{O}$ . (Kuhlmann.)

#### Thorium fluosilicate, $\text{Th}(\text{OH})_2\text{SiF}_6$ (?).

(Cleve)

#### Tin (stannic) fluosilicate, $\text{SnF}_4, \text{SiF}_4$ .

Very easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

#### Uranyl fluosilicate.

Very sl sol in acids. (Berzelius)  
 Sol in alcohol (Stolba, Z. anal. 3. 71.)

#### Vanadium fluosilicate.

Deliquescent Sol in  $\text{H}_2\text{O}$ . (Guyard, Bull. Soc. (2) 25. 352.)

#### Yttrium fluosilicate.

Insol in pure, sol. in acidified  $\text{H}_2\text{O}$ . (Berzelius)

#### Zinc fluosilicate, $\text{ZnSiF}_6 + 6\text{H}_2\text{O}$ .

Very easily sol. in  $\text{H}_2\text{O}$  (Berzelius.)

#### Zirconium fluosilicate.

Sol. in  $\text{H}_2\text{O}$ . Solution clouds up on boiling. (Berzelius.)

#### Fluostannic acid.

#### Ammonium fluostannate, $(\text{NH}_4)_2\text{SnF}_6$

Sol in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 224.)  
 $4\text{NH}_4\text{F}, \text{SnF}_4$  Sol. in  $\text{H}_2\text{O}$  (Marignac.)

#### Barium fluostannate, $\text{BaSnF}_6$

Slowly sol. in  $\text{H}_2\text{O}$ .  
 $+3\text{H}_2\text{O}$  Sol. in 18 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Marignac, Ann. Min. (5) 15. 246.)  
 Decomp. by warming with  $\text{H}_2\text{SO}_4$  with evolution of  $\text{HF}$ . (Ermich, M. 1904, 25. 1912.)

#### Calcium fluostannate, $\text{CaSnF}_6 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Marignac, Ann. Min. (5) 15. 250.)

#### Cadmium fluostannate, $\text{CdSnF}_6 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

#### Cobaltous fluostannate, $\text{CoSnF}_6 + 6\text{H}_2\text{O}$ .

(Gossner, Zeit. Kryst. 1907, 42. 482.)

#### Cupric fluostannate, $\text{CuSnF}_6 + 4\text{H}_2\text{O}$ .

Not deliquescent. (Marignac, Ann. Min. (5) 15. 291.)

#### Lithium fluostannate, $\text{Li}_2\text{SnF}_6 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 242.)

#### Magnesium fluostannate, $\text{MgSnF}_6 + 6\text{H}_2\text{O}$

Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 256.)

#### Manganous fluostannate, $\text{MnSnF}_6 + 6\text{H}_2\text{O}$ .

Slowly efflorescent. (Marignac.)

#### Nickel fluostannate, $\text{NiSnF}_6 + 6\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 262.)

Potassium fluostannate,  $K_2SnF_6 \cdot H_2O$ .

Two modifications—(a) *Thin plates*. Sol in 2.3 pts  $H_2O$  at  $100^\circ$ , and in 15–16 pts at  $18^\circ$ . (Marignac.)

(b) *Octahedra*. Sol in 3 pts.  $H_2O$  at  $100^\circ$ , and 27 pts at  $18^\circ$ . (Marignac.)

Sol. in hot  $H_2O$ . Can be cryst. from hot  $H_2O$ . With conc.  $H_2SO_4$ , HF is evolved. (Emich, M. 1904, 25. 911.)

Potassium hydrogen fluostannate,  $3KF, HF, SnF_6$ .

Sol. in  $H_2O$ . (Marignac.)

Silver fluostannate,  $Ag_2SnF_6 \cdot 4H_2O$ .

Sl. deliquescent. Easily sol. in  $H_2O$ . (Marignac.)

Sodium fluostannate,  $Na_2SnF_6$ .

Sol. in 13–19 pts.  $H_2O$  at  $20^\circ$ . (Marignac.)

Strontium fluostannate,  $SrSnF_6 \cdot 2H_2O$ .

Sol. in 5.5 pts.  $H_2O$  at  $18^\circ$ . (Marignac.)

Zinc fluostannate,  $ZnSnF_6 \cdot 6H_2O$ .

Sol. in  $H_2O$ . (Marignac.)

Fluosulphonic acid,  $HSO_3F$ .

See Sulphuryl hydroxyl fluoride.

Ammonium fluosulphonate,  $FSO_2NH_4$ .

Easily sol. in  $H_2O$  from which it can be cryst.

Sol. in ethyl alcohol, more sol. in methyl alcohol. Can be cryst. from abs. alcohol. (Traube, B. 1913, 46. 2528.)

Sodium fluosulphonate,  $FSO_2Na$

Hydrosopic.

Sol. in alcohol and acetone. (Traube.)

Fluosulphuric acid.

Tricassium difluodisulphate,  $S_2O_7F_2Cs_3H + H_2O$ .

As the K salt. (Weinland, Z. anorg. 1899, 21. 53.)

Tripotassium difluodisulphate,

$S_2O_7F_2K_3H + H_2O$ .

Sol. in HF; quite stable in air; sol. in  $H_2O$  with decomp. (Weinland, Z. anorg. 1899, 21. 51.)

Trirubidium difluodisulphate,  $S_2O_7R_2Tb_3H + H_2O$ .

Sol. in HF. (Weinland, Z. anorg. 1899, 21. 53.)

Fluotantallic acid.

Ammonium fluotantalate,  $(NH_4)_2TaF_7$ .

Very sol. in  $H_2O$ . (Marignac, A. ch. (4) 9. 272.)

$(NH_4)_2TaF_7$ . (Balke, J. Am. Chem. Soc. 1905, 27. 1151.)

Cæsium fluotantalate,  $CsTaF_7$ .

Can be recryst. from HF + Aq. (Balke.)  $Cs_2TaF_7$ . Can not be recryst. from  $H_2O$  as it tends to go into  $CsF, TaF_5$ . (Balke, J. Am. Chem. Soc. 1905, 27. 1151.)

$15CsF, TaF_5$ . Sl. sol. in  $H_2O$ . (Pennington, J. Am. Chem. Soc. 1896, 18. 59.)

Calcium fluotantalate.

Difficulty sol. in  $H_2O$ . (Berzelius.)

Cupric fluotantalate,  $CuTaF_7 \cdot 4H_2O$ .

Deliquescent. Easily sol. in  $H_2O$ . (Marignac, A. ch. (4) 9. 294.)

Lead fluotantalate.

Difficulty sol. in  $H_2O$ . (Berzelius.)

Lithium fluotantalate,  $LiF, TaF_5 \cdot 2H_2O$ .

Can be recryst. from conc. HF. (Balke, J. Am. Chem. Soc. 1905, 27. 1143.)

Potassium fluotantalate,  $K_2TaF_7$ .

Sl. sol. in cold, much more easily in hot  $H_2O$ . Decomposes, with formation of a white precipitate on boiling. (Berzelius.)

Much more sol. in HF + Aq. 1 pt. of the salt is sol. in 200 pts.  $H_2O$  containing a trace of HF, and in 150–160 pts. of  $H_2O$  containing a little more HF. (Marignac, A. ch. (4) 9. 267.)

Potassium hydrogen fluotantalate,  $KF, HF, TaF_5$  (?)

Sol. in  $H_2O$ . (Berzelius.)

Rubidium fluotantalate,  $Rb_2TaF_7$ .

Sol. in HF + Aq. (Pennington, J. Am. Ch. Soc. 1896, 18. 58.)

$3RbF, 2TaF_5$ . (Balke, J. Am. Chem. Soc. 1905, 27. 1151.)

Sodium fluotantalate,  $3NaF, TaF_5$ .

Easily sol. in  $H_2O$ .

$Na_2TaF_7 \cdot H_2O$ . Sol. in  $H_2O$ . (Marignac.)

Thallous fluotantalate,  $Tl_2TaF_7$ .

Sol. in  $H_2O$ . On boiling the aqueous solution tantalic acid separates.

Decomp. by conc.  $H_2SO_4$ . Difficulty sol. in cold, easily sol. in hot HF. (Ephraim, B. 1909, 42. 4461.)

Zinc fluotantalate,  $ZnTaF_7 \cdot 7H_2O$ .

Very deliquescent. Sol. in  $H_2O$ . (Marignac, A. ch. (4) 9. 249.)

Fluotelluric acid.

Ammonium fluotellurate,  $NH_4TeF_6 \cdot H_2O$ .

Decomp. by  $H_2O$ . (Hugbom, Bull. Soc. (2) 35. 60.)

**Barium fluotellurate**,  $\text{Ba}(\text{TeF}_6)_2 + \text{H}_2\text{O}$ .

As above.

**Potassium fluotellurate**,  $\text{KTeF}_6$ .

As above.

$\text{TeO}_5\text{F}_3\text{K}_2 + 3\text{H}_2\text{O}$ . Stable in dry air; only sl. sol. in  $\text{H}_2\text{O}$  with decomp.; sol. in HF (Weinland, Z. anorg. 1899, 21. 61.)

**Rubidium difluotellurate**,  $\text{TeO}_5\text{F}_2\text{Rb}_2 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in HF. (Weinland, Z. anorg. 1899, 21. 62.)

**Fluotitanic acid.**

Known only in solution as titanium hydrofluoric fluoride.

**Ammonium fluotitanate**,  $(\text{NH}_4)_2\text{TiF}_6$ .

Sol. in  $\text{H}_2\text{O}$  (Marignac.)

$3\text{NH}_4\text{F}$ ,  $\text{TiF}_4$ . Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Ammonium fluosquittitanate**,  $6\text{NH}_4\text{F}$ ,  $\text{Ti}_2\text{F}_8$ .

Easily sol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{NH}_4\text{F} + \text{Aq}$ . (Peterson, J. pr. (2) 40. 54.)

Insol. in  $\text{NH}_4\text{F} + \text{Aq}$ . (Piccini, C. R. 97. 1064.)

$4\text{NH}_4\text{F}$ ,  $\text{Ti}_2\text{F}_8$ . Properties as the corresponding K salt. (Piccini, B. 18. 257 R.)

**Barium fluotitanate**,  $\text{BaTiF}_6$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . More easily sol. in dil.  $\text{HNO}_3$  or  $\text{HCl}$ . (Engelskirchen, Dissert 1903.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . (Emich, M. 1904, 25. 907.)

**Cadmium fluotitanate**,  $\text{CdTiF}_6 + 6\text{H}_2\text{O}$ .

Extremely sol. in  $\text{H}_2\text{O}$ . Easily sol. in 50% alcohol. (Engelskirchen, Dissert 1903.)

**Cæsium fluotitanate**,  $\text{Cs}_2\text{TiF}_6$ .

More sol. in hot than cold  $\text{H}_2\text{O}$  and much more sol. than the Rb comp. (Engelskirchen, Dissert. 1903.)

$4\text{CsF}$ ,  $\text{TiF}_4$ . More sol. in  $\text{H}_2\text{O}$  than  $\text{Cs}_{11}\text{TaF}_{20}$  and is not decomp. by pure  $\text{H}_2\text{O}$ . (Pennington, J. Am. Chem. Soc. 1896, 18. 60.)

**Calcium fluotitanate**,  $\text{CaTiF}_6 + 3\text{H}_2\text{O}$

Decomp. by pure  $\text{H}_2\text{O}$ . Sol. without decomp. in acidified  $\text{H}_2\text{O}$  (Berzelius)

Separates a precipitate with cold  $\text{H}_2\text{O}$ , which dissolves on heating. (Marignac, Ann. Min. (5) 15. 250.)

**Cupric fluotitanate**,  $\text{CuTiF}_6 + 4\text{H}_2\text{O}$ .

Sol. in pure  $\text{H}_2\text{O}$  with partial decomp.; easily and completely sol. in acidified  $\text{H}_2\text{O}$ . (Berzelius.)

**Cupric fluotitanate ammonium fluoride**,

$\text{CuTiF}_6$ ,  $\text{NH}_4\text{F} + 4\text{H}_2\text{O}$

Efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 267.)

**Cupric fluotitanate potassium fluoride**,  $\text{CuTiF}_6$ ,  $\text{KF} + 4\text{H}_2\text{O}$ .

As the above salt (Marignac)

**Ferrous fluotitanate**,  $\text{FeTiF}_6 + 6\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Weber, Pogg. 120. 287.)

**Ferric fluotitanate.**

Decomp. by  $\text{H}_2\text{O}$ . (Berzelius)

**Lead fluotitanate.**

Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Lithium fluotitanate**,  $\text{Li}_2\text{TiF}_6 + 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Engelskirchen, Dissert, 1903.)

**Magnesium fluotitanate**,  $\text{MgTiF}_6 + 6\text{H}_2\text{O}$ .

Easily sol. in cold  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 257.)

**Nickel fluotitanate**,  $\text{NiTiF}_6 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Weber, Pogg. 120. 282.)

**Potassium fluotitanate**,  $\text{K}_2\text{TiF}_6$ .

Difficultly sol. in cold, much more easily in hot  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve at:

0° 3° 6° 10° 14° 20°

0.550 0.667 0.775 0.909 1.042 1.28 pts.  $\text{K}_2\text{TiF}_6$ . (Marignac, A. ch. (4) 8. 65.)

Sol. in 78.6 pts  $\text{H}_2\text{O}$  at 21°. Sol. in acids. (Piccini, Gazz. ch. it. 1886, 18. 101.)

Sol. in 78 pts.  $\text{H}_2\text{O}$  at 20°; 9.4 pts at 100°. By addition of small amount of HF, the solubility is increased. (Weiss and Kaiser, Z. anorg. 1910, 65. 354.)

Sol. in HF. (Marchetti, Z. anorg. 1895, 10. 66.)

$+ \text{H}_2\text{O}$ . Much less sol. in  $\text{H}_2\text{O}$  in presence of KBr or KI. (Hall, J. Am. Chem. Soc. 1904, 26. 1246.)

Sol. in  $\text{H}_2\text{O}$  or HF with decomp. (Marchetti, Z. anorg. 1895, 10. 66.)

**Potassium fluosquittitanate**,  $4\text{KF}$ ,  $\text{Ti}_2\text{F}_8$ .

Scarcely sol. in  $\text{H}_2\text{O}$ , sol. in dil. acids. (Piccini, B. 18. 257 R.)

**Rubidium fluotitanate**,  $\text{Rb}_2\text{TiF}_6$ .

Very sl. sol. in cold, somewhat more sol. in hot  $\text{H}_2\text{O}$ . (Engelskirchen, Dissert. 1903.)

**Silver fluotitanate.**

Very deliquescent. (Marignac.)

**Sodium fluotitanate**,  $\text{Na}_2\text{TiF}_6$ .

Much more sol. in  $\text{H}_2\text{O}$  than the corresponding potassium salt. (Marignac, Ann. Min. (5) 15. 238.)

Sodium hydrogen fluotitanate,  $\text{Na}_2\text{TiF}_6$ ,  $\text{NaHF}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

Strontium fluotitanate,  $\text{SrTiF}_6 + 2\text{H}_2\text{O}$ .

Sol. in cold  $\text{H}_2\text{O}$ . Solution clouds up on heating. (Marignac)

Zinc fluotitanate,  $\text{ZnTiF}_6 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (3) 60. 304)

### Fluovanadic acid.

Ammonium fluovanadate,  $3\text{NH}_4\text{F}$ ,  $\text{VF}_5$ .

Moderately sol. in  $\text{H}_2\text{O}$ . More easily sol. in dil. acids. Nearly insol. in alcohol or  $\text{MF} + \text{Aq.}$  (Petersen, J. pr. (2) 40. 52.)

$2\text{NH}_4\text{F}$ ,  $\text{VF}_5 + \text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Petersen.)

$\text{NH}_4\text{F}$ ,  $\text{VF}_5 + 2\text{H}_2\text{O}$ . As above. (Petersen.)

Cadmium fluovanadate,  $\text{CdF}_2$ ,  $\text{VF}_5 + 7\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Piochini and Giorgis, Gazz. ch. it. 22, 1. 89.)

Cobalt fluovanadate,  $\text{CoF}_2$ ,  $\text{VF}_5 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (Petersen, l. c.)

Nickel fluovanadate,  $\text{NiF}_2$ ,  $\text{VF}_5 + 2\text{H}_2\text{O}$ .

As the Co salt. (Petersen.)

Potassium fluovanadate,  $2\text{KF}$ ,  $\text{VF}_5 + \text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. Insol. in  $\text{KF} + \text{Aq.}$  (Petersen, J. pr. (2) 40. 51.)

Potassium fluovanadate fluoxyvanadate,

$4\text{KF}$ ,  $\text{VF}_5$ ,  $\text{VOF}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ , and still more easily in  $\text{HF} + \text{Aq.}$  Sl. sol. in  $\text{KF} + \text{Aq.}$  (Petersen, J. pr. (2) 40. 274.)

Sodium fluovanadate,  $5\text{NaF}$ ,  $2\text{VF}_5 + \text{H}_2\text{O}$ .

As the potassium salt. (Petersen.)

Thallous fluovanadate,  $\text{TlF}$ ,  $\text{VF}_5 + 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ .

Sol. with decomp. in conc.  $\text{H}_2\text{SO}_4$ , dil.  $\text{HNO}_3$ , or cold dil.  $\text{HCl}$ .

Insol. in  $\text{NaOH} + \text{Aq.}$  (Ephraim, B. 1909, 42. 4460)

$2\text{TlF}$ ,  $\text{VF}_5 + \text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ .

Sol. in conc.  $\text{H}_2\text{SO}_4$ , dil.  $\text{HNO}_3$ , or cold dil.  $\text{HCl}$  with decomp.

Insol. in cold or hot  $\text{NaOH} + \text{Aq.}$  (Ephraim, B. 1909, 42. 4461.)

Zinc fluovanadate,  $\text{ZnF}_2$ ,  $\text{VF}_5 + 7\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. on heating. (Piochini and Giorgis.)

### Fluoxycolumbic acid.

Ammonium fluoxycolumbate,  $3\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$ .

Cubic salt. Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (4) 8. 38.)

$2\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$ . Lamellar salt. Much more sol. in  $\text{H}_2\text{O}$  than  $2\text{KF}$ ,  $\text{CbOF}_3$ . (M.)

$5\text{NH}_4\text{F}$ ,  $3\text{CbOF}_3 + \text{H}_2\text{O}$ . Hexagonal salt. (M.)

$\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$ . Rectangular salt. (M.)

Ammonium fluoxycolumbate columbium fluoride,  $3\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$ ,  $\text{CbF}_5$ .

(Marignac.)

Cupric fluoxycolumbate,  $\text{CuF}_2$ ,  $\text{CbOF}_3 + 4\text{H}_2\text{O}$ .

Sl. deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (4) 8. 42.)

Potassium fluoxycolumbate,  $2\text{KF}$ ,  $\text{CbOF}_3 + \text{H}_2\text{O}$ .

Sol. in 12.5-13 pts.  $\text{H}_2\text{O}$  at  $17-21^\circ$ . Much more sol. in hot  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  containing  $\text{HF}$ . (Marignac.)

$3\text{KF}$ ,  $\text{CbOF}_3$ . Decomp. by  $\text{H}_2\text{O}$  into above salt. (M.)

$5\text{KF}$ ,  $3\text{CbOF}_3 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (M.)

$4\text{KF}$ ,  $3\text{CbOF}_3 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (M.)

$3\text{KF}$ ,  $2\text{Cb}_2\text{O}_7 + 5\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ .

(Petersen, J. pr. (2) 40. 287.)

$\text{KF}$ ,  $\text{Cb}_2\text{O}_7 + 3\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Petersen.)

$2\text{KF}$ ,  $3\text{Cb}_2\text{O}_7$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HF}$ . (Kruss and Nilson, B. 20. 1689.)

See also Fluoxypercolumbate, potassium.

Potassium hydrogen fluoxycolumbate,  $3\text{KF}$ ,  $\text{HF}$ ,  $\text{CbOF}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac)

Sodium fluoxycolumbate,  $2\text{NaF}$ ,  $\text{CbOF}_3 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

$\text{NaF}$ ,  $\text{CbOF}_3 + \text{H}_2\text{O}$ . (Marignac.)

Zinc fluoxycolumbate,  $\text{ZnF}_2$ ,  $\text{CbOF}_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (4) 8. 41.)

### Fluoxhypermolybdic acid.

Ammonium fluoxhypermolybdate,  $\text{MoOF}_3$ ,  $2\text{NH}_4\text{F}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Mauro, Gazz. ch. it. 19. 179.)

$3\text{MoOF}_3$ ,  $5\text{NH}_4\text{F} + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mauro.)

Cupric fluoxhypermolybdate,  $\text{CuF}_2$ ,  $\text{MoOF}_3 + 4\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Mauro, Recl. Ac. Linc. 1892, 1. 194.)

**Potassium fluoxyhypomolybdate**,  $\text{MoOF}_3 \cdot 2\text{KF} + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in  $\text{HF}$  or  $\text{HCl} + \text{Aq}$  (Mauro and Panabianco, Gazz. ch. it. 12. 80.)  
 $3\text{MoOF}_3 \cdot 5\text{KF} + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. (Mauro, Gazz. ch. it. 19. 179.)

**Thallous fluoxyhypomolybdate**,  $2\text{TlF} \cdot \text{MoOF}_3$ .

(Mauro, B. 1894, 27R. 109.)

**Zinc fluoxyhypomolybdate**,  $\text{ZnF}_2 \cdot \text{MoOF}_3 + 6\text{H}_2\text{O}$ .

Rapidly deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Mauro, Real. Ac. Linc. 1892. 1. 194.)

**Fluoxyhypovanadic acid.**

See Fluoxyvanadic acid.

**Fluoxymanganic acid.**

**Ammonium fluoxymanganate**,  $(\text{NH}_4)_2\text{MnOF}_4$ .  
 Precipitate. (Nicklès.)

**Potassium fluoxymanganate**,  $\text{K}_2\text{MnOF}_4$ .  
 Precipitate. (Nicklès, C. R. 65. 107.)

**Sesquifluoxymanganic acid.**

**Potassium sesquifluoxymanganate**,  
 $\text{K}_4\text{Mn}_2\text{OF}_{12} = 4\text{KF} \cdot \text{Mn}_2\text{OF}_6$ .  
 Precipitate. (Nicklès.)

**Fluoxymolybdic acid.**

See also Fluoxyhypomolybdic, and fluoxypermolybdic acids.

**Ammonium fluoxymolybdate**,  $\text{NH}_4\text{F} \cdot \text{MoO}_3\text{F}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Mauro, Gazz. ch. it. 20. 109.)

$+ \text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{O}$  than  $2\text{NH}_4\text{F} \cdot \text{MoO}_3\text{F}_2$ . (Delafontaine, N. Arch. Sci. ph. nat. 30. 250)

Correct formula is  $3\text{NH}_4\text{F} \cdot \text{MoO}_3\text{F}_2$ . (Mauro, Gazz. ch. it. 18. 120)

$2\text{NH}_4\text{F} \cdot \text{MoO}_3\text{F}_2$ . Much more sol. than  $2\text{KF} \cdot \text{MoO}_3\text{F}_2$ . (Delafontaine.)

$3\text{NH}_4\text{F} \cdot \text{MoO}_3\text{F}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Mauro.)  
 $5\text{NH}_4\text{F} \cdot 3\text{MoO}_3\text{F}_2 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Mauro, Gazz. ch. it. 20. 109.)

**Ammonium fluoxymolybdate molybdate**,  
 $\text{MoO}_3\text{F}_2 \cdot 4\text{NH}_4\text{F} \cdot (\text{NH}_4)_2\text{MoO}_4$ .

Sol. in  $\text{H}_2\text{O}$ , but with decomp. (Mauro, Gazz. ch. it. 18. 120.)

**Cadmium fluoxymolybdate**,  $\text{CdF}_2 \cdot \text{MoO}_3\text{F}_2 + 6\text{H}_2\text{O}$ .

Sl. efflorescent. (Delafontaine, J. B. 1867. 236.)

**Cobaltous fluoxymolybdate**,  $\text{CoF}_2 \cdot \text{MoO}_3\text{F}_2 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Delafontaine, J. B. 1867. 236.)

**Cupric fluoxymolybdate**,  $\text{CuF}_2 \cdot \text{MoO}_3\text{F}_2 + 4\text{H}_2\text{O}$ .

Deliquescent. (Mauro, Real. Ac. Linc. 1892, 1. 194.)

**Nickel fluoxymolybdate**,  $\text{NiF}_2 \cdot \text{MoO}_3\text{F}_2 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Delafontaine, J. B. 1867. 236.)

**Potassium fluoxymolybdate**,  $2\text{KF} \cdot \text{MoO}_3\text{F}_2 + \text{H}_2\text{O}$ .

Easily sol. in boiling  $\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in  $\text{HF}$  (Marchetti, Z. anorg. 1895, 10. 68.)

$\text{KF} \cdot \text{MoO}_3\text{F}_2 + \text{H}_2\text{O}$ . Gradually efflorescent. (Delafontaine.)

**Rubidium fluoxymolybdate**,  $2\text{RbF} \cdot 2\text{MoO}_3\text{F}_2 + 2\text{H}_2\text{O}$ .

Sol. in cold, more sol. in hot  $\text{H}_2\text{O}$ . (Delafontaine.)

**Sodium fluoxymolybdate**,  $\text{NaF} \cdot \text{MoO}_3\text{F}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Delafontaine.)

**Thallous fluoxymolybdate**,  $2\text{TlF} \cdot \text{MoO}_3\text{F}_2 + \text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . (Delafontaine.)

**Zinc fluoxymolybdate**,  $\text{ZnF}_2 \cdot \text{MoO}_3\text{F}_2 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Delafontaine.)

**Fluoxypercolumbic acid.**

**Potassium fluoxypercolumbate**,  $2\text{KF} \cdot \text{Cbo}_3\text{F}_2 + \text{H}_2\text{O}$ .

(Piccini, Z. anorg. 2. 21.)

Sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in  $\text{HF}$ . (Marchetti, Z. anorg. 1895, 10. 67.)

**Fluoxypermolybdic acid.**

**Ammonium fluoxypermolybdate**,  $\text{MoO}_3\text{F}_2 \cdot 3\text{NH}_4\text{F}$ .

Sol. in  $\text{H}_2\text{O}$ . (Piccini, Z. anorg. 1. 51.)

**Cæsium fluoxypermolybdate**,  $\text{MoO}_3\text{F}_2 \cdot 2\text{CsF} + \text{H}_2\text{O}$ .

(Piccini)

**Potassium fluoxypermolybdate**,  $\text{MoO}_3\text{F}_2 \cdot 2\text{KF} + \text{H}_2\text{O}$ .

Not very sol. in  $\text{H}_2\text{O}$ ; more sol. in  $\text{HF} + \text{Aq}$  without decomp. (Piccini.)

Rubidium fluoxypermolybdate,  $\text{MoO}_3\text{F}_3$ ,  $2\text{RbF} + \text{H}_2\text{O}$ .

Somewhat more sol. in  $\text{H}_2\text{O}$  than K salt. Easily sol. in  $\text{HF} + \text{Aq.}$  (Piccini.)

#### Fluoxypertantalic acid.

Potassium fluoxypertantalate,  $2\text{KF}$ ,  $\text{TaO}_3\text{F}_3 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Piccini, Z. anorg. 2. 21.)

Fluoxypertitanic acid,  $\text{TiO}_2\text{F}_3$ ,  $\text{HF}$ .

Known only in solution. (Piccini, B. 18. 255 R.)

Ammonium fluoxypertitanate,  $\text{TiO}_2\text{F}_3$ ,  $2\text{NH}_4\text{F}$ .

Very unstable. (Piccini, Gazz. ch. it. 17. 479.)

$\text{TiO}_2\text{F}_3$ ,  $3\text{NH}_4\text{F}$ . Sol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}_2$ . (Piccini, Z. anorg. 1895, 10 439.)

$2\text{TiO}_2\text{F}_3$ ,  $3\text{NH}_4\text{F}$ . Sol. in  $\text{H}_2\text{O}$ . (Piccini, B. 18. 698 R.)

Barium fluoxypertitanate,  $\text{TiO}_2\text{F}_3$ ,  $\text{BaF}_2$ .

Precipitate. Easily sol. in acids. (Piccini, B. 18. 698 R.)

$2\text{TiO}_2\text{F}_3$ ,  $3\text{BaF}_2$ . Insol in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Piccini, Gazz. ch. it. 17. 479.)

Potassium fluoxypertitanate,  $\text{TiO}_2\text{F}_3$ ,  $2\text{KF}$ .

Sol. in  $\text{H}_2\text{O}$ . (Piccini, B. 21. 1391.)

Sol. in  $\text{H}_2\text{O}_2$ . (Piccini, Z. anorg. 1895, 10. 438.)

#### Fluoxypertungstic acid.

Potassium fluoxypertungstate,  $2\text{KF}$ ,  $\text{WO}_3\text{F}_3 + \text{H}_2\text{O}$ .

(Piccini, Z. anorg. 2. 11.)

#### Fluoxytantallic acid.

See also Fluoxypertantallic acid.

Ammonium fluoxytantalate,  $3\text{NH}_4\text{F}$ ,  $\text{TaOF}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ . The solution clouds up by standing or on warming. (Joly, C. R. 81. 1266.)

#### Fluoxytitanic acid.

See also Fluoxypertitanic acid.

Barium fluoxytitanate,  $\text{TiOF}_3$ ,  $\text{BaF}_2$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Piccini, Gazz. ch. it. 17. 479.)

#### Fluoxytungstic acid.

Ammonium fluoxytungstate,  $2\text{NH}_4\text{F}$ ,  $\text{WO}_3\text{F}_3$ .

Very sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (3) 69. 65.)

$\text{NH}_4\text{F}$ ,  $\text{WO}_3\text{F}_3 + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Crystals unchanged from  $\text{H}_2\text{O}$  containing  $\text{HF}$ . (Marignac.)

#### Ammonium fluoxytungstate tungstate,

$4\text{NH}_4\text{F}$ ,  $\text{WO}_3\text{F}_3$ ,  $(\text{NH}_4)_2\text{WO}_4$ .

Incompletely sol. in  $\text{H}_2\text{O}$ . Residue dissolves in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Marignac.)

#### Cadmium fluoxytungstate.

Very sol. in  $\text{H}_2\text{O}$ . (Marignac.)

Cupric fluoxytungstate,  $\text{CuF}_2$ ,  $\text{WO}_3\text{F}_3 + 4\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Marignac, C. R. 55. 883.)

Cupric fluoxytungstate ammonium fluoride,

$\text{CuF}_2$ ,  $\text{WO}_3\text{F}_3$ ,  $\text{NH}_4\text{F} + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

#### Manganese fluoxytungstate.

Very sol. in  $\text{H}_2\text{O}$ . (Marignac.)

Nickel fluoxytungstate,  $\text{NiF}_2$ ,  $\text{WO}_3\text{F}_3 + 10\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Marignac.)

Potassium fluoxytungstate,  $\text{KF}$ ,  $\text{WO}_3\text{F}_3 + \text{H}_2\text{O}$ .

Can be recrystallised without decomp. only from  $\text{H}_2\text{O}$  containing  $\text{HF}$ . (Marignac, A. ch. (3) 69. 70.)

$2\text{KF}$ ,  $\text{WO}_3\text{F}_3 + \text{H}_2\text{O}$ . Difficultly sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Berzelius.)

Sol. in 17 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Marignac.)

Can be recrystallised without decomp. from  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  containing  $\text{HF}$ . (Marignac.)

Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in  $\text{HF}$ .

(Marchetti, Z. anorg. 1895, 10. 71.)

See also Fluoxypertungstate, potassium.

#### Silver fluoxytungstate.

Very easily sol. in  $\text{H}_2\text{O}$ . (Marignac.)

Sodium fluoxytungstate,  $2\text{NaF}$ ,  $\text{WO}_3\text{F}_3$ .

More sol. in  $\text{H}_2\text{O}$  than the corresponding K compound. (Berzelius.)

Thalious fluoxytungstate,  $\text{TlF}$ ,  $\text{WO}_3\text{F}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Ephraim and Heymann, B. 1909, 42. 4463.)

$2\text{TlF}$ ,  $\text{WO}_3\text{F}_3$ . Insol. in  $\text{H}_2\text{O}$  but decomp. thereby. (Ephraim and Heymann, B. 1909, 42. 4462.)

$3\text{TlF}$ ,  $2\text{WO}_3\text{F}_3$ . Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids. (Ephraim and Heymann, B. 1909, 42. 4462.)

Zinc fluoxytungstate,  $\text{ZnF}_2$ ,  $\text{WO}_3\text{F}_3 + 10\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Fluoxxyuronic acid.**

Ammonium fluoxxyurate,  $3\text{NH}_4\text{F}$ ,  $\text{UO}_2\text{F}_2$

Easily sol. in  $\text{H}_2\text{O}$ , less in  $\text{HF}$ . Insol. in alcohol. (Bolton.)

100 g. solution sat. at  $27^\circ$  contain 10.11 g. salt.

100 g. solution sat. at  $81.3^\circ$  contain 20.71 g. salt.

(Burger, Dissert. 1904.)

Barium fluoxxyurate,  $3\text{BaF}_2$ ,  $2\text{UO}_2\text{F}_2 + 2\text{H}_2\text{O}$ .

Traces dissolve in hot  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Bolton.)

Potassium fluoxxyurate,  $3\text{KF}$ ,  $\text{UO}_2\text{F}_2$ .

Sol. in 8 pts  $\text{H}_2\text{O}$  at  $21^\circ$ . Insol. in alcohol and ether. (Bolton, J. pr. 99. 269.)

Does not exist. (Smithells, Chem. Soc. 43. 125.)

$4\text{KF}$ ,  $\text{UO}_2\text{F}_2$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Ditte, C. R. 91. 115.)

$5\text{KF}$ ,  $2\text{UO}_2\text{F}_2$ . (Baker, Chem. Soc. 35. 760.)

$3\text{KF}$ ,  $2\text{UO}_2\text{F}_2 + 2\text{H}_2\text{O}$ . (Baker.)

Sodium fluoxxyurate,  $\text{NaF}$ ,  $\text{UO}_2\text{F}_2$ .

+  $2\text{H}_2\text{O}$ . Not efflorescent

+  $4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sol. in conc.  $\text{HCl} + \text{Aq}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$ .

(Bolton, J. B. 1866. 212.)

$4\text{NaF}$ ,  $\text{UO}_2\text{F}_2$ . (Ditte.)

Does not exist. (Smithells, Chem. Soc. 43. 125.)

**Fluoxxyvanadic acid.**

Ammonium fluoxxyvanadate,  $12\text{NH}_4\text{F}$ ,  $\text{V}_2\text{O}_5$ ,  $2\text{VOF}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ , and not attacked by cold conc.  $\text{H}_2\text{SO}_4$ . (Baker, Chem. Soc. 33. 388.)

Formula is  $3\text{NH}_4\text{F}$ ,  $\text{VO}_2\text{F}$ . (Petersen, J. pr. (2) 40. 289.)

$3\text{NH}_4\text{F}$ ,  $\text{VO}_2\text{F}$ . Sol. in  $\text{H}_2\text{O}$ . (Petersen, l. c.)

Much less sol. in  $\text{H}_2\text{O}$  in presence of  $\text{NH}_4\text{F}$ . (Piccini and Giorgis, Gazz. ch. it. 27. 1. 65.)

+  $\text{H}_2\text{O}$ . (Piccini and Giorgis, Gazz. ch. it. 1892. 22. 55.)

$3\text{NH}_4\text{F}$ ,  $\text{VOF}_3$ . "Hypovanadate" Quite sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{MF} + \text{Aq}$ . Less sol. in alcohol than in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 195.)

$2\text{NH}_4\text{F}$ ,  $\text{VOF}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Petersen.)

+  $\text{H}_2\text{O}$ . (Piccini and Giorgis.)

$7\text{NH}_4\text{F}$ ,  $4\text{VOF}_3 + 5\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Petersen.)

$3\text{NH}_4\text{F}$ ,  $2\text{VO}_2\text{F}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. Sol. in conc.  $\text{HF} + \text{Aq}$ . (Piccini and Giorgis, Gazz. ch. it. 24. 1. 68.)

$3\text{NH}_4\text{F}$ ,  $2\text{VOF}_3 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp.

$\text{V}_2\text{O}_5$ ,  $2\text{NH}_4\text{F}$ . (Ditte, C. R. 106. 270.)

$\text{V}_2\text{O}_5$ ,  $8\text{NH}_4\text{F} + 4\text{H}_2\text{O}$ . As above.

$\text{V}_2\text{O}_5$ ,  $4\text{NH}_4\text{F} + 4\text{H}_2\text{O}$ . As above. Sol. in  $\text{H}_2\text{O}$ .

Ammonium hydrogen fluoxxyvanadate,  $7\text{NH}_4\text{F}$ ,  $\text{HF}$ ,  $4\text{VO}_2\text{F}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 284.)

Ammonium hydrogen trifluoxxyvanadate,  $3\text{HF}$ ,  $9\text{NH}_4\text{F}$ ,  $5\text{VOF}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{MF} + \text{Aq}$ . (Petersen, J. pr. (2) 40. 280.)

$3\text{NH}_4\text{F}$ ,  $3\text{HF}$ ,  $2\text{VOF}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Baker, Chem. Soc. 33. 388.)

Identical with  $3\text{HF}$ ,  $9\text{NH}_4\text{F}$ ,  $5\text{VOF}_3$ . (Petersen.)

Barium fluoxxyvanadate,  $\text{BaF}_2$ ,  $\text{VO}_2\text{F}$ .

Ppt. (Ephraim, Z. anorg. 1903. 35. 79.)

Cadmium fluoxxyvanadate,  $\text{CdF}_2$ ,  $\text{VOF}_3 + 7\text{H}_2\text{O}$ .

"Hypovanadate." As the Co salt. (Piccini and Giorgis.)

Cobalt fluoxxyvanadate,  $\text{CoF}_2$ ,  $\text{VOF}_3 + 7\text{H}_2\text{O}$ .

"Hypovanadate." Sol. in  $\text{H}_2\text{O}$ . (Piccini and Giorgis.)

Nickel fluoxxyvanadate,  $\text{NiF}_2$ ,  $\text{VOF}_3 + 7\text{H}_2\text{O}$ .

"Hypovanadate." As the Co salt. (Piccini and Giorgis.)

Potassium fluoxxyvanadate,  $7\text{KF}$ ,  $3\text{VOF}_3$ .

Very sl. sol. in  $\text{H}_2\text{O}$  and  $\text{MF} + \text{Aq}$ . Easily sol. in dil. acids. (Petersen, J. pr. (2) 40. 199.)

$2\text{KF}$ ,  $\text{VOF}_3$ . As above. (Petersen.)

$2\text{KF}$ ,  $2\text{V}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ . (Ditte, C. R. 105. 1037.)

$2\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ . As above.

$2\text{KF}$ ,  $4\text{V}_2\text{O}_5 + 8\text{H}_2\text{O}$ . As above.

$4\text{KF}$ ,  $\text{V}_2\text{O}_5$ . Less sol. than  $4\text{KF}$ ,  $3\text{V}_2\text{O}_5$ .

+  $2\text{H}_2\text{O}$ , and +  $3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

$4\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$ , and +  $6\text{H}_2\text{O}$ . Less sol. than  $2\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ .

$8\text{KF}$ ,  $\text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ , and +  $3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

Potassium trifluoxxyvanadate,  $2\text{KF}$ ,  $\text{VOF}_3$ .

Ppt. (Petersen, J. pr. (2) 40. 272.)

$6\text{KF}$ ,  $\text{V}_2\text{O}_5$ ,  $2\text{VOF}_3 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in cold conc.  $\text{H}_2\text{SO}_4$ . (Baker, Chem. Soc. 33. 300.)

Formula is  $3\text{KF}$ ,  $2\text{VO}_2\text{F}$ . (Piccini and Giorgis.)

See also Fluovanadate fluoxxyvanadate, potassium.

Potassium fluoxxyvanadate,  $2\text{KF}$ ,  $\text{VO}_2\text{F}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 278.)

3KF, VO<sub>2</sub>F. As above. (Petersen.)  
3KF, 2VO<sub>2</sub>F. Sol. in H<sub>2</sub>O; scarcely attacked by H<sub>2</sub>SO<sub>4</sub>. (Piccini and Giorgis.)

Potassium hydrogen fluoxyvanadate, 3KF, HF, 2VOF<sub>2</sub>.  
Sol. in H<sub>2</sub>O. (Petersen.)

Sodium fluoxyvanadate, 8NaF, 3VOF<sub>2</sub>+2H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Petersen, J. pr. (2) 40, 200.)  
3NaF, VO<sub>2</sub>F, VOF<sub>2</sub> (?). Very easily decomp. (Piccini and Giorgis.)

2NaF, 2V<sub>2</sub>O<sub>5</sub>+10H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Ditte, C. R. 106, 270.)

4NaF, V<sub>2</sub>O<sub>5</sub>. As above.

4NaF, 3V<sub>2</sub>O<sub>5</sub>+18H<sub>2</sub>O. As above.

6NaF, V<sub>2</sub>O<sub>5</sub>+5H<sub>2</sub>O. As above

8NaF, V<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O. (As above)

Thallos fluoxyvanadate, 2TiF, VOF<sub>2</sub>.

Somewhat sol. in cold H<sub>2</sub>O without decomp. Sol. in boiling H<sub>2</sub>O with exception of a black residue, which is easily sol. in dil H<sub>2</sub>SO<sub>4</sub>. (Ephraim, B. 1909, 42, 4460.)

3TiF, 2VO<sub>2</sub>F. Insol. in H<sub>2</sub>O. Sol. in H<sub>2</sub>O containing H<sub>2</sub>SO<sub>4</sub>. (Ephraim and Heymann, B. 1909, 42, 4459.)

Zinc fluoxyvanadate, ZnF<sub>2</sub>, ZnO, 2VOF<sub>2</sub>+14H<sub>2</sub>O.

Decomp. on air; sol. in H<sub>2</sub>O. (Baker, Chem. Soc. 33, 388.)

True composition is represented by the formula ZnF<sub>2</sub>, VO<sub>2</sub>F+7H<sub>2</sub>O. (Petersen.)

ZnF<sub>2</sub>, VO<sub>2</sub>F+7H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Piccini and Giorgis.)

ZnF<sub>2</sub>, VOF<sub>2</sub>+7H<sub>2</sub>O. "Hypovanadate." Sol. in cold H<sub>2</sub>O, but decomp. by boiling; sol. in dil. HF+Aq. (Piccini and Giorgis.)

Fluozirconic acid.

Ammonium fluozirconate, (NH<sub>4</sub>)<sub>2</sub>ZrF<sub>6</sub>.

Sol. in H<sub>2</sub>O.

8NH<sub>4</sub>F, ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O. (Marignac.)

Cadmium fluozirconate, 2CdF<sub>2</sub>, ZrF<sub>4</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O; can be recrystallized therefrom (Marignac, A. ch. (3) 60, 257.)

CdZrF<sub>6</sub>+6H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac.)

Cesium fluozirconate, CsF, ZrF<sub>4</sub>+H<sub>2</sub>O

Sol. in H<sub>2</sub>O without decomp. (Wells, Z. anorg. 1895, 10, 434.)

2CsF, ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O without decomp.

(Wells, Z. anorg. 1895, 10, 434.)

2CsF, 3ZrF<sub>4</sub>+2H<sub>2</sub>O. Only sl. sol. in H<sub>2</sub>O. (Wells, Z. anorg. 1895, 10, 434.)

Cupric fluozirconate, 2CuF<sub>2</sub>, ZrF<sub>4</sub>+12H<sub>2</sub>O.

Easily sol. in cold H<sub>2</sub>O. (Marignac, A. ch. (3) 60, 296.)

3CuF<sub>2</sub>, 2ZrF<sub>4</sub>+16H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac.)

Lithium fluozirconate, 2LiF, ZrF<sub>4</sub>.

Ppt. (Wells, Am. J. Sci. 1897, (4) 3, 468.)

4LiF, ZrF<sub>4</sub>+11H<sub>2</sub>O. Sol. in H<sub>2</sub>O with decomp. (Wells, Am. J. Sci. 1897, (4) 3, 469.)

Magnesium fluozirconate, MgZrF<sub>6</sub>+5H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac.)

Manganous fluozirconate, MnZrF<sub>6</sub>+5H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac, J. pr. 83, 202.)

Nickel fluozirconate, 2NiF<sub>2</sub>, ZrF<sub>4</sub>+12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac, A. ch. (3) 60, 291.)

NiZrF<sub>6</sub>+6H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac.)

Nickel potassium fluozirconate, K<sub>2</sub>ZrF<sub>6</sub>,

NiZrF<sub>6</sub>+8H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac.)

Potassium fluozirconate, KF, ZrF<sub>4</sub>+H<sub>2</sub>O.

Much more sol. in hot, than cold H<sub>2</sub>O. (Marignac.)

2KF, ZrF<sub>4</sub>=K<sub>2</sub>ZrF<sub>6</sub>. 100 pts. H<sub>2</sub>O dissolve at 2°, 0.781 pt.; at 15°, 1.41 pts.; at 19°, 1.69 pts.; at 100°, 25.0 pts. K<sub>2</sub>ZrF<sub>6</sub>. (Marignac.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20, 829.)

3KF, ZrF<sub>4</sub>.

Sodium fluozirconate, 5NaF, ZrF<sub>4</sub>.

100 pts. H<sub>2</sub>O dissolve 0.387 pt. at 18°, and 1.67 pts. at 100° (Marignac.)

2NaF, ZrF<sub>4</sub>. (Wells, Am. J. Sci. 1897, (4) 3, 469.)

5NaF, 2ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O with decomp. (Wells.)

Tellurium fluozirconate, TeF, ZrF<sub>4</sub>.

Sol. in H<sub>2</sub>O without decomp. (Wells, Am. J. Sci. 1897, (4) 3, 470.)

+H<sub>2</sub>O. Sol. in H<sub>2</sub>O without decomp. (Wells.)

3TeF, ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O without decomp. (Wells.)

5TeF, 3ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O without decomp. (Wells.)

Zinc fluozirconate, ZnZrF<sub>6</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac.)

2ZnF<sub>2</sub>, ZrF<sub>4</sub>+12H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac, A. ch. (3) 60, 257.)

Fulminating gold.

See Auroamidoimide.

Fulminating platinum.

See Fulminoplatinum.

**Fluoxxyuramic acid.****Ammonium fluoxxyuranate**,  $3\text{NH}_4\text{F}$ ,  $\text{UO}_2\text{F}_2$ .Easily sol. in  $\text{H}_2\text{O}$ , less in  $\text{HF}$ . Insol. in alcohol. (Bolton.)100 g. solution sat. at  $27^\circ$  contain 10.11 g. salt.100 g. solution sat. at  $81.3^\circ$  contain 20.71 g. salt.

(Burger, Dissert. 1904.)

**Barium fluoxxyuranate**,  $3\text{BaF}_2$ ,  $2\text{UO}_2\text{F}_2 + 2\text{H}_2\text{O}$ .Traces dissolve in hot  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Bolton.)**Potassium fluoxxyuranate**,  $3\text{KF}$ ,  $\text{UO}_2\text{F}_2$ .Sol. in 8 pts.  $\text{H}_2\text{O}$  at  $21^\circ$ . Insol. in alcohol and ether. (Bolton, J. pr. 99. 269.)

Does not exist. (Smithells, Chem. Soc. 43. 125.)

 $4\text{KF}$ ,  $\text{UO}_2\text{F}_2$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Ditte, C. R. 91. 115.) $5\text{KF}$ ,  $2\text{UO}_2\text{F}_2$ . (Baker, Chem. Soc. 35. 760.) $3\text{KF}$ ,  $2\text{UO}_2\text{F}_2 + 2\text{H}_2\text{O}$ . (Baker.)**Sodium fluoxxyuranate**,  $\text{NaF}$ ,  $\text{UO}_2\text{F}_2$ . $+2\text{H}_2\text{O}$ . Not efflorescent. $+4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sl. sol. in conc.  $\text{HCl} + \text{Aq}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Bolton, J. B. 1866. 212.) $4\text{NaF}$ ,  $\text{UO}_2\text{F}_2$ . (Ditte.)

Does not exist. (Smithells, Chem. Soc. 43. 125.)

**Fluoxxyvanadic acid.****Ammonium fluoxxyvanadate**,  $12\text{NH}_4\text{F}$ ,  $\text{V}_2\text{O}_5$ ,  $2\text{VOF}_2$ .Easily sol. in  $\text{H}_2\text{O}$ , and not attacked by cold conc.  $\text{H}_2\text{SO}_4$ . (Baker, Chem. Soc. 33. 388.)Formula is  $3\text{NH}_4\text{F}$ ,  $\text{VO}_2\text{F}$ . (Petersen, J. pr. (2) 40. 289.) $3\text{NH}_4\text{F}$ ,  $\text{VO}_2\text{F}$ . Sol. in  $\text{H}_2\text{O}$ . (Petersen, l. c.)Much less sol. in  $\text{H}_2\text{O}$  in presence of  $\text{NH}_4\text{F}$  (Piccini and Giorgis, Gazz. ch. it. 27. 1. 65.) $+ \text{H}_2\text{O}$ . (Piccini and Giorgis, Gazz. ch. it. 1892. 22. 55.) $3\text{NH}_4\text{F}$ ,  $\text{VOF}_2$ . "Hypovanadate." Quite sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{MF} + \text{Aq}$ . Less sol. in alcohol than in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 195.) $2\text{NH}_4\text{F}$ ,  $\text{VOF}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Petersen.) $+ \text{H}_2\text{O}$ . (Piccini and Giorgis.) $7\text{NH}_4\text{F}$ ,  $4\text{VOF}_2 + 5\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Petersen.) $3\text{NH}_4\text{F}$ ,  $2\text{VO}_2\text{F}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. Sol. in conc.  $\text{HF} + \text{Aq}$ . (Piccini and Giorgis, Gazz. ch. it. 24. 1. 68.) $3\text{NH}_4\text{F}$ ,  $2\text{VOF}_2 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. $\text{V}_2\text{O}_5$ ,  $2\text{NH}_4\text{F}$ . (Ditte, C. R. 106. 270.) $\text{V}_2\text{O}_5$ ,  $8\text{NH}_4\text{F} + 4\text{H}_2\text{O}$ . As above. $\text{V}_2\text{O}_5$ ,  $4\text{NH}_4\text{F} + 4\text{H}_2\text{O}$ . As above. Sol. in  $\text{H}_2\text{O}$ .**Ammonium hydrogen fluoioxyvanadate**,  $7\text{NH}_4\text{F}$ ,  $\text{HF}$ ,  $4\text{VO}_2\text{F}$ .Very sol. in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 284.)**Ammonium hydrogen trifluoxxyvanadate**,  $3\text{HF}$ ,  $9\text{NH}_4\text{F}$ ,  $5\text{VOF}_2$ .Easily sol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{MF} + \text{Aq}$ . (Petersen, J. pr. (2) 40. 280.) $3\text{NH}_4\text{F}$ ,  $3\text{HF}$ ,  $2\text{VOF}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Baker, Chem. Soc. 33. 388.)Identical with  $3\text{HF}$ ,  $9\text{NH}_4\text{F}$ ,  $5\text{VOF}_2$ . (Petersen.)**Barium fluoxxyvanadate**,  $\text{BaF}_2$ ,  $\text{VO}_2\text{F}$ .

Ppt. (Ephraim, Z. anorg. 1903. 35. 79.)

**Cadmium fluoxxyvanadate**,  $\text{CdF}_2$ ,  $\text{VOF}_2 + 7\text{H}_2\text{O}$ .

"Hypovanadate." As the Co salt. (Piccini and Giorgis.)

**Cobalt fluoxxyvanadate**,  $\text{CoF}_2$ ,  $\text{VOF}_2 + 7\text{H}_2\text{O}$ ."Hypovanadate." Sol. in  $\text{H}_2\text{O}$ . (Piccini and Giorgis.)**Nickel fluoxxyvanadate**,  $\text{NiF}_2$ ,  $\text{VOF}_2 + 7\text{H}_2\text{O}$ .

"Hypovanadate." As the Co salt. (Piccini and Giorgis.)

**Potassium fluoxxyvanadate**,  $7\text{KF}$ ,  $3\text{VOF}_2$ .Very sl. sol. in  $\text{H}_2\text{O}$  and  $\text{MF} + \text{Aq}$ . Easily sol. in dil. acids. (Petersen, J. pr. (2) 40. 199.) $2\text{KF}$ ,  $\text{VOF}_2$ . As above. (Petersen.) $2\text{KF}$ ,  $2\text{V}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ . (Ditte, C. R. 105. 1067.) $2\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ . As above. $2\text{KF}$ ,  $4\text{V}_2\text{O}_5 + 8\text{H}_2\text{O}$ . As above. $4\text{KF}$ ,  $\text{V}_2\text{O}_5$ . Less sol. than  $4\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ , and  $+3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . $4\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$ , and  $+6\text{H}_2\text{O}$ . Less sol. than  $2\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ . $8\text{KF}$ ,  $\text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ , and  $+3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .**Potassium trifluoxxyvanadate**,  $2\text{KF}$ ,  $\text{VOF}_2$ .

Ppt. (Petersen, J. pr. (2) 40. 272.)

 $6\text{KF}$ ,  $\text{V}_2\text{O}_5$ ,  $2\text{VOF}_2 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in cold conc.  $\text{H}_2\text{SO}_4$ . (Baker, Chem. Soc. 33. 300.)Formula is  $3\text{KF}$ ,  $2\text{VO}_2\text{F}$ . (Piccini and Giorgis.)

See also Fluovanadate fluoxxyvanadate, potassium.

**Potassium fluoioxyvanadate**,  $2\text{KF}$ ,  $\text{VO}_2\text{F}$ .Easily sol. in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 278.)

- 3KF, VO<sub>2</sub>F. As above. (Petersen.)  
 3KF, 2VO<sub>2</sub>F. Sol. in H<sub>2</sub>O; scarcely attacked by H<sub>2</sub>SO<sub>4</sub>. (Piccini and Giorgis.)
- Potassium hydrogen fluoxyvanadate**, 3KF, HF, 2VOF<sub>2</sub>.  
 Sol. in H<sub>2</sub>O. (Petersen.)
- Sodium fluoxyvanadate**, 8NaF, 3VOF<sub>2</sub>+2H<sub>2</sub>O.  
 Sol. in H<sub>2</sub>O. (Petersen, J. pr. (2) 40, 200.)  
 3NaF, VO<sub>2</sub>F, VOF<sub>2</sub> (?). Very easily decomp. (Piccini and Giorgis.)  
 2NaF, 2V<sub>2</sub>O<sub>5</sub>+10H<sub>2</sub>O Sol. in H<sub>2</sub>O. (Ditte, C. R. 106. 270.)  
 4NaF, V<sub>2</sub>O<sub>5</sub>. As above  
 4NaF, 3V<sub>2</sub>O<sub>5</sub>+18H<sub>2</sub>O. As above.  
 6NaF, V<sub>2</sub>O<sub>5</sub>+5H<sub>2</sub>O. As above.  
 8NaF, V<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O. (As above.)
- Thalious fluoxyvanadate**, 2TiF, VOF<sub>2</sub>.  
 Somewhat sol. in cold H<sub>2</sub>O without decomp.  
 Sol. in boiling H<sub>2</sub>O with exception of a black residue, which is easily sol. in dil H<sub>2</sub>SO<sub>4</sub>. (Ephraim, B. 1909, 42. 4460.)  
 3TiF, 2VO<sub>2</sub>F. Insol. in H<sub>2</sub>O. Sol. in H<sub>2</sub>O containing H<sub>2</sub>SO<sub>4</sub>. (Ephraim and Heymann, B. 1909, 42. 4459.)
- Zinc fluoxyvanadate**, ZnF<sub>2</sub>, ZnO, 2VOF<sub>2</sub>+14H<sub>2</sub>O.  
 Decomp. on air; sol. in H<sub>2</sub>O. (Baker, Chem. Soc. 33. 388.)  
 True composition is represented by the formula ZnF<sub>2</sub>, VO<sub>2</sub>F+7H<sub>2</sub>O. (Petersen)  
 ZnF<sub>2</sub>, VO<sub>2</sub>F+7H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Piccini and Giorgis.)  
 ZnF<sub>2</sub>, VOF<sub>2</sub>+7H<sub>2</sub>O "Hypovanadate."  
 Sol. in cold H<sub>2</sub>O, but decomp. by boiling; sol. in dil. HF+Aq. (Piccini and Giorgis.)
- Fluozirconic acid.**
- Ammonium fluozirconate**, (NH<sub>4</sub>)<sub>2</sub>ZrF<sub>6</sub>.  
 Sol. in H<sub>2</sub>O.  
 3NH<sub>4</sub>F, ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O. (Marignac.)
- Cadmium fluozirconate**, 2CdF<sub>2</sub>, ZrF<sub>4</sub>+6H<sub>2</sub>O.  
 Sol. in H<sub>2</sub>O; can be recrystallised therefrom. (Marignac, A. ch. (3) 60. 257.)  
 CdZrF<sub>6</sub>+6H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac.)
- Cæsium fluozirconate**, CsF, ZrF<sub>4</sub>+H<sub>2</sub>O.  
 Sol. in H<sub>2</sub>O without decomp. (Wells, Z. anorg. 1895, 10. 434.)  
 2CsF, ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O without decomp. (Wells, Z. anorg. 1895, 10. 434.)  
 2CsF, 3ZrF<sub>4</sub>+2H<sub>2</sub>O. Only sl. sol. in H<sub>2</sub>O. (Wells, Z. anorg. 1895, 10. 434.)
- Cupric fluozirconate**, 2CuF<sub>2</sub>, ZrF<sub>4</sub>+12H<sub>2</sub>O.  
 Easily sol. in cold H<sub>2</sub>O. (Marignac, A. ch. (3) 60. 296.)  
 3CuF<sub>2</sub>, 2ZrF<sub>4</sub>+16H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac.)
- Lithium fluozirconate**, 2LiF, ZrF<sub>4</sub>.  
 Ppt. (Wells, Am. J. Sci. 1897, (4) 3. 468.)  
 4LiF, ZrF<sub>4</sub>+ $\frac{1}{2}$ H<sub>2</sub>O. Sol. in H<sub>2</sub>O with decomp. (Wells, Am. J. Sci. 1897, (4) 3. 469.)
- Magnesium fluozirconate**, MgZrF<sub>6</sub>+5H<sub>2</sub>O.  
 Sol. in H<sub>2</sub>O. (Marignac.)
- Manganous fluozirconate**, MnZrF<sub>6</sub>+5H<sub>2</sub>O.  
 Sol. in H<sub>2</sub>O. (Marignac, J. pr. 83. 202.)
- Nickel fluozirconate**, 2NiF<sub>2</sub>, ZrF<sub>4</sub>+12H<sub>2</sub>O.  
 Sol. in H<sub>2</sub>O. (Marignac, A. ch. (3) 60. 291.)  
 NiZrF<sub>6</sub>+6H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac.)
- Nickel potassium fluozirconate**, K<sub>2</sub>ZrF<sub>6</sub>, NiZrF<sub>6</sub>+8H<sub>2</sub>O.  
 Sol. in H<sub>2</sub>O. (Marignac.)
- Potassium fluozirconate**, KF, ZrF<sub>4</sub>+H<sub>2</sub>O.  
 Much more sol. in hot, than cold H<sub>2</sub>O. (Marignac.)  
 2KF, ZrF<sub>4</sub>=K<sub>2</sub>ZrF<sub>6</sub>. 100 pts. H<sub>2</sub>O dissolve at 2°, 0.781 pt.; at 15°, 1.41 pts.; at 19°, 1.69 pts.; at 100°, 25.0 pts. K<sub>2</sub>ZrF<sub>6</sub>. (Marignac.)  
 Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1895, 20. 829.)  
 3KF, ZrF<sub>4</sub>.
- Sodium fluozirconate**, 5NaF, ZrF<sub>4</sub>.  
 100 pts. H<sub>2</sub>O dissolve 0.387 pt. at 18°, and 1.67 pts. at 100°. (Marignac.)  
 2NaF, ZrF<sub>4</sub>. (Wells, Am. J. Sci. 1897, (4) 3. 469.)  
 5NaF, 2ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O with decomp. (Wells)
- Tellurium fluozirconate**, TeF, ZrF<sub>4</sub>.  
 Sol. in H<sub>2</sub>O without decomp. (Wells, Am. J. Sci. 1897, (4) 3. 470.)  
 +H<sub>2</sub>O. Sol. in H<sub>2</sub>O without decomp. (Wells.)  
 3TeF, ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O without decomp. (Wells.)  
 5TeF, 3ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O without decomp. (Wells.)
- Zinc fluozirconate**, ZnZrF<sub>6</sub>+6H<sub>2</sub>O.  
 Sol. in H<sub>2</sub>O. (Marignac.)  
 2ZnF<sub>2</sub>, ZrF<sub>4</sub>+12H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac, A. ch. (3) 60. 257.)
- Fulminating gold.**  
 See Auroamidoimide.
- Fulminating platinum.**  
 See Fulminoplatinum.

**Fulminating silver.**

See Silver nitride.

**Fulminoplatinum compounds.**

See—

*Dichlorofulminoplatinum.*

*Trichlorofulminoplatinum.*

*Tetrachlorofulminoplatinum.*

*Chloroxyfulminoplatinum.*

**Fusocobaltic chloride,  $\text{Co}(\text{NH}_3)_4(\text{OH})\text{Cl}_2 + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by  $\text{NH}_4\text{Cl} + \text{Aq}$ , decomp. by boiling  $\text{H}_2\text{O}$ ; pptd. from aqueous solution by alcohol. (Fremy, C. R. 32, 501.)

— nitrate,  $\text{Co}(\text{NH}_3)_4(\text{OH})(\text{NO}_3)_2 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Properties as the chloride. (Fremy)

— sulphate,  $\text{Co}(\text{NH}_3)_4(\text{OH})\text{SO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Fremy, C. R. 32, 501.)

Insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl} + \text{Aq}$ , or  $\text{H}_2\text{SO}_4$ , from which it is precipitated by  $\text{H}_2\text{O}$  (Vortmann, N. 6, 412.)

**Fusible white precipitate.**

See Mercuridiammonium chloride.

**Gadolinium, Gd.**

(Marignac, C. R. 102, 92.)

**Gadolinium bromide,  $\text{GdBr}_3 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{HBr}$ . (Benedicks, Z. anorg. 1900, 22, 403.)

**Gadolinium chloride,  $\text{GdCl}_3 + 6\text{H}_2\text{O}$ .**

Somewhat deliquescent. Sol. in  $\text{H}_2\text{O}$  (Benedicks.)

**Gadolinium platinum chloride.**

See Chloroplatinate, gadolinium.

**Gadolinium fluoride,  $\text{GdF}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in hot  $\text{HF}$ . (Popovici, B. 1908, 41, 635.)

**Gadolinium hydroxide,  $\text{Gd}(\text{OH})_3$ .**

Ppt. (Benedicks, Z. anorg. 1900, 22, 402.)

**Gadolinium oxide,  $\text{Gd}_2\text{O}_3$ .**

Sol. in acids. (de Boisbaudran, C. R. 111, 394.)

Somewhat hygroscopic; easily sol. in acids. (Benedicks.)

**Gallium, Ga.**

Not decomp. by  $\text{H}_2\text{O}$ ; easily sol. in cold  $\text{HCl} + \text{Aq}$ . Slowly sol. in warm dil.  $\text{HNO}_3 + \text{Aq}$ . Not attacked by conc.  $\text{HNO}_3$ , free from

$\text{N}_2\text{O}_5$  below  $40-50^\circ$ , and only slowly in presence of  $\text{N}_2\text{O}_3$ . (Dupré, C. R. 86, 720.)

Easily sol. in cold or warm  $\text{KOH} + \text{Aq}$ . (de Boisbaudran, A. ch. (5) 10, 100)

**Gallium bromide,  $\text{GaBr}_3$ .**

Deliquescent, and sol. in  $\text{H}_2\text{O}$ .

**Gallium dichloride,  $\text{GaCl}_2$ .**

Deliquescent, and decomp. by  $\text{H}_2\text{O}$ . (Nilsson and Petersen, C. R. 107, 527.)

**Gallium chloride,  $\text{GaCl}_3$ .**

Deliquescent, and very sol. in little  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$ , with formation of basic salt, which is slowly sol. in dil.  $\text{HCl} + \text{Aq}$

**Gallium hydroxide.**

Sol. in acids; sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ , less easily in  $\text{NH}_4\text{OH} + \text{Aq}$ , even in presence of ammonium salts.

**Gallium iodide,  $\text{GaI}_3$ .**

Deliquescent, and sol. in  $\text{H}_2\text{O}$  (de Boisbaudran and Jungfleisch, C. R. 86, 578)

**Gallium suboxide,  $\text{Ga}_2\text{O}_3$  (?)**

Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Dupré)

Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

**Gallium oxide,  $\text{Ga}_2\text{O}_3$ .**

Sol. in acids.

**Germanium, Ge.**

Insol. in  $\text{HCl} + \text{Aq}$ . Easily sol. in aqua regia. Decomp. by  $\text{HNO}_3 + \text{Aq}$  to oxide. Conc.  $\text{H}_2\text{SO}_4$  decomp. to sulphate. Insol. in boiling  $\text{KOH} + \text{Aq}$  (Winkler, J. pr. (2) 34, 177; 36, 177.)

**Germanium tetrabromide,  $\text{GeBr}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Winkler.)

**Germanium dichloride,  $\text{GeCl}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Winkler.)

**Germanium tetrachloride,  $\text{GeCl}_4$ .**

Sinks in  $\text{H}_2\text{O}$ , and is gradually decomp. thereby. (Winkler, J. pr. 34, 177.)

Insol. in and not attacked by hot conc.  $\text{H}_2\text{SO}_4$ . (Friedrich, W. A. B. 102, 2b, 540.)

**Germanium chloroform,  $\text{GeHCl}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . (Winkler.)

**Germanium tetrafluoride,  $\text{GeF}_4$ .**

Deliquescent, and sol. in  $\text{H}_2\text{O}$ .  $+3\text{H}_2\text{O}$ . Deliquescent. Melts in its crystal  $\text{H}_2\text{O}$  when warmed. (Winkler.)

**Germanium potassium fluoride.***See* Fluogermanate, potassium.**Germanium hydride,  $\text{GeH}_4$ .**Sl. sol. in hot  $\text{HCl}$  Sol. in  $\text{NaOCl} + \text{Aq.}$   
(Vogelen, *Z. anorg.* 1902, 30. 327)**Germanium tetraiodide,  $\text{GeI}_4$** Deliquescent, and sol. in  $\text{H}_2\text{O}$  with decomp.  
(Winkler)**Germanium monoxide,  $\text{GeO}$ .**Not appreciably sol. in dil  $\text{H}_2\text{SO}_4 + \text{Aq.}$   
Easily sol. in  $\text{HCl} + \text{Aq.}$  Insol. in alkalis.  
(Winkler, *J. pr.* (2) 34. 177.)Somewhat sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{H}_2\text{SO}_4 + \text{Aq.}$   
even when hot and conc. (van Bemmelen, *R. t. c.* 6. 205.)**Germanium dioxide,  $\text{GeO}_2$ .**Not very difficultly sol. in  $\text{H}_2\text{O}$ .  
Sol. in 247.1 pts  $\text{H}_2\text{O}$  at  $20^\circ$ ; in 93.3 pts.  
at  $100^\circ$ . (Winkler.)Easily sol. in alkali carbonates or hydrates  
+  $\text{Aq.}$ ; sl. sol. in acids.**Germanium oxychloride,  $\text{GeOCl}_3$ .**Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Winkler, *J. pr.* (2) 36. 177.)**Germanium monosulphide,  $\text{GeS}$** Sol. in 402.9 pts.  $\text{H}_2\text{O}$ . Sol. in conc. hot  
 $\text{HCl} + \text{Aq.}$  Sol. in  $\text{KOH} + \text{Aq.}$  Sol. in  
 $(\text{NH}_4)_2\text{S} + \text{Aq}$  when precipitated. Insol. in  
 $(\text{NH}_4)_2\text{S} + \text{Aq}$  if crystalline. Also exists in a  
colloidal state. (Winkler.)**Germanium disulphide,  $\text{GeS}_2$ .**Sol. in 221.9 pts.  $\text{H}_2\text{O}$ . Easily sol. in  
 $\text{KOH} + \text{Aq.}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  Insol. in acids.  
Exists also in a colloidal state. (Winkler.)**Glass.**

Numerous and extensive researches have been made on the action of  $\text{H}_2\text{O}$  and various solutions on glass. The older work has a certain historical interest, but only a brief statement of some of the more important results can be given here. For a very thorough résumé of the work before the year 1861, Storer's Dictionary, p. 555, should be consulted.

All glass is more or less attacked by  $\text{H}_2\text{O}$ , the more easily the greater the amount of alkali present, the finer it is powdered, and the higher the temperature.

Glass, as that of a flask, is decomposed to a considerable extent by several days' boiling with  $\text{H}_2\text{O}$ , a portion of the fixed alkali being dissolved, but when powdered glass is rubbed with distilled  $\text{H}_2\text{O}$  in a mortar, the  $\text{H}_2\text{O}$  remains pure and exhibits no alkalinity. (Schuele.)

Glass of aluminosilicates is partially dissolved by long boiling with  $\text{H}_2\text{O}$ . (Luvolser)

$\text{H}_2\text{O}$  extracts potash or soda from glass together with

a portion of the silicates, the decomposition taking place the more easily in proportion as the glass is richer in alkalis, more minutely divided, or the temperature of the water higher. (Beechhof, *Kunst. Arch.* 1. 143.)

Powdered crown glass and some varieties of window glass render cold  $\text{H}_2\text{O}$  alkaline when in contact therewith. (Dumas.)

100 pts. finely divided flint glass lose 7 pts. potash when boiled one week with  $\text{H}_2\text{O}$ . (Griffiths, *Q. J. Sci.* 20. 258.)

Retorts of ordinary or flint glass are partially dissolved by  $\text{H}_2\text{O}$  when it is evaporated therein. (Chevreul, 1811.)

Finely powdered plate glass (Faraday, *Pogg.* 18. 509), and Thüringian potash glass (Ludwig, *Arch. Pharm.* 91. 17) reddens moistened turmeric paper.

The alkaline reaction disappears by continued washing, but reappears when the glass is frantically rubbed. (Griffiths.)

Cold  $\text{H}_2\text{O}$  takes up  $\text{SiO}_2$  as well as alkali from glass powder. (Fuchs.)

Powdered lead glass gives up appreciable amounts of  $\text{PbO}$  to weakly acidified  $\text{H}_2\text{O}$ . (Pelouze.)

When powdered white glass, containing 12.4%  $\text{Na}_2\text{O}$ , 15.5%  $\text{CaO}$ , and 72.1%  $\text{SiO}_2$ , is treated repeatedly with  $\text{H}_2\text{O}$ , more than 3% of the glass is dissolved, and the undissolved part gives up 1.6%  $\text{CaO}$  to  $\text{HCl} + \text{Aq}$  with effervescence. A glass containing more alkali, 1.4, 6.16, 3%  $\text{Na}_2\text{O}$ , 6.4%  $\text{CaO}$ , 77.3%  $\text{SiO}_2$ , lost with the same treatment 18.2%, and the residue gave up 2%  $\text{CaO}$  to  $\text{HCl} + \text{Aq}$ . (Pelouze, *C. R.* 13. 117.)

In the above case the fineness of the glass has an influence as well as its composition. When the same sample of glass was boiled 1 hour with  $\text{H}_2\text{O}$ , amounts were dissolved in the proportion 1.4, 28, according as the glass was in form of a coarse, fine, or very fine powder. Glass of the composition of the above samples, as given by Pelouze, lost 10 and 32% respectively.

If powdered glass is boiled with  $\text{H}_2\text{O}$  and  $\text{CO}_2$  conducted into the solution, it is absorbed, if boiled with  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$  is dissolved. (Pelouze.)

Glass tubes are converted into a white crystalline mass by heating with  $\text{H}_2\text{O}$  several months to  $75-150^\circ$ , lead glass and Bohemian glass most easily, English crown glass least. A little  $\text{H}_2\text{O}$  attacks glass more than much  $\text{H}_2\text{O}$ .

The action of  $\text{H}_2\text{O}$  is greatly increased by finely pulverising the glass.

$\text{H}_2\text{O}$  dissolved 10% of a glass containing 12%  $\text{Na}_2\text{O}$ , 15.5%  $\text{CaO}$ , and 72.5%  $\text{SiO}_2$ , and 32% of another glass containing 16.3%  $\text{Na}_2\text{O}$ , 6.4%  $\text{CaO}$ , and 77.3%  $\text{SiO}_2$ . (Vogel, *B. A. Munchen*, 1867. 437.)

Action of  $\text{H}_2\text{O}$  on a glass containing 74%  $\text{SiO}_2$ , 8.6%  $\text{CaO}$ , 14%  $\text{Na}_2\text{O}$ , 0.6%  $\text{K}_2\text{O}$ , with traces of  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{MnO}$ , and  $\text{MgO}$ .

By boiling with  $\text{H}_2\text{O}$  a decrease of 3.9 mg. was observed for the first hour, which soon became constant at 2.2 mg. per hour. The action was then proportional to the time, and also to the surface in contact with the liquid, but independent of the amount of liquid evaporating.

The action decreases rapidly with the temperature, so that at  $90-100^\circ$  only  $\frac{1}{4}$  as much glass is dissolved as by boiling  $\text{H}_2\text{O}$ . (Emmerling, *A.* 160. 257.)

When steam condenses in tubes of Na glass, they are so strongly attacked that the  $\text{H}_2\text{O}$  has an alkaline reaction, but tubes of hard or Bohemian K glass are not so strongly attacked. (Tollens, *B.* 9. 1540.)

The effect of  $\text{H}_2\text{O}$  is so great as to impart a distinctly alkaline reaction to water condensing in a tube of ordinary glass. By condensing water in long tubes of various kinds of glass the following results were obtained.

I. Easily fusible Thuringian glass. Surface exposed = 324 sq. cm.

After 2 hours, 62.0 mg. KOH were dissolved.

After 3 hours more, 36.0 mg. KOH were dissolved.

After 3 hours more, 33.2 mg. KOH were dissolved.

After 3 hours more, 20.8 mg. KOH were dissolved.

After 3 hours more, 20.8 mg. KOH were dissolved.

Or, in 14 hours, 172.8 mg. KOH were dissolved.

II. Less easily fusible Thuringian glass. Surface exposed = 490 sq. cm.

After 3 hours, 19.2 mg. KOH were dissolved.

After 3 hours more, 15.2 mg. KOH were dissolved.

After 3 hours more, 12.4 mg. KOH were dissolved.

After 3 hours more, 11.2 mg. KOH were dissolved.

Or, after 12 hours, 58.0 mg. KOH were dissolved.

III. Combustion tubing of very difficultly fusible Bohemian glass. Surface exposed = 1130 sq. cm.

After 3 hours 4.16 mg. KOH were dissolved.

After 3 hours more 4.16 mg. KOH were dissolved.

After 3 hours more 4.16 mg. KOH were dissolved.

After 3 hours more 4.16 mg. KOH were dissolved.

Or, after 12 hours, 16.64 mg. KOH were dissolved.

IV. Easily fusible Bohemian glass. Surface exposed = 1394 sq. cm.

After 3 hours, 7.88 mg. KOH were dissolved.

After 3 hours more, 8.56 mg. KOH were dissolved.

After 3 hours more, 1.97 mg. KOH were dissolved.

Or, after 9 hours, 24.32 mg. KOH were dissolved. (Kreusler and Henzold, B. 17. 34.)

From the above the following table has been calculated.

50 ccm. H<sub>2</sub>O dissolves from a surface of 1000 sq. m in 1 hour:—

96.0 mg. from easily fusible Thuringian glass.

12.8 mg. from less fusible Thuringian glass.

1.2 mg. from combustion tube of Bohemian glass.

2.0 mg. from harder tube of Bohemian glass.

(Kreusler and Henzold, B. 17. 34.)

100 ccm. H<sub>2</sub>O dissolves so much glass from a flask every 2 seconds when in contact therewith that 0.1 ccm.  $\frac{1}{2}$  normal oxalic acid is neutralised thereby (Bohlig, Z. anal. 23. 518.)

Action of H<sub>2</sub>O on various kinds of Na glass  
1 g of finely powdered glass was boiled 10–15 minutes in a silver dish with 100 ccm. H<sub>2</sub>O, and the per cent of Na<sub>2</sub>O (or K<sub>2</sub>O) in the solution was determined.

	%Na <sub>2</sub> O (K <sub>2</sub> O)
Orthoclase feldspar . . . . .	0 17
Glass of a Bohemian combustion tube . . . . .	0 56
“ flask (German manuf.) . . . . .	0 69
“ champagne bottle . . . . .	1 7
Natrolite . . . . .	1 32
Glass of a wine bottle (Hungarian) . . . . .	2 22
Glass which was attacked by H <sub>2</sub> O under pressure . . . . .	3 7
Lead glass . . . . .	3 8
Glass that broke easily . . . . .	4 8
Glass tubing that became rough when fused . . . . .	6 1
Glass tubing that became opaque by fusing . . . . .	14 35
Solid water glass . . . . .	28 97

(Wartha, Z. anal. 24. 220)

The relative ease by which various kinds of glass are attacked by H<sub>2</sub>O is shown by the following table. The glass was powdered and heated on a water bath with exclusion of atmospheric CO<sub>2</sub>.

Potassium water glass . . . . .	291
Sodium water glass . . . . .	196
Yellow glass rich in alkali . . . . .	34
Thuringian glass . . . . .	19
Ditto from Tittel and Co. . . . .	8
Window glass . . . . .	8
Lead glass from Jena . . . . .	6
Bohemian glass from Kavalier . . . . .	2 4
Lead crystal glass . . . . .	1 4
Thermometer glass, 16IV, from Jena . . . . .	1 0
Zinc glass, 362, from Jena . . . . .	0 8
Lead glass, 434, from Jena . . . . .	0 6
Lead glass, 433, from Jena . . . . .	0 2
Heaviest lead silicate, from Jena . . . . .	0 0

(Mylus, C. C. 1888. 1313.)

Solubility of various kinds of glass in H<sub>2</sub>O.

The amounts dissolved from various kinds of glass by heating 5 hours with H<sub>2</sub>O were as follows.

Yellow glass rich in alkali (13% K <sub>2</sub> O, 15% Na <sub>2</sub> O) . . . . .	249 mg.
Poor Thuringian glass (6.6% K <sub>2</sub> O, 16.5% Na <sub>2</sub> O) . . . . .	91.4 “
Glass from Tittel and Co. (7.1% K <sub>2</sub> O, 14.3% Na <sub>2</sub> O) . . . . .	30 4 “
Bottle glass from Schilling (4.2% K <sub>2</sub> O, 11.9% Na <sub>2</sub> O) . . . . .	13 0 “
Bohemian glass from Kavalier (13.3% K <sub>2</sub> O, 11.4% Na <sub>2</sub> O) . . . . .	10 1 “
Rhenish window glass (13.5% Na <sub>2</sub> O) . . . . .	8 4 “
Lead crystal glass from Ehrenfeld (12.1% K <sub>2</sub> O) . . . . .	8.5 “
Green bottle glass (1.3% K <sub>2</sub> O, 9.5% Na <sub>2</sub> O) . . . . .	6.5 “

Solubility of various kinds of glass in  $H_2O$ —  
*Continued.*

Thermometer glass 16III from	
• Jena (14.0% $Na_2O$ , 7% $ZnO$ )	6.4 mg.
Lead glass, No. 483, from Jena	
(47% $PbO$ , 7.3% $K_2O$ )	3.3 "
Lead silicate	0.6 "
(Mylius and Forster, B. 22, 1100)	

By calculation from the electrical conductivity of the solutions formed, various data were obtained by Kohlrausch (B. 24, 3565), which showed that different varieties of glass were attacked in very different degree by cold  $H_2O$ , and, moreover, the amount dissolved was proportionately much greater during the first few minutes of treatment with  $H_2O$  than afterwards, and, furthermore, the rate of decrease was much faster for good glass than poor. Increase of temperature increased the rate of solubility to a very great degree, the increase for  $1^\circ C$  being about 17%. In 7 hours at  $80^\circ$  half as much was dissolved as in 6 months at  $18^\circ$ . Extensive tables are given (Kohlrausch, B. 24, 3651.) See also Kohlrausch (W. Ann. 44, 577).

A very extensive research on the action of  $H_2O$  on glass, with a historical review of the work previously done on the subject, has been published by Mylius and Forster. (Z. anal. 31, 241.) The general results may be summed up as follows:—

1. The solution of glass in  $H_2O$  is caused by a decomposition, by which free alkali is formed.

2. The silicic acid of the glass is brought into solution by a secondary reaction of the free alkali in the solution.

3. The constituents of the solution change according to the conditions of the digestion.

4. The amount of alkali going into solution from a given surface under certain conditions is a measure for the resistance of a glass under those conditions.

5. The rate of attack of glass surfaces by cold  $H_2O$  decreases rapidly with the length of time of digestion, and finally approaches a constant value.

6. The solubility increases very rapidly with increase of temperature.

7. The ratio of the solubility of several kinds of glass is dependent on the temperature.

8. From glasses which show the same ease of attack unequal amounts of substance may be dissolved.

9. The solubility of a glass is influenced by the condition of the surface from "weathering" by prolonged exposure to the  $CO_2$  and  $H_2O$  of the air.

10. The poorer a glass is the less will its solubility decrease by prolonged treatment with  $H_2O$ .

11. A good glass is essentially less easily

attacked after having been previously treated with  $H_2O$ .

12. After treatment with  $H_2O$ , glass surfaces have the property of fixing alkali from the solutions formed, and giving it up again by a subsequent treatment with  $H_2O$ .

13. Potassium glass is much more sol. than sodium glass (contrary to previous researches), but the difference decreases as the glass becomes richer in  $CaO$ .

14. In glass flasks which are to be only slightly attacked by cold or hot  $H_2O$ , the  $CaO$ , alkalis, and  $SiO_2$  must stand in a fixed relation to each other.

15. Of the more common varieties of glass, lead flint glass is least sol. in  $H_2O$ , but its surface is corroded, and it is easily decomposed by acids.

(Mylius and Forster, Z. anal. 31, 241.)

Bottle glass containing much  $Al_2O_3$  is easily attacked by acids.

From powdered flint glass, boiling  $HCl + Aq$  extracts  $K$ , but no  $Pb$  (Griffiths).

Bottles of flint glass with  $(NH_4)_2CO_3 + Aq$  became so fragile that on shaking pieces of glass were detached (Griffiths).

All glass is decomposed by  $HF$ .

Conc.  $H_3PO_4$  also attacks all glass.

Glass containing small amounts of  $SiO_2$  are attacked by  $H_2SO_4$ ; poorer glass by boiling  $HCl$ ,  $HNO_3$ , and aqua regia. (Berzelius.)

Conc.  $HNO_3$  does not act on flint glass at  $145-150^\circ$ . (Sorby, C. R. 50, 990.)

Glass of ordinary chemical apparatus gives up traces of metals to  $HCl$  and  $HNO_3 + Aq$ , but hard Bohemian glass consisting of 75%  $SiO_2$ , 15%  $K_2O$ , 10%  $CaO$ , resists the action of warm conc. acids; also an easily fusible Na-K glass with 77%  $SiO_2$ , 7.7%  $K_2O$ , 5%  $Na_2O$ , 10.3%  $CaO$ , is not easily attacked. (Stas.)

$KOH$ , and  $NaOH + Aq$  dissolve  $SiO_2$  from glass the more easily the hotter and the more conc. the solutions are. (Müller.)  $NH_4OH$ , and  $(NH_4)_2CO_3 + Aq$  attack many kinds of glass, especially flint glass.  $CaO.H_2$  attacks glass appreciably at  $45^\circ$  and lower; still more strongly on boiling. (Lamy, A. ch. 5, 14, 155.)

The action of various solvents on the glass mentioned on page 359 in Emmerling's experiments is as follows.

The action of  $HCl + Aq$  containing 0.2 to 3%  $HCl$  is practically null, but is increased either by dilution or concentration. A very small quantity (0.02%)  $HCl$  added to  $H_2O$  almost wholly prevents its action on glass. With  $HCl + Aq$  (11%  $HCl$ ) a decrease of 4.2 mg. was noticed in the first hour, and only 3-4 mg. afterwards. The same is the case for  $HNO_3 + Aq$  in still greater degree, 0.008%  $HNO_3$  sufficing to nearly counteract the solvent action of  $H_2O$ .

$H_2SO_4 + Aq$  has about double the solvent effect possessed by  $H_2O$ .

Oxalic and acetic acids both diminish the solvent action of  $H_2O$ .

The addition of even traces (0.04%) of

$\text{Na}_2\text{CO}_3$  increases the solvent action, and this is further rapidly increased by an increase in the amount of  $\text{Na}_2\text{CO}_3$ .  $\text{Na}_2\text{CO}_3 + \text{Aq}$  containing 1%  $\text{Na}_2\text{CO}_3$  dissolves about 10 times as much as pure  $\text{H}_2\text{O}$ , i. e. about 35 mg. per hour.

The above is also the case with  $\text{KOH} + \text{Aq}$ , but in even greater degree  $\text{KOH} + \text{Aq}$  containing 0.025%  $\text{KOH}$  dissolved three times as much as pure  $\text{H}_2\text{O}$ .

$(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  has about the same action as  $\text{H}_2\text{O}$ .

With  $\text{NH}_4\text{OH} + \text{Aq}$  (9%  $\text{NH}_3$ ) 7 mg. decrease for the first hour, and 3 mg. afterwards was noticed. The concentration of the  $\text{NH}_4\text{OH} + \text{Aq}$  was apparently without effect.

The addition of  $\text{NH}_4\text{Cl}$  decreases the solvent action of  $\text{H}_2\text{O}$  proportionately to the amount added, but with new flasks large amounts are dissolved.

With  $\text{NH}_4\text{Cl} + \text{Aq}$  (7%  $\text{NH}_4\text{Cl}$ ) 4.2 mg. were dissolved in the first hour, and the amount dissolved gradually decreased to null after 24 hours on account of the liberation of  $\text{HCl}$  by the decomp. of  $\text{NH}_4\text{Cl}$ .

$\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{KNO}_3$ , and  $\text{Na}_2\text{SO}_4$  show a similar behaviour to that of  $\text{NH}_4\text{Cl}$ .

$\text{Na}_2\text{HPO}_4 + \text{Aq}$  containing 0.4%  $\text{Na}_2\text{HPO}_4$

has six times the solvent action of pure  $\text{H}_2\text{O}$ , but the action is not increased by further concentration.

In general, those salts the acids of which form insol. Ca salts, as  $\text{Na}_2\text{CO}_3$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{C}_2\text{O}_4$ , increase the solvent action of  $\text{H}_2\text{O}$ , and this effect is greater the more concentrated the solution.  $\text{KCl}$ ,  $\text{KNO}_3$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{CaCl}_2$  decrease the effect, and the stronger the solution the less is the action.

All Na glass with approximately the above composition has the same power of resistance against  $\text{H}_2\text{O}$ ; Bohemian K glass shows a greater resistance, especially against acids. (Emmerling, A. 160. 257.)

Action of various reagents on hard Bohemian glass. 100 ccm. substance dissolved mg. glass in 6 days at  $100^\circ$ .

$\text{H}_2\text{O}$	10.0
$\text{H}_2\text{S} + \text{Aq}$	8.7
Dil. $(\text{NH}_4)_2\text{S} + \text{Aq}$	52.5
Conc. $(\text{NH}_4)_2\text{S} + \text{Aq}$	47.2
Conc. $\text{NH}_4\text{OH} + \text{Aq}$	42.5
Dil. $\text{NH}_4\text{OH} + \text{Aq}$	7.7
$\text{NH}_4\text{SH} + \text{Aq}$	51.2

(Cowper, Chem. Soc. 41. 254.)

Action of various solutions on glass of different composition. (The figures denote decrease in weight in mg. of a 100 ccm. flask.)

	Time	1	2	3	4	5	6	7	8	9	10
$\text{H}_2\text{O}$	5 hrs.	62	31	29	17	13	9	7	7	5	4
$\text{H}_2\text{SO}_4 + \text{Aq}$ (25% $\text{H}_2\text{SO}_4$ )	3 "		43	35	8	7	6	5	5	5	3
$\text{HCl} + \text{Aq}$ (12% $\text{HCl}$ )	3 "	85		27	4	2	1	1	1	0	0
$\text{NH}_4\text{OH} + \text{Aq}$ (10% $\text{NH}_3$ )	3 "			62	11	8	7	7	6	5	5
$\text{Na}_2\text{HPO}_4 + \text{Aq}$ (12% $\text{Na}_2\text{HPO}_4$ )	3 "			81	64	40	35	34	30	15	12
$\text{Na}_2\text{CO}_3 + \text{Aq}$ (2% $\text{Na}_2\text{CO}_3$ )	3 "	283	160	130	124	50	45	42	42	26	25

Composition of above varieties of glass.

	1	2	3	4	5	6	7	8	9	10
$\text{SiO}_2$	76.22	74.09	76.39	68.58	74.48	74.69	66.75	74.12	77.07	74.40
$\text{Al}_2\text{O}_3$		0.40	0.50	1.85	0.50	0.45	1.31	0.50	0.30	0.70
$\text{CaO}$	4.27	5.85	5.50	7.60	7.15	7.85	13.37	8.55	8.10	8.85
$\text{K}_2\text{O}$		7.32	4.94	2.24	6.64	8.64	05.50	4.86	3.75	4.40
$\text{Na}_2\text{O}$	19.51	12.34	12.67	19.75	11.23	8.37	3.07	11.97	10.78	11.65

It is seen that glass which resists the attack of  $\text{H}_2\text{O}$  also resists acids and alkalis, and that the relative resistance of all varieties to any of the solutions is the same. Therefore the action of  $\text{H}_2\text{O}$  may be accepted as a criterion for judging of the resistance of a glass to all solvents. Glass No. 10, in which the molecular ratio of  $\text{SiO}_2:\text{CaO}:\text{K}_2\text{O}(\text{Na}_2\text{O})$  is 8:1:1.5, is recommended as best suited for chemical uses. (Weber and Sauer, B. 26. 70.)

Mylius and Förster (B. 25. 97) recommend a glass in which the molecular ratio of  $\text{SiO}_2:\text{CaO}:\text{K}_2\text{O}(\text{Na}_2\text{O})$  is 7.2:1:1.1 as the best suited for chemical apparatus.

In an exhaustive research on the action of aqueous solutions on glass, which cannot be given in full on account of its great length, the following conclusions are reached:—

1. Solutions of caustic alkalis act on glass much more strongly than  $\text{H}_2\text{O}$ , dissolving all the constituents of the glass—that is, the glass as such. Very dilute solutions form an exception.

2. Of the caustic alkalis,  $\text{NaOH} + \text{Aq}$  has the strongest action, then come  $\text{KOH}$ ,  $\text{NH}_4\text{OH}$ , and  $\text{BaO}_2\text{H}_2 + \text{Aq}$  in the order named.

3. Increase in temperature increases the

strength of the attack of alkalis very considerably.

4. At high temperatures, the ease with which glass is attacked increases at first rapidly with the concentration of the alkali, but afterwards more slowly.

5. At ordinary temperatures very concentrated alkali solutions have less action on glass than dil. solutions.

6. Solutions of pure alkalis, if not too conc., act less on glass than when contaminated with small amounts of  $\text{SiO}_2$ .

7. Alkali carbonates + Aq. attack glass much more than  $\text{H}_2\text{O}$ , even when they are very dilute. The action corresponds less to that of the caustic alkalis than to that of other salts. With equivalent concentration,  $\text{Na}_2\text{CO}_3$  + Aq. has a stronger action than  $\text{K}_2\text{CO}_3$  + Aq.

8. The action of salt solutions on glass is a compound one, depending both on the concentration and the kind of salt dissolved, and is made up of the action of the  $\text{H}_2\text{O}$  and the salt in solution.

9. Each kind of attack is differently influenced by the composition of the glass.

10. Solutions of those salts, the acids of which form insol. Ca salts, have a stronger action than  $\text{H}_2\text{O}$ , and the action increases with the concentration.

11. Solutions of those salts, the acids of which form sol. Ca salts, have less action than  $\text{H}_2\text{O}$ , and the action decreases with the concentration. (Förster, B. 25, 2494.)

Data on this subject published since the first edition of this work have not been considered.

### Glucinic acid.

#### Potassium glucinate, $\text{K}_2\text{GIO}_2$ .

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and acids. (Krüss and Morasht, B. 23, 733.)

#### Glucinum (Beryllium), Gl.

Not attacked by hot or cold  $\text{H}_2\text{O}$ . Sol. in cold dil.  $\text{HNO}_3$  + Aq. (Wöhler, Pogg. 13, 577.)

Sol. only in boiling conc.  $\text{HNO}_3$  + Aq. (Debray, A. ch. (3) 44, 5.)

Sol. in dil.  $\text{HCl}$  + Aq. dil. and conc.  $\text{H}_2\text{SO}_4$  + Aq. and  $\text{KOH}$  + Aq., but insol in  $\text{NH}_4\text{OH}$  + Aq. (Wöhler, Debray.)

Sol. in hot  $\text{HCl}$ , hot conc.  $\text{HNO}_3$ , and hot conc.  $\text{H}_2\text{SO}_4$ . (Lebeau, A. ch. 1899, (7), 16, 474.)

#### Glucinum azoimide, $\text{GIN}_2$ .

Decomp. by hot  $\text{H}_2\text{O}$ . (Curtius, J. pr. 1898, (2), 58, 292.)

#### Glucinum borocarbide, $3\text{Gl}_2\text{C}$ , $\text{B}_3\text{C}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in mineral acids especially  $\text{HNO}_3$ . (Lebeau, A. ch. 1899, (7) 16, 481.)

#### $\text{C}_4\text{B}_3\text{Gl}_6$ . Stable in air.

Easily sol. in mineral acids, conc. and dil. (Lebeau, C. R. 1898, 126, 1349.)

#### Glucinum bromide, $\text{GlBr}_2$ .

Sol. in  $\text{H}_2\text{O}$  with evolution of much heat. (Wöhler.)

Sol. in abs. alcohol. (Lebeau, A. ch. 1899, (7) 16, 484.)

#### Glucinum carbide, $\text{Gl}_2\text{C}$ .

Decomp. by  $\text{H}_2\text{O}$ . Slowly attacked by cold or hot conc.  $\text{HCl}$  and  $\text{HNO}_3$ . Gradually but completely sol. in dil. acids. (Lebeau, A. ch. 1899, (7), 16, 476.)

$\text{GlC}_2$ . Not easily decomp. by strong acids. Easily sol. with decomp. in dil. acids. (Lebeau, C. R. 1895, 121, 497.)

#### Glucinum chloride, $\text{GlCl}_2$ .

Anhydrous. Fumes and deliquesces in air. Sol. in  $\text{H}_2\text{O}$  with hissing and evolution of much heat. Easily sol. in alcohol.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 828.)

Sol. in alcohol and ether. Sl. sol. in  $\text{C}_2\text{H}_5$ ,  $\text{CHCl}_3$ ,  $\text{Cl}_4$  and  $\text{CS}_2$ . (Lebeau, A. ch. 1899, (7) 16, 493.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

+  $4\text{H}_2\text{O}$ . Very hygroscopic.

Easily sol. in  $\text{H}_2\text{O}$  and in alcohol. (Mielitner, Z. anorg. 1913, 80, 73.)

#### Glucinum chloride ammonia, $\text{GlCl}_2 \cdot 4\text{NH}_3$ .

(Mielitner, Z. anorg. 1913, 80, 73.)

#### Glucinum chloride iodine trichloride, $2\text{GlCl}_2 \cdot \text{GlCl}_3 + 8\text{H}_2\text{O}$ .

Hygroscopic (Weinland, Z. anorg. 1902, 30, 140.)

#### Glucinum ferric chloride, $\text{GlCl}_2 \cdot \text{FeCl}_3 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Neumann, A. 244, 329.)

#### Glucinum mercuric chloride, $\text{GlCl}_2 \cdot 3\text{HgCl}_2 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Atterberg, B. 6, 1288.)

#### Glucinum thallic chloride, $3\text{GlCl}_2 \cdot 2\text{TlCl}_3$ .

Cryst. from  $\text{HCl}$  solution. (Neumann, A. 244, 348.)

#### Glucinum stannic chloride.

See Chlorostannate, glucinum.

**Glucinum fluoride, basic,  $2\text{GIO}$ ,  $5\text{GIOF}_2$** 

Sol. in  $\text{H}_2\text{O}$ . (Lebeau, A. ch. 1899, (7) 16. 484.)

**Glucinum fluoride,  $\text{GIOF}_2$** 

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . Insol. in anhydrous HF. Sol. in alcohol. (Lebeau, C. R. 1898, 126. 1421.)

Sol. in  $\text{H}_2\text{O}$  in all proportions. Somewhat sol. in abs. alcohol. Easily sol. in 90% alcohol, also in a mixture of alcohol and ether. Insol. in anhydrous HF. (Lebeau, A. ch. 1899, (7) 16. 484.)

**Glucinum potassium fluoride,  $\text{GIOF}_2$ , KF**

Sl. sol. in  $\text{H}_2\text{O}$ . (Awdejew.) Much more sol. in hot than cold  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{GIOF}_2$ , 2KF. Sol. in about 50 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ , and 19 pts. boiling  $\text{H}_2\text{O}$ . (Maignac.)

**Glucinum sodium fluoride,  $\text{GIOF}_2$ ,  $2\text{NaF}$** 

Sol. in  $3\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at  $100^\circ$ , and 68 pts. at  $18^\circ$ . (Maignac.)

**Glucinum hydroxide,  $\text{GIO}_2\text{H}_2$** 

Easily sol. in acids. Sol. in  $\text{H}_2\text{SO}_4$ +Aq. Sol. in  $\text{CO}_2$ +Aq; 100 cem. sat.  $\text{CO}_2$ +Aq dissolve 0.0185 g. GIO. (Sestini, Gazz. ch. it. 20. 313.)

Also sol. in KOH, NaOH,  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3$ +Aq, especially when freshly precipitated; also in  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3$ +Aq. (Debray.)

Insol. in  $\text{NH}_4\text{OH}$ +Aq containing  $\text{NH}_4\text{Cl}$ +Aq.

Very al. sol. in  $\text{Li}_2\text{CO}_3$ +Aq. (Gmelin.)

Sol. in  $\text{H}_2\text{SO}_4$ +Aq. (Berthier.)

Sol. in  $\text{BaO}_2\text{H}_2$ +Aq, from which it is pptd. by  $\text{NH}_4$  salts, but not by boiling. Sol. in boiling  $\text{NH}_4\text{Cl}$ +Aq when freshly pptd.

Sol. in  $\text{NH}_4\text{F}$ +Aq. (Helmholtz, Z. anorg. 8. 130.)

**Solubility of  $\text{GIO}_2\text{H}_2$  in NaOH+Aq.**

G Na in 20 cem.	G GI in 20 cem.
0.3358	0.0358
0.6717	0.0882
0.8725	0.1175
1.7346	0.2847

(Rubenbauer, Z. anorg. 1902, 30. 334.)

When glucinum hydroxide is treated with alkali, more dissolves at first than corresponds with the true equilibrium under the prevailing conditions, for such solutions spontaneously deposit more or less glucinum hydroxide according to the concentration. (Rubenbauer.)

**Solubility of freshly pptd.  $\text{GIO}_2\text{H}_2$  in NaOH+Aq at room temperature.**

millimols Na per l	G GIO dissolved in 1 l
649	3.6
540	2.92
540	2.53
483	1.69
383	1.61
388	1.53
386	1.45
390	1.24

In the first two cases the values were obtained by adding to  $\text{GIOCl}_2$ +Aq at  $0^\circ$ , ice cold  $\text{NH}_4\text{OH}$  and treating the ppt with NaOH+Aq. In the remaining cases by dissolving basic  $\text{GIOCO}_2$  in HCl and pouring into NaOH+Aq. (Haber, Z. anorg. 1904, 38. 386.)

**Solubility of  $\text{GIO}_2\text{H}_2$ , which is one week old, in NaOH+Aq at  $t^\circ$ .**

NaOH	$t^\circ$	G GIO in 1 l
$\frac{1}{2}$ -N	$20-23^\circ$	0.060
1-N	$20-23^\circ$	0.170
2-N	$20-23^\circ$	0.570
$\frac{1}{2}$ -N	$50-53^\circ$	0.080
1-N	$50-53^\circ$	0.230
2-N	$50-53^\circ$	0.900
$\frac{1}{2}$ -N	$100^\circ$	0.080
1-N	$100^\circ$	0.290
2-N	$100^\circ$	1.020

(Haber.)

**Solubility of  $\text{GIO}_2\text{H}_2$  in NaOH+Aq at  $25^\circ$ .**

G mole	
Na	GI
0.268	0.0330
0.318	0.0492
0.446	0.0841
0.526	0.089
0.563	0.101
0.801	0.143
0.854	0.202

(Wood, Chem. Soc. 1910, 97. 884.)

Insol. in  $\text{NH}_4\text{OH}$ +Aq and in alkyl amines. (Renz, B. 1903, 36. 2753.)

Sol. in  $\text{GISO}_4$ +Aq. (Parsons, J. phys. Chem. 1907, 11. 658.)

A form insol. in acids and alkalis can be obtained by sufficiently long heating in boiling  $\text{H}_2\text{O}$ ,  $\text{Na}_2\text{CO}_3$ +Aq,  $\text{NH}_4\text{OH}$ +Aq, or solutions of NaOH or KOH so dil that the  $\text{GIO}_2\text{H}_2$  is either insol or very al. sol. therein. (van Oordt, C. C. 1906, I. 108.)

100 cem. of glycerine+Aq containing about 60% by vol. of glycerine dissolve 0.1 g. GIO. (Müller, Z. anorg. 1905, 43. 322.)

Contains  $\frac{1}{2}\text{H}_2\text{O}$  (Schaffgotsch);  $\frac{4}{3}\text{H}_2\text{O}$  (Atterberg).

Solubility of  $\text{GlO}_2\text{H}_2$ , which has been boiled with alkali, in various solvents.

Alkali used	Time	Solvent	Solubility
* 10-N NaOH	2½ hrs.	0.106-N NaOH 0.39-N NaOH 0.97-N NaOH 2.0-N NaOH 2.0-N NaOH	1 mol. $\text{GlO}_2\text{H}_2$ : 331 mole NaOH 1 mol. $\text{GlO}_2\text{H}_2$ : 183 mole NaOH 1 mol. $\text{GlO}_2\text{H}_2$ : 91.8 mole NaOH 1 mol. $\text{GlO}_2\text{H}_2$ : 49 mole NaOH 1 mol. $\text{GlO}_2\text{H}_2$ : 49 mole NaOH
NaOH NaOH	Long time 2 hrs.	10-N $\text{K}_2\text{CO}_3$ Dil. HCl Hot conc. HCl Dil. acetic acid	Insol. Sl. sol. Slowly sol. Almost insol.
KOH	Till flocculent ppt. appeared	1-N KOH  1-N NaOH Warm dil. HCl	Insol. " Sol.
½-N $\text{Na}_2\text{CO}_3$	3 hrs.	1-N NaOH Dil. HCl	Easily sol.
{ ½-N $\text{Na}_2\text{CO}_3$ for then 1/10-N $\text{Na}_2\text{CO}_3$ for	3 hrs. and 4 hrs.	1-N NaOH Dil. HCl	Sl. sol. Slowly sol.
½-N $\text{K}_2\text{CO}_3$ 10-N $\text{K}_2\text{CO}_3$	6 hrs. Short time	10-N $\text{K}_2\text{CO}_3$ 1-N NaOH Cold 10-N $\text{K}_2\text{CO}_3$	Insol. Easily sol. Very slowly sol.
$\text{NH}_4\text{OH}$	5 hrs.	½-N NaOH	Very sl. sol.

(Haber.)

**Glucinum iodide,  $\text{GlI}_2$ .**Sol. in  $\text{H}_2\text{O}$  with evolution of much heat. (Wöhler.)Decomp. in moist air and by  $\text{H}_2\text{O}$ 

Sol. in abs. alcohol. Insol. in most neutral organic solvents, as benzene, toluene, etc. (Lebeau, C. R. 1898, 126, 1273.)

Insol. in  $\text{C}_2\text{H}_5$ ,  $\text{C}_2\text{H}_6$  and oil of turpentine. Easily sol. in  $\text{CS}_2$ . Sol. in anhydrous alcohols without evolution of heat. (Lebeau, A. ch. 1899, (7) 16, 490.)**Glucinum iodide ammonia,  $2\text{GlI}_2 \cdot 3\text{NH}_3$ .**

Ppt (Lebeau, A. ch. 1899, (7) 16, 492.)

**Glucinum oxide,  $\text{GlO}$ .***Crystalline.* Insol. in acids except conc.  $\text{H}_2\text{SO}_4$ . (Ebelmen, C. R. 32, 710.)*Amorphous.* Absolutely insol. in  $\text{H}_2\text{O}$ . The higher the temp. to which the substance has been heated the more insol. is it in acids. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Insol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$ , or  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq}$ . (Rose.)When obtained by ignition of  $\text{GlSO}_4$ , it is very slowly but completely sol. in  $\text{HCl}$ , and  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Rose.)Insol. in hydrazids. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Lebeau, C. R. 1896, 123, 819.)Insol. in liquid  $\text{NH}_3$ . (Gore, Am. ch. J. 1898, 20, 828.)**Glucinum peroxide basic,  $2\text{GlO}_2 \cdot 3\text{GlO}$ .** $+ 8\frac{1}{2}\text{H}_2\text{O}$ . (Komarovski, Chem. Soc. 1913, 104 (2) 707.)**Glucinum oxybromides.**Sol. in  $\text{H}_2\text{O}$  if three or less equivalents of base are present to one of acid; insol. if more of the base is present. (Ordway, Am. J. Sci. (2) 26, 207.)**Glucinum oxychloride,  $\text{Gl}_2\text{OCl}_2 = \text{GlO} \cdot \text{GlCl}_2$ .**Insol. in  $\text{H}_2\text{O}$ . $3\text{GlCl}_2 \cdot 2\text{GlO} + 2\text{H}_2\text{O}$  (?). Sol. in  $\text{H}_2\text{O}$ . (Atterberg.) $\text{GlCl}_2 \cdot 3\text{GlO} + 3\text{H}_2\text{O}$  (?). Sol. in  $\text{H}_2\text{O}$ , but solution soon becomes cloudy and deposits a fine ppt. By boiling the solution it is decomp. into above salt, and  $\text{GlCl}_2$ ,  $12\text{GlO}_2\text{H}_2 + 10\text{H}_2\text{O}$ , which is insol. in  $\text{H}_2\text{O}$ ; decomp. into  $\text{GlO}_2\text{H}_2$  by washing. Sol. in acids. (Atterberg.)**Glucinum oxyfluoride,  $5\text{GlF}_2 \cdot 2\text{GlO}$ .**Readily sol. in  $\text{H}_2\text{O}$ . (Lebeau, C. R. 1898, 126, 1419.)**Glucinum phosphide.**Decomp. by  $\text{H}_2\text{O}$ . (Wöhler.)**Glucinum selenide.**Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Glucinum sulphide.**

Slowly sol without decomp. in  $H_2O$ , but easily decomp. by acids. (Wöhler.)

**Gold, Au.**

Gold which has been pptd. from  $AuCl_3 + Aq$  by  $FeSO_4$  is sl. sol. in  $HCl$ . (Awerkiow, Z. anorg. 1909, 61, 10.)

Not attacked by  $H_2O$ . Insol in  $HNO_3$  or  $HCl + Aq$ . Easily sol. in aqua regia or any mixture evolving  $Cl$  or  $Br$ . Sol. in selenic acid, or antimoniac acid +  $Aq$ ; less easily in arsenic acid +  $Aq$ . Sol. in mixtures of  $HCl$  and nitrates, or  $HNO_3$  and chlorides; also in  $(NaCl + KNO_3 + K_2Al_2(SO_4)_4 + Aq)$  (?). Insol in  $H_2SO_4$ , except in presence of  $KMnO_4$ ,  $HNO_3$ , or  $HIO_3$ . Sol. in a solution of  $I$  in ether in direct sunlight.

Sol. in solutions of ferric, and cupric salts.

Sol. in  $HCl + Aq$  containing  $H_2CrO_4$ ,  $H_2MnO_4$ ,  $H_2SeO_4$ ,  $H_2AsO_4$ , or  $FeCl_3$  (Wurtz).

Attacked by fuming  $HCl$  (sp. gr. 1.178) at ord. temp. in direct light, especially in the presence of a trace of  $MnCl_2$ , but not attacked in the dark even in the presence of this salt. (Berthelot, C. R. 1904, 138, 1298.)

100 cem. hot conc.  $HCl$  dissolve 0.008 g yellow Au powder in 4 hours. (Hanriot and Raoult, C. R. 1912, 155, 1086.)

Upon boiling 25 and 50 cc.  $HCl + Aq$  (sp. gr. 1.178), dil. to 125 cc. with 250 mg. sheet Au  $\frac{1}{2}$  in. square, 0.009 in. thick, weighing 250 mg. for several hours, there was no loss of weight of Au. (McCaughy, J. Am. Chem. Soc. 1900, 21, 1263.)

From 5 g. finely divided ordinary yellow gold; 100 cc.  $HNO_3$  of 22° B. dissolve 0.002 g. in 2 hrs.

100 cc.  $HNO_3$  of 32° B. dissolve 0.0119 g. in 2 hrs.

100 cc.  $HNO_3$  of 36° B. dissolve 0.028 g. in 2 hrs.

100 cc.  $HNO_3$  monohydrate dissolve 0.076 g. in 2 hrs. (Hanriot and Raoult, C. R. 1912, 155, 1085.)

From 5 g. brown gold:

100 cem.  $HNO_3$  of 22° Baume dissolve 0.006 g. in 2 hrs.

100 cem.  $HNO_3$  of 32° Baume dissolve 0.039 g. in 2 hrs.

100 cem.  $HNO_3$  of 36° Baume dissolve 0.078 g. in 2 hrs.

100 cem.  $HNO_3$  monohydrate dissolve 1.540 g. in 2 hrs. (Hanriot and Raoult.)

Sl. sol. in boiling  $HNO_3$  (sp. gr. = 1.42). The solution deposits Au by standing several days. (Dewey, J. Am. Chem. Soc. 1910, 32, 320.)

Best composition of aqua regia for dissolving Au is 200 cc.  $HCl$  (sp. gr. 1.1946) 45 cc.  $HNO_3$  (sp. gr. 1.4) and 245 cc.  $H_2O$ . 1 pt. Au is sol. in 4.3 pts. of such a mixture. (Przewoznik, C. C. 1910, II, 1743.)

Sol. in 1 pt.  $HNO_3 + 4$  pts.  $HCl$  as representing the most economical mixture. (Przewoznik, Chem. Soc. 1911, 100, (2), 484.)

Easily sol. in nitrosulphonic acid from sulphuric acid manufacture, when mixed with equal parts conc.  $HCl + Aq$  (Bornträger, Rep. anal. Ch. 1887, 741.)

Sol. in hot conc.  $H_2SO_4$  in the presence of  $MnO_2$ ,  $Mn_2O_3$ ,  $Mn_2O_4$ ,  $PbO_2$ ,  $Pb_2O_3$ ,  $Pb_3O_4$ ,  $CrO_3$ ,  $CrO_2$ , and  $Ni_2O_3$ . Solution also takes place slowly in the cold. Sol. in hot  $H_2SO_4 + KMnO_4$ . Slowly sol. in cold, more rapidly in hot  $H_2SO_4 + HNO_3$ . (Lenher, J. Am. Chem. Soc. 1904, 26, 550.)

Sol. in a hot solution of crystalline telluric acid in  $H_2SO_4$  or  $H_3PO_4$ .

Sol. in hot  $H_2PO_4$  in the presence of  $MnO_2$ ,  $Mn_2O_3$ ,  $Mn_2O_4$ , the higher oxides of lead,  $CrO_3$ , chromium tetroxide and nickel oxide. Solution takes place more slowly in the cold. Sol. in hot  $H_2PO_4$  in the presence of  $KMnO_4$ . Slowly sol. in a cold, more rapidly sol. in a hot mixture of  $H_2PO_4$  and  $HNO_3$ .

Sol. in hot arsenic acid in the presence of  $MnO_2$ ,  $Mn_2O_3$ , and  $Mn_2O_4$ . (Lenher, J. Am. Chem. Soc. 1904, 26, 550.)

Gold leaf is not attacked by cold conc.  $H_2SeO_4$ , when completely free from halogens, but is dissolved by conc.  $H_2SeO_4$  at 300°. (Lenher, J. Am. Chem. Soc. 1902, 24, 354.)

### Solubility of thin sheet Au in $HCl$ solution of non alum

Time, hours	Mg Au dissolved			
	1 g Fe 25 cc HCl	1 g Fe 50 cc HCl	2 g Fe 25 cc HCl	2 g Fe 50 cc HCl

Temp. 38–43°.

16	1.00	1.30	1.08	1.47
22	1.12	1.55	1.20	1.81
40	1.52	2.15	1.82	2.75
49	1.71	2.34	2.02	2.95
64	1.96	3.10	2.60	3.79
72	2.12	3.30	2.83	4.05
89	2.32	3.65	3.22	4.65
100	2.40	3.75	3.38	4.81
113	2.45	3.96	3.51	5.12
124	2.60	4.09	3.63	5.39
161	2.78	4.36	3.95	5.96
185	2.90	4.49	4.11	6.22

Temp. 98–100°

1	1.13	0.78	1.15	1.27
2	1.99	1.74	2.56	2.86
4	3.46	3.31	4.55	5.06
16	10.09	11.37	13.15	15.56
20	12.20	13.72	15.59	19.41
24	14.37	16.49	17.96	23.29
36	17.38	23.27	22.07	31.73
42	18.79	26.30	24.02	35.29
54	20.94	31.39	29.49	42.11
59½	21.64	33.12	30.64	44.43

The solution contained the given amounts of Fe as iron alum, the sp gr of the HCl was 1.178, and the solutions diluted to 125 cc. (McCaughy, J. Am. Chem. Soc. 1909, 31, 1233.)

The solvent action of ferric salt occurs even in presence of a ferrous salt, but decreases with increase of concentration of ferrous salt (McCaughy)

Solubility of thin sheet Au in HCl solution of  $\text{CuCl}_2$

Time, hours	Mg Au dissolved			
	1 g Cu 25 cc HCl	1 g. Cu 50 cc HCl	2 g. Cu 25 cc HCl	2 g Cu 50 cc HCl

Temp. 38-43°.

19	0 03	0 26	0 05	0 39
25	0 09	0 36	0 05	0 54
43	0 10	0 54	0 14	0 94
49½	0 12	0 61	0 15	1 07
66½	0 11	0 76	0 17	1 40
78	0 14	0 87	0 22	1 58
91	0 14	0 92	0 24	1 75
102	0 16	1 02	0 27	1 90
139	0 18	1 34	0 32	2 45
163	0 23	1 60	0 39	2 84

Temp. 98-100°.

1	0 15	0 34	0 17	0 46
4	0 55	1 23	0 55	1 35
16	1 34	5.00	2 12	8 80
20	1 63	6.53	2 78	11 86
26	2 17	9 13	3 59	15 70
38	3 13	13 98	5 07	23 14
43	3 61	16 54	5 77	26 62
48	4 07	19 26	6 26	30 80
60	4 82	26 37	7 47	39 09

Conditions the same as above for HCl+iron alum. (McCaughy.)

Finely powdered gold is sol. in conc HCl in the presence of alcohol, etc.

0.0302 g. Au. is sol. in 100 cc. HCl+100 cc.  $\text{CH}_3\text{OH}$ .

0.0230 g. Au. is sol. in 100 cc. HCl+100 cc.  $\text{CHCl}_3$ .

0.0066 g. Au. is sol. in 100 cc. HCl+100 cc.  $\text{C}_2\text{H}_5\text{OH}$ .

0.0190 g. Au. is sol. in 100 cc. HCl+100 cc.  $\text{C}_2\text{H}_5\text{OH}$ .

0.0125 g. Au. is sol. in 100 cc. HCl+50 cc.  $\text{CCl}_3\text{CH}(\text{OH})_2$ .

(Awerkiev, C. C. 1908, II. 1566.)

Solubility of Au which has been pptd. from  $\text{AuCl}_3+\text{Aq}$  by various precipitants in HCl+formaldehyde

HCHO (10%) ccm	HCl (1 19) ccm	Au dissolved g	Au used was pptd from $\text{AuCl}_3+\text{Aq}$ by
150	150	0 0007	$\text{FeSO}_4$
100	100	0 0006	"
125	25	0 0008	"
100	200	0 0009	sugar
150	150	0 0003	oxalic acid
250	250	0 0002	"
500	500	0 0008	$\text{FeSO}_4$
100	500	0	oxalic acid
100	200	0 0004	"
100	200	0	"
150	300	0 0006	sugar
250	125	0 001	"
150	75	0 0013	$\text{FeSO}_4$
100	200	0 0008	"
100	200	0 0006	HCHO
100	100	0 0005	"
180	540	0	
360	720	0 001	$\text{FeSO}_4$
360	720	0 0019	sugar
200	400	0 0013	$\text{FeSO}_4$

In the last four cases the solubility was determined at the ordinary temp., in the first sixteen the gold was boiled with the mixture of HCl and HCHO.

(Awerkiev, Z. anorg. 1909, 61. 3.)

Solubility of Au in boiling HCl+paraformaldehyde.

$(\text{CH}_2\text{O})_2$ g	HCl (1 19) g.	Dissolved Au g	Au used was pptd from $\text{AuCl}_3+\text{Aq}$ by
5	25	0 0005	$\text{FeSO}_4$
5	25	0 0004	oxalic acid
25	125	0 006	sugar
20	400	0 0024	$\text{CH}_3\text{OH}$
20	400	0 0034	$\text{CH}_3\text{OH}$
20	400	0 003	"
20	400	0 0065	sugar
20	400	0 0044	formic acid
20	400	0 0005	"
40	400	0 001	$\text{CH}_3\text{OH}$
20	300	0 0024	$\text{FeSO}_4$
20	300	0 003	"
10	200	0 0008	$\text{CH}_3\text{OH}$
10	200	0 0006	oxalic acid
60	120	0 0015	$\text{FeSO}_4$

(Awerkiev.)

## Solubility of Au in boiling HCl+methyl alcohol.

CH <sub>3</sub> OH (90%) ccm.	HCl (1 lb) ccm.	Dissolved Au g.	Au used was pptd from AuCl <sub>3</sub> +Aq by
100	100	0.0302	FeSO <sub>4</sub>
150	150	0.0043	oxalic acid
150	150	0.028	sugar
25	25	0.001	CH <sub>3</sub> OH
50	50	0.0002	oxalic acid
50	50	0.0005	CH <sub>3</sub> OH
50	50	0.0002	oxalic acid
50	50	0.0015	FeSO <sub>4</sub>
50	50	0.002	"
100	100	0.0009	oxalic acid
500	500	0.0128	FeSO <sub>4</sub>
1000	1000	0.0281	"
50	100	0.0034	"
100	200	0.0006	"
100	300	0	"
75	25	0.005	HCOH
90	30	0.005	"
75	25	0.0014	"
80	20	0.0005	"
100	50	0.0018	FeSO <sub>4</sub>
100	50	0.0008	CH <sub>3</sub> OH
50	200	0.001	"

(Awerkw.)

## Solubility of Au in boiling HCl+ethyl alcohol.

C <sub>2</sub> H <sub>5</sub> OH (95%) ccm.	HCl (1.19) ccm.	Dissolved Au g.	Au used was pptd from AuCl <sub>3</sub> +Aq by
25	50	0.0006	FeSO <sub>4</sub>
100	200	0.0111	"
200	400	0.0017	"
150	50	0.0003	sugar
100	300	0.0004	"
100	100	0.0015	"
200	200	0.0055	C <sub>2</sub> H <sub>5</sub> OH
250	250	0.0021	sugar
300	300	0.0197	FeSO <sub>4</sub>
1000	1000	0.007	CH <sub>3</sub> OH
150	150	0.008	"

(Awerkw.)

## Solubility of Au in boiling HCl+amyl alcohol.

C <sub>5</sub> H <sub>11</sub> OH g.	HCl (1 lb) g.	Dissolved Au g.	Au used was pptd from AuCl <sub>3</sub> +Aq by
100	100	0.019	FeSO <sub>4</sub>
100	200	0.0048	"
150	150	0.0024	sugar
100	100	0.0027	"
150	50	0.0032	"
300	100	0.0023	FeSO <sub>4</sub>
200	200	0.0067	C <sub>5</sub> H <sub>11</sub> OH
500	500	0.028	FeSO <sub>4</sub>

(Awerkw.)

## Solubility of Au in boiling HCl+phenol.

C <sub>6</sub> H <sub>5</sub> OH g.	HCl (1 lb) g.	Dissolved Au g.	Au used was pptd from AuCl <sub>3</sub> +Aq by
10+25	100	0.001	C <sub>6</sub> H <sub>5</sub> OH
10	40	0.0004	oxalic acid
20	50	0.0003	"
25	100	0.0005	FeSO <sub>4</sub>
25	150	0	HCOH
50	200	0.0005	"
25	250	0.0005	FeSO <sub>4</sub>
25	250	0.0012	"

(Awerkw.)

## Solubility of Au in boiling HCl+chloroform.

CHCl <sub>3</sub> g.	HCl (1 lb) g.	Dissolved Au g.	Au used was pptd from AuCl <sub>3</sub> +Aq by
50	100	0.0009	FeSO <sub>4</sub>
100	100	0.023	"
100	100	0.0017	"
150	50	0.0012	"
200	400	0.0024	sugar
250	250	0.002	"
300	300	0.0103	"

(Awerkw.)

Colloidal gold is sol. in dil. alkalis. (Paal, B 1902, 35. 2236.)

Rather quickly sol. in 10-15% solution I in KI+Aq.

Very slowly sol. in 5% solution of I in KI+Aq.

Scarcely sol. in more dil. solution of I in KI+Aq.

Easily sol. in 10% NH<sub>4</sub>I+I Less easily sol. in 5% NH<sub>4</sub>I+I (Döring.)Sol. in cold Na<sub>2</sub>S+Aq when Na<sub>2</sub>S is present in proportion of 843 pts. Na<sub>2</sub>S to 1 pt Au. (Becker, Silb. Am. J. (3) 33. 199.)In finely divided state Au is sol in boiling KCN+Aq. Not attacked by boiling HgCl<sub>2</sub>+Aq. (Vogel, J. pr. 20. 366.)

Solubility of Au (disks) in KCN+Aq with (A) oxygen passed through solution, and (B) agitated with oxygen.

% KCN	g Au dissolved in 24 hours	
	A	B
1	0.00845	0.0187
5	0.01355	0.0472
20	0.0115	0.0314
50	0.00505	0.108

(MacLaurin, Chem. Soc. 1893, 63. 729.)

The solution of Au in KCN+Aq is essentially hastened by sunlight. (Caldecott, Proc. Chem. Soc. 1904, 20. 199.)

The presence of oxygen is necessary for the solution of Au in KCN+Aq. The rate of solution of Au in KCN+Aq varies with the strength of the solution, being small for conc. solutions, increasing as the solution becomes more dilute, reaching a maximum at 0.25% KCN, and then again diminishing. (MacLaurin, Chem. Soc. 1885, 67. 211.)

Solubility of Au (strips) in dil. KCN + Aq

% KCN	Mg Au dissolved in 24 hours
0	0.010
0 0005	0 043-0 07
0 001	0 10-0.23
0 0016	0 16
0 002	0.44
0 00325	1 77
0 004	4 29
0 008	48 43
0 016	74 96
0 0325	150 54
0 065	168 12

(Christy, Elektrochem Z 1901, 7. 205.)

Finely divided metallic gold is completely sol. at the ord. temp. in solutions of potassium ferrocyanide. Solution takes place very slowly even when the potassium ferrocyanide solution is boiling. (Beutel, Z anorg 1912, 78. 158.)

Sol. in  $\text{RbCl}_4$ +Aq. (Erdmann, Arch. Pharm. 1894, 232. 30.)

Not attacked by  $\text{FeCl}_3$ +Aq when air is excluded but very energetically attacked in presence of HCl and oxygen. (McIlhenny, Am. J. Sci., 1896, (4), 2. 293.)

Not attacked by several days heating with  $\text{SOCl}_2$  at  $150^\circ$ . At  $200^\circ$  there is sl. action in 10 days. (North, J. Am. Chem. Soc 1912, 34. 892.)

$\text{SO}_2\text{Cl}_2$  in excess dissolves pulverulent Au by several hours heating at  $180^\circ$ . (North, Bull. Soc. (4), 9. 647.)

Sol. in  $\text{PCl}_5$ . (Baudrimont, A. ch. (4) 2. 418.)

Easily sol. in acid solutions of thiocarbamide especially in presence of suitable oxidizing compounds. (Moir, Chem. Soc 1906, 89. 1345.)

#### Gold arsenide, $\text{AuAs}$ .

$\text{H}_2\text{O}$  or alcohol slowly extracts As;  $\text{HNO}_3$ +Aq converts into Au and  $\text{H}_3\text{AsO}_4$ . Sol. in aqua regia. Not attacked by cold, decomp. by hot conc.  $\text{H}_2\text{SO}_4$ . (Tivoli, C. C. 1887. 778; J. B. 1887. 610.)

#### Gold bismuthide, $\text{Au}_2\text{Bi}$ .

Min. *Maldonite*. Sol. in aqua regia.

#### Aurous bromide, $\text{AuBr}$ .

Insol. in  $\text{H}_2\text{O}$ . (Thomsen, C. C. 1860. 606.)

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ .  
Sol. in  $\text{NH}_4\text{OH}$ +Aq. with decomp.  
Decomp. by HBr and  $\text{KBr}$ +Aq. Sol. in KCN+Aq without decomp. Slowly decomp. by alcohol, ether, acetone and moist  $\text{CHCl}_3$ . (Lengfeld, Am. Ch. J. 1901, 26. 325.)

#### Gold (auroauric) bromide, $\text{Au}_2\text{Br}_4$ .

Not deliquescent.  $\text{H}_2\text{O}$  or ether dissolves out  $\text{AuBr}_3$ . (Thomsen, C. C. 1860. 606.)

Does not exist. (Kruss, B. 20. 640.)  
Existence is maintained by Petersen. (J. pr. (2) 46. 334.)

#### Auric bromide, $\text{AuBr}_3$ .

Not deliquescent. Slowly sol. in  $\text{H}_2\text{O}$ , more readily in ether.

Can be recryst. from  $\text{AsBr}_3$ ,  $\text{SbBr}_3$ ,  $\text{TiBr}_3$  or  $\text{SnBr}_3$ . (Lindet, Bull. Soc. 1886, (2) 45. 149.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

#### Aurous phosphorus tribromide, $\text{AuBr}_2\text{PBr}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Lindet, J. pr. (2) 32. 494.)

#### Auric phosphorus pentabromide, $\text{AuBr}_3\text{PBr}_5$ .

Decomp. by  $\text{H}_2\text{O}$ . (Lindet.)

#### Aurous bromide phosphorus trichloride, $\text{AuBr}_2\text{PCl}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Lindet.)

#### Auric praseodymium bromide, $\text{PrBr}_3\text{AuBr}_3\cdot 10\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sol. in conc HBr. (Von Schule, Z. anorg. 1898, 18. 355.)

#### Aurous bromide ammonia, $\text{AuBr}_2\cdot 2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$  and dil. HCl.  
Sol. in aqua regia. (Meyer, C. R. 1906, 143. 281.)

#### Gold carbide, $\text{Au}_2\text{C}_2$ .

Ppt. Decomp. by boiling  $\text{H}_2\text{O}$  without evolution of  $\text{C}_2\text{H}_2$ . Decomp. by HCl with evolution of  $\text{C}_2\text{H}_2$ . (Mathews, J. Am. Chem. Soc. 1900, 22. 110.)

#### Aurous chloride, $\text{AuCl}$ .

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. thereby into Au and  $\text{AuCl}_3$ . (Thomsen, J. pr. (2) 13. 341.)

Insol. in  $\text{H}_2\text{O}$  and dil.  $\text{HNO}_3$ .  
Decomp. by conc.  $\text{HNO}_3$  to Au and  $\text{AuCl}_3$ .  
Sol. in HCl, HBr and in sol. of alkali chloride and bromides, with decomp.

Decomp. by alcohol, ether and acetone. (Lengfeld, Am. Ch. J. 1901, 26. 324.)

**Gold (auric) chloride,  $\text{AuCl}_3$ .**

Deliquescent. Very sol in  $\text{H}_2\text{O}$ . Sol. in 1.47 pts.  $\text{H}_2\text{O}$ . (Abl.) Sol. in conc.  $\text{HCl}$ , or  $\text{HNO}_3$  + Aq without decomp.

$\text{AsCl}_3$  dissolves about 22% at  $100^\circ$  and 2.5% at  $15^\circ$ . Solubility in  $\text{SnCl}_2$  is about the same. Much less sol. in  $\text{SnCl}_4$  or  $\text{TiCl}_4$ ,  $\text{SnCl}_4$  dissolving 4% at  $160^\circ$  and hardly a trace at  $0^\circ$ . Very sl. sol. in hot or cold  $\text{SiCl}_4$ . (Lindet, Bull. Soc. (2) 45. 149.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin and Kraus, Am. Ch. J. 1893, 20. 829.)

Sol. in alcohol with gradual decomp. (Gmelin.) Sol. in ether with decomp. in light or on long standing. Ether extracts  $\text{AuCl}_3$  from  $\text{AuCl}_3$  + Aq (Proust) Sol in volatile oils with gradual decomp.

Sol. in ether. (Mylius, Z. anorg. 1911, 70. 207.)

Very sol. in ether. (Willstätter, B. 1903, 38. 1830.)

Completely sol. in ether. (Frank, C. C. 1913, II. 541.)

Insol. in or decomp. by alcohol, ether,  $\text{CS}_2$ ,  $\text{C}_6\text{H}_6$ , oil of turpentine, pentane, hexane,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethyl nitrate, nitrobenzol, ethyl acetate, ethyl propionate and pyridine. (Leuher, J. Am. Chem. Soc. 1903, 25. 1138.)

+  $2\text{H}_2\text{O}$ . (Thomsen.)

**Auroauric chloride,  $\text{Au}_2\text{Cl}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  into  $\text{AuCl}_3$  and  $\text{AuCl}$  (Thomsen, J. pr. (2) 13. 357.)

Does not exist. (Krüss and Schmidt, J. pr. (2) 38. 77.)

Existence is maintained by Christensen (J. pr. (2) 46. 328.)

**Auric chloride with  $\text{MCl}$ .**

See Chloraurate, M.

**Auric nitrosyl chloride,  $\text{AuCl}_2\text{NOCl}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Sudborough, Chem. Soc. 59. 662.)

**Aurous phosphorus trichloride,  $\text{AuCl}_2\text{PCl}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in about 100 pts.  $\text{PCl}_3$  at  $15^\circ$ , and about 8 pts. at  $120^\circ$ . Sol. in  $\text{AsCl}_3$ . (Lindet, C. R. 101. 1492.)

**Auric phosphorus pentachloride,  $\text{AuCl}_3\text{PCl}_5$ .**

Decomp. by  $\text{H}_2\text{O}$ . Nearly insol. in  $\text{PCl}_3$ . Sol. in  $\text{AsCl}_3$ . (Lindet.)

**Aurous potassium chloride,  $\text{AuCl}_2\text{KCl}$ .**

Decomp. by  $\text{H}_2\text{O}$  or  $\text{HCl}$  + Aq into  $\text{KCl}$ ,  $\text{KAuCl}_4$ , and  $\text{Au}$ . (Berzelius.)

**Auric potassium chloride.**

See Chloraurate, potassium.

**Auric selenium chloride,  $\text{AuCl}_3\text{SeCl}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{AsCl}_3$ . (Lindet, C. R. 101. 1492.)

**Gold (aurous) sodium chloride,  $\text{AuCl}$ ,  $\text{NaCl}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in alcohol. (Meillet, J. Pharm. 3. 417.)

Formula is  $4\text{NaCl}$ ,  $\text{AuCl}$ ,  $\text{AuCl}_2$  (Jorgensen.)

**Auric sodium chloride.**

See Chloraurate, sodium.

**Auric sulphur chloride,  $\text{AuCl}_3\text{SCl}_4$ .**

Easily decomp. by  $\text{H}_2\text{O}$ . (Lindet, C. R. 101. 1492.)

**Aurous chloride ammonia,  $\text{AuCl}$ ,  $\text{NH}_3$ .**

Ppt. Unstable (Diemer, J. Am. Chem. Soc. 1913, 35. 554.)

$\text{AuCl}$ ,  $3\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$  and dil. acids.

Sol. in aqua regia. Sol. in conc.  $\text{H}_2\text{SO}_4$  with decomp. (Meyer, C. R. 1906, 143. 282.)

$\text{AuCl}$ ,  $12\text{NH}_3$ . (Meyer.)

**Auric fluoride,  $\text{AuF}_3$ .**

Very unstable

Is incapable of existence not only in presence of  $\text{H}_2\text{O}$  but under the ordinary conditions met with in the laboratory and in nature. (Lenher, J. Am. Chem. Soc. 1903, 25. 1138.)

**Auric hydroxide,  $\text{Au}_2\text{O}_3\text{H}_2$ .**

Nearly insol. in most acids. Easily sol. in very conc.  $\text{HNO}_3$  + Aq (Proust), from which all  $\text{Au}_2\text{O}_3\text{H}_2$  is separated by dilution (Fremy). Extremely sl. sol. in fuming  $\text{HNO}_3$ . Sol. in dil.  $\text{HNO}_3$  + Aq when pure (Krüss, A. 237. 281). Not attacked by  $\text{H}_3\text{PO}_4$ . Insol. in  $\text{HF}$ . Sol. in  $\text{HCl}$ , or  $\text{HBr}$  + Aq (Fremy).

Sol. in  $\text{H}_2\text{SeO}_4$  + Aq. (Mitscherlich.)

Sl. sol. in conc.  $\text{H}_2\text{SO}_4$ , somewhat sol. in  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$  + Aq. (Rose.)

Nearly insol. in cold  $\text{KOH}$  + Aq, but dissolved on boiling. Insol. in  $\text{NH}_4\text{OH}$  + Aq or alkali carbonates + Aq (Rose). Sl. sol. in boiling  $\text{CaCl}_2$  + Aq,  $\text{NaCl}$  + Aq,  $\text{BaCl}_2$  + Aq (Pelletier). Sol. in  $\text{NH}_4\text{CN}$ , and  $\text{KCN}$  + Aq (Himly).

Sl. sol. in  $\text{KCl}$ , or  $\text{NaCl}$  + Aq. (Pelletier.)

Sol. in  $\text{K}_4\text{Fe}(\text{CN})_6$  + Aq at ord. temp. rapidly on boiling. (Beutel, Z. anorg. 1912, 78. 154.)

$\text{AuO}$ ,  $\text{OH} = \text{Au}_2\text{O}_3$ ,  $\text{H}_2\text{O}$ . (Krüss.)

**Auroauric hydroxide,  $\text{Au}_2\text{O}_3(\text{OH})_2 = 3\text{Au}_2\text{O}_3 + 2\text{H}_2\text{O}$ .**

Insol. in boiling conc.  $\text{KOH}$  + Aq. Decomp. by conc.  $\text{HCl}$  or  $\text{HNO}_3$  + Aq into  $\text{Au}$  and  $\text{Au}_2\text{O}_3$ , which dissolves (Schüttlander, A. 217. 336.)

**Aurous iodide,  $\text{AuI}$ .**

Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3$  + Aq, with separation of  $\text{Au}$ . Decomp. immediately by ether, more slowly by alcohol.

Partially sol. in KI,  $\text{FeI}_3$ , or  $\text{HI} + \text{Aq}$  (Pelletier). Sl. attacked by  $\text{NH}_4\text{OH}$ , or  $\text{NaCl} + \text{Aq}$  at  $35^\circ$  (Fordos). Instantly decomposed by  $\text{KOH} + \text{Aq}$ .

Gold (auric) iodide,  $\text{AuI}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in alkali iodides, and  $\text{HI} + \text{Aq}$ . Decomposed on air or by alkalis. (Johnston, Phil. Mag. J. 9, 266.)

Aurous iodide ammonia,  $\text{AuI}, \text{NH}_3$ .

Decomposed by  $\text{H}_2\text{O}$  or dil. acids. (Meyer, C. R. 1906, 143, 281.)

Sol. in aqua regia.  
 $\text{AuI}, 6\text{NH}_3$ . (Meyer.)

Aurous oxide,  $\text{Au}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol. Decomposed by boiling with  $\text{HCl} + \text{Aq}$  into Au and  $\text{AuCl}_3$ .  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  do not attack. Sol. in cold aqua regia. Sol. in  $\text{HI} + \text{Aq}$ . Sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  when freshly precipitated (Berzelius.)

According to Krüss (A. 237, 281) all hitherto prepared  $\text{Au}_2\text{O}$  is impure. Pure  $\text{Au}_2\text{O}$  is sol. in cold  $\text{H}_2\text{O}$  when freshly precipitated, from which hydroxide is precipitated by boiling. Partly sol. in  $\text{HCl}$ , or  $\text{HBr} + \text{Aq}$ . Sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  when freshly precipitated. Not affected by any other acid or solvent. (Krüss.)

The so-called solution of  $\text{Au}_2\text{O}$  in  $\text{H}_2\text{O}$  is in reality a colloidal suspension. (Vaino, B. 1905, 38, 462.)

Auric oxide,  $\text{Au}_2\text{O}_3$ .

See Auric hydroxide.

Auroauric oxide,  $\text{Au}_2\text{O}_3$ .

Sol. in cold  $\text{HCl} + \text{Aq}$ ; forms insol. compound with  $\text{HF}$ . (Prat, C. R. 70, 842.)

Obtained pure by Krüss (A. 237, 296.)

Gold phosphide,  $\text{Au}_3\text{P}_2$ .

Not attacked by  $\text{HCl} + \text{Aq}$ .  $\text{HNO}_3$  forms  $\text{H}_2\text{PO}_4$ , and leaves undissolved Au. (Schröter, J. B. 1849, 247.)

$\text{Au}_3\text{P}_2$ . Decomposed on air or with  $\text{H}_2\text{O}$ . (Cavazzi, Gazz. ch. it. 16, 40.)

$\text{Au}_3\text{P}_2$ . Readily attacked by aqua regia or  $\text{Cl}_2 + \text{Aq}$ . (Granger, C. R. 1897, 124, 498.)

Gold purple (mixture of Au and  $\text{SnO}_2$ ).

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in aqua regia.  $\text{HCl} + \text{Aq}$  dissolves all Sn and leaves Au. Boiling  $\text{HNO}_3 + \text{Aq}$  dissolves a little Sn.

Insol. in boiling  $\text{KOH} + \text{Aq}$  (Berzelius).  $\text{KOH} + \text{Aq}$  extracts excess of  $\text{SnO}_2$ , and the residue becomes sol. in  $\text{H}_2\text{O}$ , from which it is pptd. by  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Figuier, A. ch. (3) 11, 353.)

Sol., when still moist, in  $\text{NH}_4\text{OH} + \text{Aq}$ , but insol. if it has been dried.

Obtained in colloidal state in aqueous solution containing 0.58 g. Au. and 5.41 g.  $\text{SnO}_2$

in a litre. This solution may be concentrated without coagulation. The solution is coagulated by dil.  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ , more easily by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; also by  $\text{KCl}$ ,  $\text{HgCl}_2$ ,  $\text{FeSO}_4 + \text{Aq}$ , and many other salts. Not coagulated by alcohol, but easily when ether is added to the alcohol (Schneider, Z. anorg. 5, 80.)

Gold (auric) selenide,  $\text{Au}_2\text{Se}_3$ .

$\text{HNO}_3 + \text{Aq}$  dissolves out Se. Sol. in aqua regia or alkali sulphides +  $\text{Aq}$ . (Uelsmann, J. B. 1860, 90.)

Aurous sulphide,  $\text{Au}_2\text{S}$ .

Easily sol. in  $\text{H}_2\text{O}$  when freshly prepared, but precipitated from aqueous solution by  $\text{HCl}$ ,  $\text{KCl}$ , or  $\text{NaCl} + \text{Aq}$ . When dried is insol. in  $\text{H}_2\text{O}$ .

Insol. in boiling dil. or conc.  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily sol. in aqua regia,  $\text{HCl} + \text{Aq}$  with  $\text{KClO}_3$ , etc. Slowly sol. in alkali monosulphides +  $\text{Aq}$ . Easily sol. in polysulphides +  $\text{Aq}$ .

Insol. in  $\text{KOH} + \text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ . (Krüss, B. 20, 2369.)

Known also in colloidal state in aqueous solution containing 1.74 g.  $\text{Au}_2\text{S}$  per l (Schneider, B. 24, 2241.)

Auric sulphide,  $\text{Au}_2\text{S}_3$ .

Insol. in  $\text{H}_2\text{O}$  and acids except aqua regia; sol. in alkali sulphides, or  $\text{KOH} + \text{Aq}$ . (Berzelius.)

Does not exist (Krüss, B. 22, 2369), but has since been made by Antony and Lucchesi (Gazz. ch. it. 20, 601). Insol. in  $\text{HCl}$ , or dil.  $\text{HNO}_3 + \text{Aq}$ . Decomposed by conc.  $\text{HNO}_3$ ,  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  with separation of Au. Sl. decomposed by  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in  $\text{KCN} + \text{Aq}$ ; decomposed by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Sol. in cold  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S} + \text{Aq}$ ; decomposed on boiling. (Antony and Lucchesi, Gazz. ch. it. 21, 2, 209.)

Insol. in ether. (Hofmann, B. 1904, 37, 246.)

Auroauric sulphide,  $\text{Au}_3\text{S}_2$ .

Insol. in  $\text{H}_2\text{O}$  or acids except aqua regia. Sl. sol. in cold alkali monosulphides +  $\text{Aq}$ , but easily sol. on warming. Sol. in cold polysulphides +  $\text{Aq}$ , but less in ammonium polysulphide than the other alkali polysulphides.

Not attacked by cold, but easily sol. in hot  $\text{KOH} + \text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ . (Hofmann and Krüss, B. 20, 2704.)

Obtained also in colloidal state in aqueous solution containing 0.8 g. per l. (Schneider.)

Insol. in  $\text{Na}_2\text{S} + \text{Aq}$ . sat. with S. (Ditte, A. ch. 1907, (8) 12, 273.)

Aurous potassium sulphide,  $\text{Au}_2\text{S}, 3\text{K}_2\text{S}$ .

(Antony and Lucchesi, Gazz. ch. it. 1896, 20, (2) 350.)

$\text{Au}_2\text{S}$ ,  $4\text{K}_2\text{S}+12\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 1895, 120. 322.)

Gold silver sulphide,  $\text{Ag}_3\text{AuS}_2$

Ppt. (Lucchesi, Gazz. ch. it 1896, 26. 350-53.)

Aureous sodium sulphide,  $\text{NaAuS}+4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Yorke, Chem. Soc. Q. J. 1. 236.)

$+5\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 1895, 120. 321.)

$\text{Na}_3\text{AuS}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Lucchesi, Gazz. ch. it 1896, 26. 350-53.)

$\text{Au}_2\text{S}$ ,  $2\text{Na}_2\text{S}+20\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  (Ditte, C. R. 1895, 120. 321.)

Gold telluride.

Ppt. (Berzelius, Pogg. 8. 178.)

Gold silver telluride,  $\text{Au}_2\text{Te}_2$ ,  $\text{Ag}_2\text{Te}$ .

Min. *Sylvanite*. Sol. in  $\text{HNO}_3+\text{Aq}$  with separation of Au, in aqua regia with separation of AgCl.

$3\text{Ag}_2\text{Te}$ ,  $\text{Au}_2\text{Te}$ . Min. *Petsite*.

Hartshorn, salts of.

See Carbonate carbamate, ammonium hydrogen.

Helium, He.

Coefficient of absorption for  $\text{H}_2\text{O}$  at  $18.2^\circ=0.0073$ . (Ramsay, Z. phys. Ch. 1906, 55. 347.)

Absorption of helium by  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm. pressure.

$t^\circ$	Coefficient of absorption
0	0.01500
0.5	0.01487
5	0.01460
10	0.01442
15	0.01396
20	0.01386
25	0.01371
30	0.01382
35	0.01380
40	0.01387
45	0.01403
50	0.01404

(Estreicher, Z. phys. Ch. 1899, 31. 184.)

Absorption by  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Coefficient of absorption
0	0.0134
10	0.0100
20	0.0138
30	0.0161
40	0.0191
50	0.0226

(Antropoff, Roy. Soc. Proc. 1910, 83. A. 480.)

Completely insol. in benzene and in alcohol (Ramsay, Chem. Soc. 1895, 67. 684.)

Hexamine chromium compounds.

See Luteochromium compounds.

Hexamine cobaltic compounds,

$\text{Co}_2(\text{NH}_3)_6\text{X}_4$

See Dichrochromic compounds.

$\text{Co}(\text{NH}_3)_6\text{X}_3$ .

See Luteochromic compounds.

Hexamine iridium chloride,  $\text{Ir}_2(\text{NH}_3)_4\text{Cl}_4$ .

See Iridotriamine chloride.

Hexathionic acid,  $\text{H}_2\text{S}_6\text{O}_4$ .

Known only in aqueous solution, which decomposes rapidly, even in presence of free sulphuric acid. (Debus, A. 244. 76.)

Potassium hexathionate,  $\text{K}_2\text{S}_6\text{O}_4$ .

Sol. in  $\text{H}_2\text{O}$ , with rapid decomp. Not obtained in pure state. (Debus, A. 244. 76.)

Holmium, Ho.

Holmium oxide,  $\text{Ho}_2\text{O}_3$ .

(Cleve, C. R. 89. 478; 91. 328.)

Consists of at least two elements. (Lecoq de Boisbaudran, C. R. 102. 1005.)

Consists of seven elements. (Kriess and Nilson.)

*Sesqui*hydraurylamine,  $(\text{AuOH})_2\text{N}$ ,  $\text{NH}_3=\text{Au}_2\text{N}_2+3\text{H}_2\text{O}$ .

Decomp. by boiling with  $\text{H}_2\text{O}$ . (Raschig, A. 235. 341.)

Hydrazidophosphoric acid.

Berium hydrazidophosphate,

$\text{OP}(\text{N}_2\text{H}_2)_2\text{O}_2\text{Ba}$ .

(Ephraim, B. 1911, 44. 3420.)

Lead hydrazidophosphate,  $\text{OP}(\text{N}_2\text{H}_2)_2\text{O}_2\text{Pb}$ .

Easily sol. in  $\text{HNO}_3$ . (Ephraim.)

Potassium hydrazidophosphate,

$\text{OP}(\text{N}_2\text{H}_2)(\text{OK})_2$ . (Ephraim.)

Sodium hydrazidophosphate,

$\text{OP}(\text{N}_2\text{H}_2)(\text{ONa})_2$ .

Can be cryst. from dil. alcohol. (Ephraim.)

Hydrazine,  $\text{N}_2\text{H}_4=\text{NH}_2-\text{NH}_2$ .

Very sol. in  $\text{H}_2\text{O}$ . (Curtius, B. 20. 1632.)

Very hygroscopic; decomp. by  $\text{H}_2\text{O}$ ; solvent for sulphur, KCl, KBr,  $\text{KNO}_3$ . (de Bruyn, R. t. c. 1894, 13. 433-40; Chem. Soc. 1895, 68 (2) 347.)

Mixes in all proportions with alcohols; al. sol. in organic solvents. (Lobry de Bruyn, Chem. Soc. 1897, 72 (2) 22.)

**Hydrazine amidosulphonate,**  
 $N_2H_4 \cdot HSO_3 \cdot NH_2$ .

Very sol. in  $H_2O$ . (Sabancjeff, Z. anorg. 1899, 20, 22.)

**Hydrazine azoimide,  $N_2H_4 \cdot HN_3$ .**

Deliquescent. Easily sol. in  $H_2O$ . Sl. sol. in alcohol, and can be crystallised therefrom. (Curtius, B. 24, 2344.)

**Hydrazine borate,  $(N_2H_4)_2(B_2O_3)_2$ .**

Sol. in  $H_2O$ . (Dschawachow, C. C. 1902, I, 1394.)

$(N_2H_4)_2(H_3B_2O_7)_2$  Sol. in  $H_2O$ . (Dschawachow, C. C. 1902, I, 1394.)

+5 $H_2O$ . Sol. in  $H_2O$ . (Dschawachow, C. C. 1902, I, 1394.)

+10 $H_2O$  Ppt. (Dschawachow, C. C. 1902, I, 1394.)

**Hydrazine cuprous bromide chloride,**

$N_2H_4Cl \cdot N_2H_4Br \cdot 3CuBr$ .  
 (Ranfaldi, Real. Ac. Linc. 1906 (5) 15, II, 95.)

**Hydrazine mercuric bromide,**

$HgBr_2 \cdot 2(N_2H_4 \cdot HBr) + H_2O$   
 Very sol. in  $H_2O$ , sol. in alcohol and acetone. Sl. sol. in acetic ether.  
 Insol. in ethyl ether. (Ferratini, C. A. 1912, 1612.)

**Hydrazine zinc bromide,  $2N_2H_4 \cdot HBr \cdot ZnBr_2 + H_2O$ .**

Very sol. in  $H_2O$ ; sol. in alcohol and acetone. (Ferratini, C. A. 1912, 1612.)

**Hydrazine carbonate.**

Very deliquescent, but only sl. sol. in  $H_2O$ . Sl. sol. in alcohol. (Curtius and Jay, J. pr. 1889, (2) 39, 41.)

**Hydrazine zinc carbonate hydrazine,**

$Zn(CO_3 \cdot NH_3 \cdot NH_4)_2 \cdot 2N_2H_4$ .  
 Easily sol. in  $H_2O$ . (Ebler and Schott, J. pr. 1909, (2) 79, 72.)

**Hydrazine chlorate,  $N_2H_4 \cdot HClO_3$ .**

Very sol. in  $H_2O$ ; sl. sol. in alcohol. Insol. in ether,  $CHCl_3$  and benzol. (Salvadori, Gazz. ch. it 1907, 87, (2) 32.)

**Hydrazine dichlorate,  $N_2H_4 \cdot 2HClO_3$ .**

Ppt. Decomp. in aq. solution. (Turrentine, J. Am. Chem. Soc. 1915, 37, 1123.)

**Hydrazine cupric chloride,  $N_2H_4Cl \cdot CuCl_2 + \frac{1}{2}H_2O$ .**

Decomp. by  $H_2O$ . (Ranfaldi, Real. Ac. Linc. 1906, (5) 15, II, 95.)

+2 $H_2O$ . Decomp. by  $H_2O$ . (Ranfaldi.)

**Hydrazine mercuric chloride,  $N_2H_4Cl \cdot HgCl_2$ .**  
 (Hoffmann and Maibung, A. 1899, 305, 221.)

**Hydrazine dithionate,  $N_2H_4 \cdot H_2S_2O_6$ .**

Sol. in  $H_2O$ , decomp. on standing in aq. solution. (Sabancjeff, Z. anorg. 1899, 20, 21.)

$2N_2H_4 \cdot H_2S_2O_6$  Sol. in  $H_2O$ . (Sabancjeff.)

**Hydrazine fluosulphate,  $N_2H_4 \cdot H_2SiF_6$ .**

Easily sol. in  $H_2O$ .  
 Difficultly sol. in ethyl and methyl alcohol. (Ebler, J. pr. 1910, (2) 81, 552.)

**Hydrazine fluotitanate,  $(N_2H_4)_2 \cdot H_2TiF_6 + 2H_2O$**

Ppt. Sol. in  $H_2O$ . (Ebler, J. pr. 1910, (2) 81, 555.)

**Hydrazine monohydrobromide,  $N_2H_4 \cdot HBr$ .**

Very easily sol. in  $H_2O$  or hot alcohol. (Curtius and Schultz, J. pr. (2) 42, 537.)

**Hydrazine dihydrobromide,  $N_2H_4 \cdot 2HBr$ .**

Easily sol. in  $H_2O$ . Sl. sol. in alcohol. (Curtius and Schulz, J. pr. (2) 42, 535.)

**Hydrazine monohydrochloride,  $N_2H_4 \cdot HCl$ .**

Extremely sol. in  $H_2O$ . Sl. sol. in boiling absolute alcohol. (Curtius and Jay, J. pr. (2) 39, 38.)

**Hydrazine dihydrochloride,  $N_2H_4 \cdot 2HCl$ .**

Easily sol. in cold  $H_2O$ , sl. sol. in hot alcohol. (Curtius, l. c.)

Sol. in 2.07 pts  $H_2O$  at 23° Sp. gr. of sat. solution at 20°/4° = 1.4226. (Schiff, Z. phys. Ch. 1896, 21, 292.)

Sp. gr. of aqueous solution at 20°.

% salt	Sp. gr.
25	1.1183
20	1.0923
15	1.0675
10	1.0436
5	1.0206

(Schiff, Z. phys. Ch. 1896, 21, 292.)

Nearly insol. in hot absolute alcohol. (Curtius and Jay, J. pr. (2) 39, 37.)

**Hydrazine dihydrofluoride,  $N_2H_4 \cdot 2HF$ .**

Easily sol. in  $H_2O$ . Nearly insol. in alcohol. (Curtius and Schulz, J. pr. (2) 42, 533.)

**Hydrazine monohydroiodide,  $N_2H_4 \cdot HI$ .**

Easily sol. in  $H_2O$ . (Curtius and Schulz.)

**Hydrazine dihydroiodide,  $N_2H_4 \cdot 2HI$ .**

(Very deliquescent. Easily sol. in  $H_2O$ . Sl. sol. in alcohol. (Curtius and Schulz, J. pr. (2) 42, 536.)

**Trihydrazine dihydroiodide,  $3N_2H_4 \cdot 2HI$** 

Easily sol. in  $H_2O$  and alcohol (Curtius and Schulz, J. pr. (2) 42. 540.)

**Hydrazine hydroxide,  $N_2H_4 \cdot H_2O$ .**

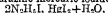
Miscible with  $H_2O$  or alcohol, but not with ether, chloroform, or benzene. (Curtius and Schulz, J. pr. (2) 42. 530.)

**Hydrazine hypophosphate,  $N_2H_4 \cdot H_2P_2O_6$ .**

Sl. sol. in  $H_2O$ . 1.5 pts. dissolve in 100 pts.  $H_2O$ . (Sabanejeff, Z. anorg. 1898, 17. 490.)

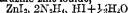
**Hydrazine hypophosphate ammonia,**

Sol. in  $H_2O$  (Sabanejeff, Z. anorg. 1899, 20. 23.)

**Hydrazine mercuric iodide,**

Very sol. in  $H_2O$ , alcohol, acetone, acetic ether

Insol. in ether. Excess of  $H_2O$  decomp. (Ferratin, Gazz. ch. it. 1912, 42. (1), 172.)

**Hydrazine zinc iodide,**

Very sol. in  $H_2O$ , sol. in alcohol and acetone. (Ferratin, C. A. 1912. 1612)

**Hydrazine nitrate,  $N_2H_4 \cdot HNO_3$ .**

Very sol. in  $H_2O$ , sl. sol. in abs. alcohol. (Sabanejeff, Z. anorg. 1899, 20. 24)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	g $N_2H_4 \cdot HNO_3$ per 100 g.	
	Sat. solution	$H_2O$
10	63.63	174.9
15	68.47	217.2
20	72.70	266.3
25	76.61	327.5
30	80.09	402.2
35	83.06	490.3
40	85.86	607.2
45	88.06	737.6
50	91.18	1034
55	93.58	1458.
60	95.51	2127

(Sommer, Z. anorg. 1914, 86. 85.)

 **$N_2H_4 \cdot 2HNO_3$ . Very unstable.**

Sol. in  $H_2O$  but solution cannot be concentrated beyond 30% without decomp.

Decomp. by abs. alcohol.

Very sol. in hydrazine hydroxide + Aq. (Sabanejeff, Z. anorg. 1898, 20. 25.)

**Hydrazine nitrite,  $N_2H_4 \cdot HNO_2$ .**

Very sol. in  $H_2O$ . Pptd. by ether from solution in alcohol; insol. in ether.

Very hygroscopic (Sommer, Z. anorg. 1913, 83. 125)

**Hydrazine perchlorate,  $N_2H_4 \cdot HClO_4 + 2H_2O$ .**

Sol. in 1 ts pts.  $H_2O$  at  $30^\circ$  and 34 pts. alcohol; crystallizes from boiling absolute alcohol. (Salvadori, Ch. Z. 31. 680.)



Solubility in  $H_2O$  at  $t^\circ$

$t^\circ$	g $N_2H_4 \cdot HClO_4$	Sp. gr
18	41.72	1.264
35	66.9	1.391

(Carlson, Dissert. 1910.)

**Hydrazine dperchlorate,  $N_2H_4 \cdot 2HClO_4 + 2H_2O$** 

Efflorescent.

Deliquescent.

102 pts. salt sol. in 100 pts.  $H_2O$  at  $29^\circ$ .

2.8 pts. salt sol. in 100 pts. alcohol.

1.0 pt. " " " 100 " ether.

(Turrentine, J. Am. Chem. Soc. 1915, 37. 1123.)

**Hydrazine phosphate,  $N_2H_4 \cdot H_2PO_4$ .**

Very sol. in  $H_2O$ . (Sabanejeff, Z. anorg. 1898, 17. 488)

$N_2H_4 \cdot 2H_2PO_4$ . Sol. in  $H_2O$ . (Sabanejeff.)

**Hydrazine phosphite,  $N_2H_4 \cdot H_2PO_3$ .**

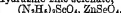
Sol. in  $H_2O$ . (Sabanejeff, Z. anorg. 1898, 17. 468)

**Hydrazine hydrogen phosphite,**

Less sol. in  $H_2O$  than the normal salt. (Sabanejeff.)

**Hydrazine selenate,  $N_2H_4 \cdot H_2SeO_4$ .**

Sol. in  $H_2O$  with decomp. (Rimini, C. C. 1907, I. 86.)

**Hydrazine zinc selenate,**

Sl. sol. in  $H_2O$  but more sol. than Cu salt. (Rimini and Malagnini, Gazz. ch. it. 1907, 37. (1), 265.)

**Hydrazine sulphocyanide,  $N_2H_4 \cdot HSCN$ .**

Very deliquescent. Sol. in  $H_2O$  and alcohol. (Curtius and Herdenreich, J. pr. 1895, [2] 62. 488.)

**Hydrazine sulphate,  $N_2H_4 \cdot H_2SO_4$ .**

Sol. with difficulty in cold, easily in hot  $H_2O$ . Insol. in alcohol. (Curtius, l. c.)

100 pts.  $H_2O$  dissolve 3.055 pts. salt at  $22^\circ$ . (Curtius and Jay, J. pr. (2) 39. 39.)

$2N_2H_4 \cdot H_2SO_4$ . Very deliquescent, and

sol. in  $H_2O$  Insol. in alcohol. (Curtius, J. pr. (2) 44. 101.)

**Hydrazine sulphite**,  $(N_2H_4)_2H_2SO_3$ .  
(Sabanejeff, Z. anorg. 1899, 20, 24.)

**Hydrazine pyrosulphite**,  $2N_2H_4 \cdot H_2S_2O_5$ .  
Sol. in  $H_2O$  with decomp.; insol. in alcohol.  
(Sabanejeff, Z. anorg. 1899, 20, 23.)

**Hydrazine thiosulphate**,  $(N_2H_4)_2H_2S_2O_4$ .  
Ppt. (Not pure.) (Ferratini, Gazz. ch. it. 1912, 42, (1) 138.)

**Hydrazine lead thiosulphate**,  
 $PbS_2O_3 \cdot 2(N_2H_4) \cdot H_2S_2O_4 + H_2O$ .  
Insol. in  $H_2O$  and alcohol.  
Sol. in  $HCl + Aq$  and in  $HNO_3 + Aq$ .  
(Ferratini, C. A. 1912, 1612)

**Hydrazine silver thiosulphate**,  
 $Ag_2S_2O_3 \cdot (N_2H_4)_2H_2S_2O_4$ .  
Insol. in  $H_2O$ ; sol. in  $NH_4OH + Aq$  and in  $HNO_3$ . (Ferratini.)

**Hydrazine sulphinic acid**.

**Barium hydrazine disulphonate**,  
 $Ba_2N_2(SO_4)_2$ .  
Insol. in  $H_2O$ ; sol. in acids. (Ephraim, B. 1911, 44. 390.)

**Hydrazinesulphonic acid**,  $N_2H_5SO_3OH$ .  
Sol. in about 24 pts.  $H_2O$  at ord temp. Decomp. by mineral acids; nearly insol. in alcohol and other organic solvents. (Traube, B. 1914, 47. 941.)

**Ammonium hydrazinesulphonate**,  
 $(N_2H_5SO_3)NH_4$ .  
Deliquescent; decomp. by acids. (Traube.)

**Barium hydrazinesulphonate**,  
 $(N_2H_5SO_3)_2Ba + 2H_2O$ .  
Sol. in  $H_2O$ ; pptd. by alcohol; decomp. by acids. (Traube.)

**Calcium hydrazinesulphonate**,  
 $(N_2H_5SO_3)_2Ca + H_2O$ .  
Sol. in  $H_2O$ . Decomp. by acids Insol. in alcohol. (Traube.)

**Potassium hydrazinesulphonate**,  $N_2H_5SO_3K$ .  
Decomp. by acids. (Traube.)

**Silver hydrazinesulphonate**,  $N_2H_5SO_3Ag$ .  
(Traube.)

**Sodium hydrazinesulphonate**,  
 $N_2H_5SO_3Na + H_2O$ .  
Decomp. by acids. (Traube.)

**Strontium hydrazinesulphonate**,  
 $(N_2H_5SO_3)_2Sr + 2H_2O$ .

Sol. in  $H_2O$ . Decomp. by acids. Insol. in alcohol. (Traube.)

**Hydriodic acid**,  $HI$ .  
See Iodhydric acid.

**Hydrobromic acid**,  $HBr$ .  
See Bromhydric acid.

**Hydrochloric acid**,  $HCl$ .  
See Chlorhydric acid.

**Hydrofluorboric acid**,  $HBF_4$ .  
See Fluoborhydric acid.

**Hydrofluoric acid**,  $HF$ .  
See Fluorhydric acid.

**Hydrogen**,  $H_2$ .  
Sl. absorbed by  $H_2O$ .

Sol. in 130 pts.  $H_2O$ , 1 vol. Recently boiled  $H_2O$  absorbs 100 vols.  $H_2O$  at  $18^\circ$  absorb 1814)

1 vol.  $H_2O$  absorbs 0.0193 vol.  $H$  at 760 mm. and all temperatures between  $0^\circ$  and  $23.6^\circ$ . (Bunsen.)

Later work does not confirm the above statement.

Absorption of  $H$  by  $H_2O$  at  $t$  and 760 mm.  
 $\beta$  = coefficient of absorption;  $\beta_1$  = "solubility" (see under Oxygen)

$t^\circ$	$\beta$	$\beta_1$
0	0.02153	0.02140
1	0.02134	0.02120
2	0.02115	0.02100
3	0.02097	0.02081
4	0.02079	0.02062
5	0.02061	0.02043
6	0.02044	0.02025
7	0.02027	0.02007
8	0.02010	0.01989
9	0.01994	0.01971
10	0.01978	0.01954
11	0.01962	0.01937
12	0.01947	0.01920
13	0.01932	0.01904
14	0.01918	0.01888
15	0.01903	0.01872
16	0.01889	0.01856
17	0.01876	0.01840
18	0.01863	0.01825
19	0.01850	0.01810
20	0.01837	0.01795
21	0.01825	0.01781
22	0.01813	0.01767
23	0.01802	0.01753
24	0.01791	0.01739
25	0.01780	0.01725
26	0.01770	0.01712

(Timofejeff, Z. phys. Ch. 6. 147.)

Absorption of H by  $H_2O$  at  $t^\circ$  and 760 mm.  
 $\beta$  = coefficient of absorption

$t^\circ$	$\beta$	$t^\circ$	$\beta$	$t^\circ$	$\beta$
0	0.0203	16	0.0182	32	0.0161
1	0.0202	17	0.0180	33	0.0160
2	0.0200	18	0.0179	34	0.0159
3	0.0199	19	0.0178	35	0.0157
4	0.0198	20	0.0177	36	0.0156
5	0.0196	21	0.0175	37	0.0155
6	0.0195	22	0.0174	38	0.0154
7	0.0194	23	0.0172	39	0.0153
8	0.0192	24	0.0171	40	0.0152
9	0.0191	25	0.0170	45	0.0149
10	0.0190	26	0.0168	50	0.0146
11	0.0189	27	0.0167	60	0.0144
12	0.0187	28	0.0166	70	0.0146
13	0.0186	29	0.0164	80	0.0149
14	0.0184	30	0.0163	90	0.0155
15	0.0183	31	0.0162	100	0.0166

(Bohr and Bock, W. Ann. 44. 318)

Absorption of hydrogen by  $H_2O$  at  $t^\circ$  and 760 mm. pressure.  $\beta$  = coefficient of absorption.  $\beta_1$  = "solubility" (see under Oxygen).

$t^\circ$	$\beta$	$\beta_1$
0	0.02148	0.02135
1	0.02126	0.02112
2	0.02105	0.02090
3	0.02084	0.02068
4	0.02064	0.02047
5	0.02044	0.02026
6	0.02025	0.02006
7	0.02007	0.01987
8	0.01989	0.01968
9	0.01972	0.01950
10	0.01955	0.01932
11	0.01940	0.01915
12	0.01925	0.01899
13	0.01911	0.01883
14	0.01897	0.01867
15	0.01883	0.01851
16	0.01869	0.01836
17	0.01856	0.01821
18	0.01844	0.01706
19	0.01831	0.01792
20	0.01819	0.01777
21	0.01805	0.01761
22	0.01792	0.01746
23	0.01779	0.01730
24	0.01766	0.01715
25	0.01754	0.01700
26	0.01742	0.01685
27	0.01731	0.01670
28	0.01720	0.01656
29	0.01709	0.01642
30	0.01699	0.01630
31	0.01692	0.01618
32	0.01685	0.01606
33	0.01679	0.01596
34	0.01672	0.01585
35	0.01668	0.01574

Absorption of hydrogen by  $H_2O$  at  $t^\circ$  and 760 mm. pressure.—Continued.

$t^\circ$	$\beta$	$\beta_1$
36	0.01661	0.01564
37	0.01657	0.01554
38	0.01652	0.01544
39	0.01648	0.01535
40	0.01644	0.01525
41	0.01640	0.01515
42	0.01635	0.01504
43	0.01631	0.01493
44	0.01627	0.01482
45	0.01624	0.01475
46	0.01620	0.01460
47	0.01617	0.01449
48	0.01614	0.01437
49	0.01611	0.01425
50	0.01608	0.01413
52	0.01606	0.01392
54	0.01605	0.01369
56	0.01603	0.01343
58	0.01602	0.01316
60	0.01600	0.01287
62	0.01600	0.01256
64	0.01600	0.01223
66	0.01600	0.01188
68	0.01600	0.01150
70	0.01600	0.01100
72	0.01600	0.01065
74	0.01600	0.01017
76	0.01600	0.00966
78	0.01600	0.00912
80	0.01600	0.00853
82	0.01600	0.00790
84	0.01600	0.00723
86	0.01600	0.00652
88	0.01600	0.00575
90	0.01600	0.00494
92	0.01600	0.00407
94	0.01600	0.00315
96	0.01600	0.00216
98	0.01600	0.00111
100	0.01600	0.0000

(Winkler, B. 24. 99.)

Critical  $t_c$ —232°. (Natanson, Z. phys. Ch. 1895, 17. 43–48.)

Coefficient of absorption for  $H_2O$  = 0.01750 at 25°; 0.01905 at 20°; 0.02059 at 15°; 0.02213 at 10°; 0.02366 at 5°. (Braun, Z. phys. Ch. 1900, 33. 734.)

Solubility in  $H_2O$  at 25° = 0.01926. (Geffcken, Z. phys. Ch. 1904, 49. 267.)

Coefficient of absorption for  $H_2O$  = 0.01810 at 20.11°. (Hufner, Z. phys. Ch. 1907, 57. 623.)

Solubility in  $H_2O$  at 25° = 0.01962. (Drucker and Moles, Z. phys. Ch. 1910, 75. 417.)

Coefficient of absorption for  $H_2O$  at 15° = 0.01892; at 20° = 0.01829. (Muller, Z. phys. Ch. 1912, 81. 493.)

Solubility of hydrogen in water at 25°.  
S = Solubility calculated according to formula, for which see original article.  
P = Pressure.

P	S	P	S
756	0 0199	1095	0 0195
757	0 0198	1097	0 0197
850	0 0200	1244	0 0202
877	0 0193	1252	0 0196
986	0 0194	1380	0 0196
992	0 0198	1393	0 0198

(Findlay, Chem. Soc. 1912, 101. 1465.)

Absorption by H<sub>2</sub>O at different pressures.

P = Hg-pressure in metres.

$\lambda$  = coefficient of solubility.

Table I. Volume of the absorbing liquid = 32.32 ccm. T = 19.5°.

P	$\lambda$	P	$\lambda$
0 9010	0 01798	3 3926	0 01789
0 9067	0 01796	4 1405	0 01776
1 0809	0 01799	4 6629	0 01761
1 2133	0 01800	5 4705	0 01748
1 3711	0 01794	5 9580	0 01725
1 5448	0 01791	6 6507	0 01706
1 8002	0 01793	7 4548	0 01674
2 5208	0 01793	7 8783	0 01652
2 9971	0 01795	8 2439	0 01632

Table II. Volume of the absorbing liquid = 32.007 ccm. T = 23°.

P	$\lambda$	P	$\lambda$
1.1154	0.01736	4.6220	0 01716
1.3758	0 01739	5 1130	0 01702
1.7416	0 01733	5 9702	0 01687
2.1712	0 01731	7 1920	0 01649
2.8724	0 01734	7 4493	0 01631
3 4115	0 01732	7 8696	0 01618
4 0229	0 01728	8 1913	0 01603

(Cassuto, Phys. Zent. 1904, 5. 235.)

Absorption of H<sub>2</sub> by acids + Aq.

M = content in gram-equivalents per liter.

S = solubility. (See under Oxygen.)

Absorption of H<sub>2</sub> by HNO<sub>3</sub> + Aq.

M	S 25°
0 741	0 01851
0.753	0 01868
1 22	0 01812
1 45	0 01782
2.09	0 01739
2 96	0 01690
3 18	0 01667
3.22	0 01633
4.13	0 01611
4.23	0 01589

(Geffcken, Z. phys. Ch. 1904, 49. 267.)

Absorption of H<sub>2</sub> by HCl + Aq.

M	S 23°
0 426	0 01875
0 432	0 01898
1 063	0 01789
1 602	0 01732
1 802	0 01699
1 928	0 01688
2 338	0 01652
2 438	0 01627
2.836	0 01606

(Geffcken.)

Absorption of H<sub>2</sub> by  $\frac{\text{H}_2\text{SO}_4}{2}$  + Aq.

M	S 25°
0 527	0.01860
0 562	0 01838
0 985	0 01780
1 122	0 01768
1.806	0 01642
1.905	0 01632
2 605	0 01575
3.045	0 01496
3.174	0 01456
3 962	0 01422
3 989	0 01402

(Geffcken.)

Solubility of H<sub>2</sub> in H<sub>2</sub>SO<sub>4</sub> + Aq at 20°.

% H <sub>2</sub> SO <sub>4</sub>	$\lambda$ 20°
0	0 0208
35 82	0 00954
61 62	0 00708
95 6	0 01097

(Christoff, Z. phys. Ch. 1906, 55. 627.)

Solubility of H<sub>2</sub> in colloidal ferric hydroxide solution is practically the same as its solubility in pure H<sub>2</sub>O.

Solubility of H<sub>2</sub> in a solution containing 18.11 g Fe(OH)<sub>3</sub> per liter at 25° = 0 3085.

Solubility of H<sub>2</sub> in a solution containing 18.309 g. Fe (OH)<sub>3</sub> per liter at 25° = 0 3083.

(Geffcken, Z. phys. Ch. 1904, 49. 299.)

Absorption of H<sub>2</sub> by bases + Aq.

M = content in gram-equivalents per liter.

S = solubility. (See under Oxygen.)

Absorption of H<sub>2</sub> by KOH + Aq.

M	S 25°
0 536	0 01658
0 715	0 01539
1.069	0 01378
1 056	0 01389
1.480	0 01195

(Geffcken, Z. phys. Ch. 1904, 49. 267.)

Absorption of H <sub>2</sub> by NaOH + Aq.		
M	S 23°	
0.543	0.01632	
0.571	0.01608	
0.692	0.01442	
0.974	0.01409	
1.059	0.01372	
1.137	0.01348	
1.850	0.01018	
3.400	0.00648	
3.430	0.00639	
4.687	0.00483	
(Geffeken.)		
Solubility of H <sub>2</sub> in salts + Aq at 15°.		
Salt	% Solk	Coefficient of absorption
H <sub>2</sub> O	0.00	0.01883
CaCl <sub>2</sub>	3.47	0.01619
	6.10	0.01450
	11.33	0.01138
	17.52	0.00839
	26.31	0.00519
MgSO <sub>4</sub>	4.94	0.01501
	10.19	0.01159
	23.76	0.00499
LiCl	3.48	0.01619
	7.34	0.01370
	14.63	0.0099
K <sub>2</sub> CO <sub>3</sub>	2.52	0.01628
	8.83	0.01183
	16.47	0.00761
	24.13	0.00462
	41.81	0.00160
KCl	3.83	0.01667
	7.48	0.01489
	12.13	0.01279
	19.21	0.01012
	22.02	0.00892
KNO <sub>3</sub>	4.73	0.01683
	8.44	0.01559
	16.59	0.01311
	21.46	0.01180
NaNO <sub>2</sub>	5.57	0.01603
	11.16	0.01370
	19.77	0.01052
	37.43	0.00578
Na <sub>2</sub> CO <sub>3</sub>	2.15	0.01630
	8.64	0.01385
	11.53	0.00839
Na <sub>2</sub> SO <sub>4</sub>	4.58	0.01519
	8.42	0.0154
	16.69	0.00775

(Gordon, Z. phys. Ch. 1895, 18. 14.)

Absorption by salts + Aq.						
Salt	t <sub>1</sub>	1000 g. salt + 100 g. H <sub>2</sub> O at t <sub>1</sub>	e <sub>1</sub> g. H <sub>2</sub> at t <sub>1</sub>	t <sub>2</sub>	Absorption- coefficient at t <sub>2</sub>	Absorption- coefficient at 23° (Calculated)
KCl	15°	1.1565	22.92	18.42	0.00809	0.00892
		1.1204	19.21	18.82	0.00865	0.01019
		1.0794	12.13	18.71	0.01240	0.01279
		1.0480	7.48	19.00	0.01447	0.01489
KNO <sub>3</sub>	15°	1.0246	3.83	19.23	0.01618	0.01667
		1.1060	11.16	17.41	0.01172	0.01180
		-	-	-	-	-
		-	-	-	-	-
K <sub>2</sub> CO <sub>3</sub>	15°	1.4393	41.81	13.17	0.00162	0.00160
		1.3112	30.99	12.77	0.00200	0.00235
		1.2354	24.13	12.69	0.00470	0.00462
		1.1553	10.47	12.51	0.00775	0.00761
		1.0807	8.83	11.32	0.01216	0.01183
		1.0405	1.53	12.20	0.01532	0.01501
		1.0248	2.82	11.23	0.01676	0.01628
NaCl	15°	1.1617	32.41	12.46	0.00900	0.00990
		-	-	-	-	-
		-	-	-	-	-
		-	-	-	-	-
NaNO <sub>2</sub>	18°	1.2993	37.43	17.27	0.00508	0.00578
		1.2090	27.95	17.36	0.00797	0.00810
		1.1417	19.77	17.40	0.01034	0.01052
		1.0705	11.16	17.05	0.01348	0.01370
Na <sub>2</sub> CO <sub>3</sub>	15°	1.0367	5.57	17.80	0.01572	0.01603
		1.1213	11.53	13.07	0.00851	0.00830
		1.0834	8.02	12.04	0.01106	0.01082
		1.0457	4.04	11.01	0.01420	0.01385
Na <sub>2</sub> SO <sub>4</sub>	15°	1.0217	2.15	11.04	0.01677	0.01630
		1.1608	16.09	18.41	0.00757	0.00775
		1.0708	8.42	18.57	0.01223	0.01254
		1.0412	4.58	18.51	0.01482	0.01519
LiCl	15°	1.0843	14.63	12.77	0.01006	0.00990
		1.0416	7.34	12.40	0.01300	0.01370
		1.0192	3.48	10.47	0.01676	0.01619
MgSO <sub>4</sub>	15°	1.2078	23.76	18.20	0.00487	0.00499
		1.1805	16.04	17.56	0.00785	0.00797
		1.1064	10.19	17.30	0.01140	0.01159
		1.0503	4.97	17.10	0.01479	0.01501
ZnSO <sub>4</sub>	18°	1.3265	20.51	18.59	0.00500	0.00505
		1.1061	17.23	18.22	0.00440	0.00461
		1.1394	12.73	17.95	0.01151	0.01175
		1.0002	6.03	17.79	0.01495	0.01526
CaCl <sub>2</sub>	15°	1.0476	24.13	17.62	0.00516	0.00519
		-	-	-	-	-
		-	-	-	-	-
		-	-	-	-	-
AlCl <sub>3</sub>	15°	1.2647	32.30	17.14	0.00525	0.00533
		1.1580	20.75	17.28	0.00860	0.00874
		1.0914	12.46	17.30	0.01100	0.01210
		1.0483	6.88	17.46	0.01460	0.01486
C <sub>12</sub> H <sub>22</sub> O <sub>11</sub>	17.6°	1.2134	47.65	13.80	0.00600	0.00602
		1.1286	30.08	14.19	0.01202	0.01294
		1.0672	16.67	14.16	0.01571	0.01661

(Steiner, W. Ann. 1894 (2), 52. 201.)

Solubility in salt solutions.  
C = concentration of the solution in terms of normal.

$\alpha$  = coefficient of absorption.

Absorption of hydrogen by  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at 20°.

P	C	$\alpha$
1.037	0.1308	0.01872
2.167	0.2765	0.01845
3.378	0.4363	0.01823
4.823	0.6333	0.01773
6.773	0.9069	0.01744
11.550	1.6308	0.01647

(Knopp, Z. phys. Ch. 1904, 48, 103.)

Absorption of hydrogen by  $\text{KNO}_3 + \text{Aq}$  at 20°

P	C	$\alpha$
1.244	0.1245	0.01835
2.094	0.2114	0.01818
4.010	0.4127	0.01785
5.925	0.6225	0.01743
7.742	0.8293	0.01667
13.510	1.5436	0.01436

(Knopp.)

Absorption of hydrogen by  $\text{NaNO}_3 + \text{Aq}$  at 20°.

P	C	$\alpha$
1.041	0.1236	0.01839
2.192	0.2634	0.01774
4.405	0.5416	0.01694
6.702	0.8442	0.01518
12.637	1.7394	0.01300

(Knopp.)

Absorption of hydrogen by  $\text{KCl} + \text{Aq}$  at 20°.

P	C	$\alpha$
1.089	0.1475	0.01823
2.123	0.2907	0.01767
4.070	0.5687	0.01661
6.375	0.9127	0.01531
7.380	1.0682	0.01472
13.612	2.1222	0.01255

(Knopp.)

Absorption of  $\text{H}_2$  by  $\text{NaCl} + \text{Aq}$ .  
 $\alpha$  = coefficient of absorption at t°.

Percent of NaCl in the solution	$\alpha_{25^\circ}$	$\alpha_{20^\circ}$	$\alpha_{15^\circ}$	$\alpha_{10^\circ}$	$\alpha_5^\circ$
5.999	0.01969	0.01969	0.01969	0.01969	0.01969
5.506					
4.496					
3.798					
1.523					
1.250					

(Braun, Z. phys. Ch. 1900, 33, 735.)

Absorption of  $\text{H}$  by  $\text{BaCl}_2 + \text{Aq}$ .  
 $\alpha$  = coefficient of absorption at t°.

Percent of $\text{BaCl}_2$ in the solution	$\alpha_{25^\circ}$	$\alpha_{20^\circ}$	$\alpha_{15^\circ}$	$\alpha_{10^\circ}$	$\alpha_5^\circ$
7.002	0.01455	0.01591	0.01716	0.01833	0.01947
6.453	0.01474	0.01605	0.01731	0.01857	0.01957
3.600	0.01502	0.01700	0.01840	0.01971	0.02089
3.291	0.01570	0.01719	0.01847	0.01983	0.02110

(Braun.)

1 vol. alcohol at t° and 760 mm. absorbs V vols.  $\text{H}$  gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	0.06925	9	0.06799	18	0.06690
1	0.06910	10	0.06787	19	0.06679
2	0.06896	11	0.06774	20	0.06668
3	0.06881	12	0.06761	21	0.06657
4	0.06867	13	0.06749	22	0.06646
5	0.06853	14	0.06737	23	0.06636
6	0.06839	15	0.06725	24	0.06621
7	0.06826	16	0.06713	..	..
8	0.06813	17	0.06701	..	..

(Bunsen's Gasometry, p. 286.)

One vol. alcohol absorbs 0.06925—0.000148t + 0.000001t<sup>2</sup> vols.  $\text{H}$  at t°.  
(Bunsen.)

Solubility in alcohol +  $\text{Aq}$  at 20° and 760 mm.

Wt. % alcohol	Vol. $\text{H}_2$ absorbed	Wt. % alcohol	Vol. $\text{H}_2$ absorbed
0	1.03	28.57	1.04
9.09	1.43	33.33	1.17
16.67	1.29	50	2.02
23.08	1.17	66.67	2.55

(Lubarsch, W. Ann. 1889, (2) 37, 525.)

Absorption of hydrogen by alcohol.

t°	Coeff of absorption	t°	Coeff of absorption
0	0.0676	13.4	0.0705
6.2	0.0693	18.8	0.0740

(Timofejeff.)

Solubility of  $\text{H}_2$  in ethyl ether at t°.

t°	Solubility
0	0.1115
5	0.1150
10	0.1195
15	0.1257

(Christoff, Z. phys. Ch. 1912, 78, 459.)

Coefficient of absorption in petroleum = 0.0582 at 20°, and 0.0552 at 10°. (Griewas and Walfisz, Z. phys. Ch. 1, 70.)

Absorption of hydrogen by chloralhydrate + Aq at 20°.

P	C	$\alpha$
4.911	0 310	0.01839
7.60	0 501	0 01802
14.56	1 030	0.01712
18 77	1 397	0.01653
29.50	2.530	0 01542
32.00	2 845	0 01518
38 42	3 770	0 01440
49 79	6 000	0 01353
60 12	9 120	0 01324
63 90	10 700	0 01307

(Knopp, Z. phys. Ch. 1904, 48. 103.)

Absorption of H<sub>2</sub> by chloralhydrate + Aq.

$t^\circ$  = temp. of the solution.

P = % chloralhydrate in the solution.

$\beta_{t^\circ}$  = coefficient of absorption at  $t^\circ$ .

$\beta_{15^\circ}$  = coefficient of absorption at 15°.

$t^\circ$	P	$\beta_{t^\circ}$	$\beta_{15^\circ}$
15 0	10.0	0 01740	0.01740
16.4	16 1	0 01719	0 01737
15 8	33 35	0 01475	0 01484
15 0	30 4	0.01470	0.01470
15 6	51 0	0 01300	0 01306
16.2	60 8	0.01281	0.01230
15.5	70 7	0.01282	0 01287
15 0	79 0	0.01320	0.01320
			$\beta_{20^\circ}$
19.4	15 5	0 01732	0 01724
17.4	28.3	0 01560	0.01540
18 7	46 56	0 01388	0.01375
10.5	52 0	0.01314	0.01280
17.0	63 0	0 01270	0.01243
17.2	66 0	0 01285	0.01260
17.9	68 0	0.01286	0.01270
18 3	78.4	0.01398	0.01380

(Müller, Z. phys. Ch. 1912, 81. 499.)

Solubility of H<sub>2</sub> in glycerol + Aq.

$t^\circ$	% glycerol	Coefficient of absorption
14	0	0 0193
	2 29	0 0189
	5.32	0 0186
	8.57	0 0182
	10.83	0 01815
	15 31	0 01765
21	0	0 0184
	2 29	0 0181
	5 68	0 0177
	6 46	0.0176
	10 40	0 0171
	18 20	0 0160

(Henkel, in Landolt-Börnstein, Tab. 4th Ed. 602)

Absorption of H<sub>2</sub> by glycerine + Aq.

$t^\circ$  = temp. of the solution.

P = % glycerine in the solution.

$\beta_{t^\circ}$  = coefficient of absorption at  $t^\circ$ .

$\beta_{15^\circ}$  = coefficient of absorption at 15°.

$t^\circ$	P	$\beta_{t^\circ}$	$\beta_{15^\circ}$
14.5	14 9	0 01654	0 01647
13 0	22 8	0.01532	0 01510
13.8	38 0	0 01226	0 01216
14.5	43 5	0 01117	0 01110
13.7	49 15	0.01019	0 01010
14 9	51 5	0 01026	0 01025
12 3	68 0	0 00822	0.00806
18 0	90 7	0.00853	0 00870

(Müller, Z. phys. Ch. 1912, 81. 496.)

Solubility of H<sub>2</sub> in glycerine + Aq at 25°.

G = % by wt. glycerine in the solvent.

S = Solubility of H<sub>2</sub>.

P = corrected pressure at end of experiment in mm. Hg at 0°.

P	G	S
716 3	4.0	0 0186
736 1	10.5	0 0178
684 3	22 0	0 0154
709 9	49 8	0 0099
730 1	50.5	0 0097
672 2	52 6	0 0090
741 1	67 0	0 0087
708 0	80 0	0 0051
665 5	82 0	0 0051
662 3	88 0	0 0044
741 8	95.0	0 0034

(Drucker and Moles, Z. phys. 1910, 75. 417.)

Absorption of H<sub>2</sub> by glucose + Aq.

$t^\circ$  = temp. of the solution.

P = % glucose in the solution.

$\beta_{t^\circ}$  = coefficient of absorption at  $t^\circ$ .

$\beta_{20^\circ}$  = coefficient of absorption at 20°.

$t^\circ$	P	$\beta_{t^\circ}$	$\beta_{20^\circ}$
20 5	12.2	0 01595	0 01600
20 5	20.7	0.01445	0.01450
21 1	32.56	0.01243	0 01250
21.8	45.8	0 01000	0 01015
21.2	59 0	0.00775	0 00780

(Müller, Z. phys. Ch. 1912, 81. 494.)

Solubility in sugar + Aq at 15°.

% Sugar	Absorption Coefficient
16.67	0 01561
30.08	0 01284
47 65	0 00892

(Gordon, Z. phys. Ch. 1895, 18. 14.)

Absorption of  $H_2$  by sucrose + Aq.  
 $t^\circ$  = temp. of the solution in the absorption vessel.  
 $P$  = % sucrose in the solution.  
 $\beta_{t^\circ}$  = coefficient of absorption at  $t^\circ$ .  
 $\beta_{15^\circ}$  = coefficient of absorption at  $15^\circ$ .

$t^\circ$	P	$\beta_{t^\circ}$	$\beta_{15^\circ}$
12 7		0 01862	0.01892
19.3		0 01840	$\beta_{20^\circ} =$ 0 01829
15.2	5 04	0 01723	0.01726
11 6	14.7	0 01647	0 01510
12	20.20	0 01500	0 01402
12 7	29.86	0.01290	0 01257
11.8	31.74	0 01220	0 01185
13 8	39.65	0 01047	0 01033
12.6	42.94	0.00956	0 00939

(Müller)

Absorption of  $H_2$  by propionic acid + Aq.  
 $a_{t^\circ}$  = coefficient of absorption at  $t^\circ$ .

Percent of propionic acid in the solution	$a_{25^\circ}$	$a_{20^\circ}$	$a_{15^\circ}$	$a_{10^\circ}$	$a_0$
0 910	0 01601	0 01291	0 01001	0 00701	0 00401
9 783					
0 500					
5 267					
3.373					
2 634					

(Braun, Z. phys. Ch. 1900, 33, 735.)

Absorption of  $H_2$  by organic acids + Aq.  
 $M$  = content in gram-equivalents per liter.  
 $S$  = solubility.

Absorption of  $H_2$  by  $CH_3COOH$  + Aq.

M	$S_{25^\circ}$
0.517	0.01925
0.528	0 01923
1.160	0 01903
1.20	0.01895
1.903	0 01885
1.980	0 01882
3.178	0 01862
3.220	0.01858
4.157	0.01849

(Geffcken, Z. phys. Ch. 1904, 49, 267.)

Absorption of  $H_2$  by  $CH_2ClCOOH$  + Aq.

M	$S_{25^\circ}$
0.527	0.01905
0.990	0.01852
1 773	0.01783

(Geffcken.)

Absorption of H by organic substances + Aq at  $t^\circ$ .  
 $V$  = absorbed volume reduced to  $0^\circ$  and 760 mm.  
 $a$  = coefficient of absorption

Substance	Grams in 1 liter	Vol of solution used in cc	$t^\circ$	V cc	$a$
Glucose	174	409 04	20 28°	5 48	0 01516
Glucose	80 8	"	20 16°	6 12	0 01049
Glucose	11 45	"	20 06°	0 36	0 01759
Urea	60	"	20 17°	6 26	0 01703
Acetamide	99	"	20 11°	6 51	0 01793
Alumina	89	"	20 08°	5 37	0 01555
Glycerol	75	"	20 16°	5 67	0 01577

(Hüfner, Z. phys. Ch. 1907, 57, 623-4.)

Solubility in organic solvents.

Solvent	Solubility at $25^\circ C$	Solubility at $20^\circ C$	$\frac{ds}{dt}$
Glycerine	Not measurable		
Water	0 01002	0 02000	-0 000016
Aniline	0 02849	0 03033	-0 000368
Amyl alcohol	0 03708	0 03533	+0 00035
Nitrobenzene	0 03708	0 03533	+0 00035
Carbon disulphide	0 03753	0 03556	+0 00079
Glacial acetic	0 06330	0 06172	+0 000310
Benzene	0 07500	0 07071	-0 000078
Acetone	0 07041	0 07027	+0 001228
Amyl acetate	0 07738	0 07432	+0 00061
Xylene	0 08185	0 07834	+0 000702
Ethyl acetate	0 08510	0 07877	+0 001278
Toluene	0 08742	0 08384	+0 000710
Ethyl alcohol (90-85%)	0 08935	0 08020	+0 00068
Methyl alcohol	0 09448	0 09016	+0 000366
Isobutyl acetate	0 09738	0 09287	+0 000942
Chloroform	no constant value		
Carbon tetrachloride			

(Just, Z. phys. Ch. 1901, 37, 359.)

Extended investigations have been made by Findlay and Shen. (Chem. Soc. 1912, 101, 1465) on the effect of colloids on solubility of  $H_2$  in  $H_2O$ . See original article.

**Hydrogen arsenide.**

See Arsenic hydride.

**Hydrogen peroxide,  $H_2O_2$ .**

Miscible with  $H_2O$ . Not stable in conc. solution. Aqueous solution gives up its  $H_2O_2$  to ether. Etheral solution is more stable than an aqueous solution of the same strength, and may be distilled without decomp. Miscible with alcohol.

Very stable in aq. solution of various conc. if perfectly free from impurity such as compds. of heavy metals, etc. (Woffenstein, B. 1894, 27, 3307.)

Coefficient of distribution between ether and  $H_2O$  determined at  $3^\circ$ ,  $7^\circ$ , and  $17.5^\circ$  with varying quantities (1.7-5%) of  $H_2O_2$ . (Ospoff, C. C. 1903, 11, 1265.)

As sol. in ether as in  $H_2O$ . A 50% solution in  $H_2O$  still contained about 25%  $H_2O_2$  after

being shaken 6 times with large quantities of fresh ether.

Insol. in petroleum ether. (Bühl, B. 1895, 28. 2855.)

+H<sub>2</sub>O, and +2H<sub>2</sub>O Does not solubilise at -20° (Wollenstein, B. 1891, 27. 3311)

**Hydrogen phosphide, gaseous (Phosphine), PH<sub>3</sub>**

Very slightly absorbed by H<sub>2</sub>O.

Statements as to solubility in H<sub>2</sub>O vary considerably.

(a) *Difficultly inflammable gas*—

1 vol. H<sub>2</sub>O absorbs 0.1123 vol PH<sub>3</sub>. (Dybowski, J. B. 1866. 735)

1 vol H<sub>2</sub>O absorbs 0.125 vol. PH<sub>3</sub>. (H. Davy.)

(b) *Easily inflammable gas*—

1 vol H<sub>2</sub>O absorbs 0.018 vol PH<sub>3</sub>. (Gengembre, Crell Ann. 1. 450)

1 vol. H<sub>2</sub>O absorbs 0.0214 vol. PH<sub>3</sub> (Henry.)

1 vol. H<sub>2</sub>O absorbs 0.025 vol. PH<sub>3</sub> (Davy.)

1 vol. H<sub>2</sub>O absorbs 0.125 vol. PH<sub>3</sub>. (Dalton, Ann. Phil. 11. 7)

1 vol. H<sub>2</sub>O absorbs 0.255 vol. PH<sub>3</sub>. (Raymond, Scher. J. 5. 389.)

1 vol. H<sub>2</sub>O dissolves 0.26 vols. PH<sub>3</sub> at 17°. (Stock, Böttger and Lenger, B. 1909, 42. 2855.)

Sol. in conc. H<sub>2</sub>SO<sub>4</sub> without immediate decomp. (Buff, Pogg. 16. 363.)

1 vol. 50% H<sub>2</sub>SO<sub>4</sub> dissolves 0.05 vol. PH<sub>3</sub>. (S. B. and L.)

Absorbed by CuSO<sub>4</sub>+Aq and by Br. (Berthelot.)

Absorbed rapidly by Cu<sub>2</sub>Cl<sub>2</sub>+Aq with formation of Cu<sub>3</sub>Cl<sub>2</sub>, 2PH<sub>3</sub>, and Cu<sub>2</sub>Cl<sub>2</sub>, 4PH<sub>3</sub>. (Ribon, C. R. 88. 581.)

1 vol. alcohol of 0.85 sp. gr. absorbs 0.5 vol ; 1 vol. ether absorbs 2 vols. (Graham.)

Sol in volatile oils; 1 vol oil of turpentine absorbs 3.25 vols. (Graham.)

Several varieties of blood absorb PH<sub>3</sub>.

**Hydrogen phosphide, liquid, P<sub>2</sub>H<sub>4</sub>**

Insol. in H<sub>2</sub>O. Apparently sol. in alcohol and oil of turpentine, but solution is very quickly decomp. (Thénard, A. ch. (3) 145.)

**Hydrogen phosphide, solid, P<sub>4</sub>H<sub>2</sub>**

Insol. in H<sub>2</sub>O and alcohol. (Leverrier, A. ch. 60. 174.)

Insol. in all liquids except liquid PH<sub>3</sub>. (Thénard, A. ch. (3) 14. 5.)

Instantly decomp. by HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>+Aq. Sol. with decomp. in alcoholic solution of KOH. (Thénard)

Somewhat sol. in liquid phosphorus. (Buck, Dissert. 1904.)

P<sub>2</sub>H<sub>4</sub>. Insol. in all solvents. (Stock, Böttger and Lenger, B. 1909, 42. 2851.)

P<sub>2</sub>H<sub>4</sub>. Sol. in liquid hydrogen phosphide and molten P. There are no other solvents which appreciably dissolve it. Insol. in liquid PH<sub>3</sub>. (S. B. and L.)

**Hydrogen selenide, H<sub>2</sub>Se.**

More sol. in H<sub>2</sub>O than hydrogen sulphide. (Berzelius.)

Solubility coefficient of H<sub>2</sub>Se at t°.

t°	Sol. Coeff.
4	3.77 vols.
9.65	3.43
13.2	3.31
22.5	2.70

(Forcrand and Fonze-Dineon, C. R. 1902, 134. 171.)

Sol in cold COCl<sub>2</sub>. (Besson, C. R. 1869, 122. 140)

**Hydrogen silicide.**

See Silicon hydride.

**Hydrogen sulphide, H<sub>2</sub>S.**

(a) *Liquid*. Dissolves S on warming, which separates on cooling.

(b) *Gas*

1 vol H<sub>2</sub>O absorbs 1.08 vols H<sub>2</sub>S at 10° (Henry, 1803)

1 vol H<sub>2</sub>O absorbs 2.53 vols H<sub>2</sub>S at 15° (de Saussure, Ann. Phil. 6. 340.)

1 vol H<sub>2</sub>O absorbs 3 vols H<sub>2</sub>S at 11°. (Gay-Lussac and Thénard)

1 vol H<sub>2</sub>O absorbs 3.66 vols H<sub>2</sub>S at ord. temp (Thompson)

1 vol H<sub>2</sub>O absorbs 2.5 vols H<sub>2</sub>S at ord temp (Dalton)

1 vol. H<sub>2</sub>O absorbs 4.3706-0.083687t+0.0005213t<sup>2</sup> vols H<sub>2</sub>S at temperatures between 2 and 43.3°. (Bunsen and Schönfeld, A. 93. 26.)

At 0° and about 820 mm. pressure, 1 cm. H<sub>2</sub>O absorbs 100 cm H<sub>2</sub>S, while only about 4 cm. are absorbed at ord. pressure. (de Forcrand and Villard, C. R. 106. 1402.)

1 vol. H<sub>2</sub>O at 760 mm. pressure and t° absorbs V vols. H<sub>2</sub>S, reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	4.3706	14	3.3012	28	2.4357
1	4.2874	15	3.2326	29	2.3819
2	4.2053	16	3.1651	30	2.3290
3	4.1243	17	3.0986	31	2.2771
4	4.0442	18	3.0331	32	2.2262
5	3.9652	19	2.9687	33	2.1764
6	3.8872	20	2.9053	34	2.1277
7	3.8103	21	2.8430	35	2.0799
8	3.7345	22	2.7817	36	2.0332
9	3.6596	23	2.7215	37	1.9876
10	3.5858	24	2.6623	38	1.9430
11	3.5132	25	2.6041	39	1.8994
12	3.4415	26	2.5470	40	1.8569
13	3.3708	27	2.4909		....

(Schönfeld, A. 93. 26.)

Absorption coefficient of  $\text{H}_2\text{S}$  in  $\text{H}_2\text{O}$  at  $0^\circ = 4.6796$ . (Prytz and Holst, W. Ann. 1895, 54, 137.)  
 1 l.  $\text{H}_2\text{O}$  dissolves 0.1004 mol  $\text{H}_2\text{S}$  at  $25^\circ$  and 760 mm. (Pollitzer, Z. anorg. 1909, 64, 145.)

Absorption of hydrogen sulphide by  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Coefficient of absorption
$0^\circ$	4.686
$10^\circ$	3.520
$20^\circ$	2.672

[Calc. fr. data of Frauser. (C. C. 1889, 1, 754.)]  
 (Winkler, Z. phys. Ch. 1906, 55, 350.)

Absorption of hydrogen sulphide by  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Coefficient of absorption
0	4.621
10	3.362
20	2.554
30	2.014
40	1.642
50	1.376
60	1.176

(Winkler, Z. phys. Ch. 1906, 55, 350.)

Solubility of  $\text{H}_2\text{S}$  in  $\text{H}_2\text{O}$ .

Layer rich in $\text{H}_2\text{S}$	
$t^\circ$	Mols. $\text{H}_2\text{S}$ per 100 mols. $\text{H}_2\text{O}$
0	0.4
6	0.5
17	0.8
26	1.2
29.5	1.6

Layer rich in  $\text{H}_2\text{O}$

$t^\circ$	Mols. $\text{H}_2\text{S}$ per 100 mols. $\text{H}_2\text{O}$
29.4	96.3
28.5	96.9
26.9	97.3
26.3	97.5
23.8	98.1
23.3	98.1
22.9	98.2
17.2	98.8
13.7	99.1
11.4	99.25
5.3	99.5

(Scheffer, Proc. K. Ak. Amsterdam, 1911, 14, 198.)

Difficultly sol. in conc.  $\text{H}_2\text{SO}_4$  with decomp.  
 Instantly decomp. by fuming  $\text{HNO}_3$ .  
 Solubility of  $\text{H}_2\text{S}$  in III + Aq at  $25^\circ$  and 760 mm.

HI Mol per l	$\text{H}_2\text{S}$ Mol per l
0.00	0.1004
1.01	0.111
1.51	0.113
1.93	0.125
2.65	0.130
2.64	0.138
3.42	0.142
4.38	0.163
5.005	0.165
5.695	0.181
6.935	0.197
* (9.21)	0.267)

\* Not exact.

(Pollitzer, Z. anorg. 1909, 64, 145.)

Solubility in acids + Aq.

l = value of  $\text{H}_2\text{S}$  dissolved in acid + Aq as determined by titration.

lo = value of  $\text{H}_2\text{S}$  dissolved in  $\text{H}_2\text{O}$  as determined by titration.

$t^\circ = 25^\circ$ .

Acid	l/lo
$\frac{1}{2}$ -N. HCl	0.975
$\frac{1}{2}$ -N. $\text{H}_2\text{SO}_4$	0.905

(McLauchlan, Z. phys. Ch. 1903, 44, 615.)

Less sol. in  $\text{NaCl}$ , or  $\text{CaCl}_2$  + Aq than in  $\text{H}_2\text{O}$ .

Sol. in  $\text{CdCl}_2$  +  $\text{NH}_4\text{OH}$  + Aq. (Crobaugh, Z. anorg. 1894, 6, 321.)

Solubility in salts + Aq.

l = value of  $\text{H}_2\text{S}$  dissolved in salt + Aq as determined by titration.

lo = value of  $\text{H}_2\text{S}$  dissolved in  $\text{H}_2\text{O}$  as determined by titration.

$t^\circ = 25^\circ$ .

Salt + Aq	l/lo*	Salt + Aq.	l/lo
$\frac{1}{2}$ -N. $\text{Na}_2\text{SO}_4$	0.73	$\frac{1}{2}$ -N. $\text{Na}_2\text{SO}_4$	0.855
$\frac{1}{2}$ -N. $\text{K}_2\text{SO}_4$	0.78	$\frac{1}{2}$ -N. $\text{K}_2\text{SO}_4$	0.890
$\frac{1}{2}$ -N. $(\text{NH}_4)_2\text{SO}_4$	0.82	$\frac{1}{2}$ -N. $(\text{NH}_4)_2\text{SO}_4$	0.91
N. $\text{NaCl}$	0.847	$\frac{1}{2}$ -N. $\text{NaCl}$	0.930
N. $\text{KCl}$	0.853	N. $\text{NaBr}$	0.935
N. $\text{NH}_4\text{Cl}$	0.960	N. $\text{KBr}$	0.945
N. $\text{NaNO}_3$	0.893	N. $\text{NH}_4\text{Br}$	1.00
N. $\text{KNO}_3$	0.913	N. $\text{KI}$	0.98
N. $\text{NH}_4\text{NO}_3$	0.990		

(McLauchlan, Z. phys. Ch. 1903, 44, 615.)

Solubility of  $H_2S$  in  $NaSH + Aq.$   
(g. mol.  $H_2S$  dissolved in 1 l.)

t°	0.05 g. mol NaSH per l	0.1 g. mol NaSH per l	0.2 g. mol NaSH per l
15	..	0 132	0 129
25	..	0 104	0 1035
35	0 082	0 082	..
45	0 061	..	..

(Goldschmidt and Larsen, Z. phys. Ch 1910,  
71. 449.)

At 18° and onl. pressure 100 vols alcohol of 0.84  
sp. gr. absorbs 606 mols  $H_2S$  (de Saussure, 1814)

1 vol. alcohol absorbs 17.891-0.6598t +  
0.00661t² vols  $H_2S$  between 0 and 22°.  
(Carius.)

1 vol alcohol at t° and 760 mm absorbs V  
vols  $H_2S$  reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	17.891	9	12.523	18	8.225
1	17.242	10	11.992	19	7.814
2	16.600	11	11.475	20	7.415
3	15.983	12	10.971	21	7.030
4	15.373	13	10.480	22	6.659
5	14.770	14	10.003	23	6.300
6	14.193	15	9.539	24	5.955
7	13.623	16	9.088	..	..
8	13.066	17	8.650	..	..

(Carius, A. 94. 140.)

Solubility in alcohol + Aq at 25°.

Molecules of $C_2H_5OH$ in 100 molecules $C_2H_5OH$ + $H_2O$	Molecules $H_2O$ in 100 molecules $C_2H_5OH + H_2O$	l/o
0 00	100	1.00
1 60	98 (7)	0.98
5.18	94.82	0.933
9.25	90.75	0.91
23.60	76.40	1.28
47.75	52.25	1.95
* (100)	0	2.16

\* Carius.

(McLauchlan.)

Sol. in methyl acetate (Marchand), ether  
(Higgins).

Insol. in caoutchouc.

Sol. in glycerine in less amount than in  
 $H_2O$ . If a certain vol. of  $H_2O$  dissolves 100  
pts.  $H_2S$ , the same vol. of glycerine (1 pt.  
glycerine + 1 pt.  $H_2O$ ) dissolves only 60 pts.  
 $H_2S$ , but the solution is very stable. After  
standing a year there is no appreciable  
decomp. (Lapage, J. Pharm. (4) 5. 256.)

According to Lindo (C. N. 57. 173), the  
solution in glycerine is no more stable than  
that in  $H_2O$ .

Sol. in  $CS_2$ .

Solubility in organic substances + Aq.  
l = value of  $H_2S$  dissolved in organic sub-  
stance + Aq as determined by titration.

lo = value of  $H_2S$  dissolved in  $H_2O$  as de-  
termined by titration.

t° = 25°.

Solution	l/o
$N-NH_2C_2H_5O_2$	1.09
$N-C_2H_5O_4$	0.944
$3-N-C_2H_5O_4$	0.858
$N-(NH_2)_2CO$	1.02
pure $C_2H_5(OH)_2$	0.863

(McLauchlan, Z. phys. Ch. 1903, 44. 615.)

Solubility in acetic acid + Aq at 25°.

Molecules of $CH_3COOH$ in 100 molecules $CH_3COOH + H_2O$	Molecules of $H_2O$ in 100 molecules $CH_3COOH + H_2O$	l/o
0	100	1.00
8.85	91.15	0.98
16.7	83.30	0.955
21.0	79	1.00
35.5	64.5	1.035
53.5	46.5	1.21
55.7	44.3	1.29
67.8	32.2	1.40
81.0	19.0	1.83
98.68	1.32	3.81

(McLauchlan.)

Hydrogen persulphide,  $H_2S_2$  or  $H_2S_8$ .

Decomp. by contact with  $H_2O$ , in which it  
is apparently insol. Sol. in ether, with subse-  
quent decomp. Sol. in  $CS_2$  (Thénard, A.  
ch. 48. 79.)

$H_2S_2$ . Quickly decomp. by ether, acetic  
ether, ethyl, or amyl alcohol.  $H_2S$  has no  
action.

Conc.  $HCl$ , or  $H_2C_2O_4 + Aq$  have no ac-  
tion. Sol. in a solution of S in  $CS_2$ , and in  
liquid hydrocarbons.

Chloroform dissolves without decomp.

(Sabbatier, C. R. 100. 1346, 1585.)

Alkalies, and  $K_2S + Aq$  decomp. instantly.

Decomp. by  $H_2O$ , dil. and conc.  $HCl$ , conc.  
 $H_2SO_4$ , alkali and alcohol. Sol. in alcohol  
containing  $HCl$  but soon decomp. in this  
solution. Miscible in all proportions  
without decomp. with benzene, ether and  $CS_2$ .  
(Bloch, B. 1908, 41. 1977.)

Formula is  $H_2S_8$ . (Rebs, A. 246. 356.)

+7 $H_2O$ . Easily decomp. by heat, (de  
Forcrand and Villard, C. R. 106. 1402.)

Hydrogen trisulphide,  $H_2S_3$ .

Decomp. by  $H_2O$ , dil. and conc.  $HCl$ , conc.  
 $H_2SO_4$ , alkali and alcohol. Somewhat sol. in  
alcohol containing  $HCl$ , but slowly decomp.  
in this solution. Miscible with ether, ben-  
zene and  $CS_2$ , and these solutions are relatively  
stable. (Bloch, B. 1908, 41. 1974.)

**Hydrogen telluride,  $\text{H}_2\text{Te}$ .**

Sl. sol. in  $\text{H}_2\text{O}$  Decomp. in the air. (Ernyei, Z. anorg. 1900, 25. 313.)

**Hydrosulphuric acid,  $\text{H}_2\text{S}$ .**

See Hydrogen sulphide.

**Hydrosulphurous acid,  $\text{H}_2\text{SO}_2$ .**

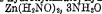
See Hyposulphurous acid.

**Hydroxylamic acid.**
**Calcium hydroxylamate,  $\text{Ca}(\text{ONH}_2)_2$ .**

Very explosive, decomp. by  $\text{H}_2\text{O}$ . (Ebler and Schott, J. p. 1908, (2) 78. 323.)

**Zinc hydroxylamate  $\text{Zn}(\text{ONH}_2)_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Ebler and Schott.)

**Zinc hydroxylamate, hydroxylamine,**


Very unstable.

Insol. in abs. alcohol. (Ebler and Schott.)

**Hydroxylamine,  $\text{NH}_2\text{O} = \text{NH}_2(\text{OH})$ .**

Known only in solution.

Sol. in alcohol. (Lossen, J. pr. 96. 462.)

Prepared in free state by de Bruyn.

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  and alcohol. Sl. sol. or insol. in  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ , ether, or ethyl acetate

Methyl alcohol at 5° dissolves 35%; ethyl alcohol at 15°, 15%; boiling dry ether, 1 2%; boiling ethyl acetate, 1 6%. (de Bruyn, R. t. c. 11. 18.)

**Hydroxylamine arsenate,  $\text{AsO}_2\text{H}_2(\text{NH}_2\text{O})_2$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ ; sol. in hot  $\text{H}_2\text{O}$  from which it can be cryst. (Hofmann, A. 1899, 307. 331.)

**Hydroxylamine azolamide.**

See Azolamide, hydroxylamine.

**Hydroxylamine bromide,  $\text{NH}_2\text{OH}, \text{HBr}$ .**

Very sol. in  $\text{H}_2\text{O}$ ; insol. in ether by which it is pptd. from solution in alcohol. (Adams, Am. Ch. J. 1902, 28. 205.)

$2\text{NH}_2\text{OH}, \text{HBr}$ . Easily sol. in  $\text{H}_2\text{O}$ , insol. in ether and ligroin. Sl. sol. in alcohol. (Adams.)

**Hydroxylamine mercuric bromide hydroxylamine,  $2\text{NH}_2\text{OH}, 2\text{HBr}, \text{HgBr}_2, 2\text{NH}_2\text{OH}$ .**

Decomp. by  $\text{H}_2\text{O}$  and methyl alcohol.

Readily decomp. by alkalis. (Adams.)

**Hydroxylamine calcium,  $\text{HO.Ca.ONH}_2$ .**

Partially decomp. by  $\text{H}_2\text{O}$  at ordinary temp. (Hofmann, Z. anorg. 1898, 16. 464.)

**Hydroxylamine chloride, basic,  $\text{NH}_2(\text{OH})\text{Cl}, \text{NH}_2\text{OH}$ .**

Sol. in  $\text{H}_2\text{O}$ . Alcohol precipitates from aqueous solution. Insol. in ether. (Lossen.)  $2\text{NH}_2(\text{OH})\text{Cl}, \text{NH}_2\text{OH}$ . Deliquescent; very sol. in  $\text{H}_2\text{O}$ , less in alcohol, and insol. in ether. (Lossen.)

**Hydroxylamine chloride,  $\text{NH}_2(\text{OH})\text{Cl}$ .**

Not deliquescent Very sol. in  $\text{H}_2\text{O}$  and hot ordinary alcohol Sl. sol. in absolute alcohol. Insol. in ether (Lossen.)

Sol. in 1.2 pts  $\text{H}_2\text{O}$  at 17°. (Schiff, Z. phys. Ch. 1896, 21. 290.)

Sp. gr. of aqueous solution at 17°.

% salt	sp gr
40	1.1852
28	1.1260
20	1.0888
14	1.0616
10	1.0437
7	1.0303
5	1.0214
3 5	1.0147

(Schiff, Z. phys. Ch. 1896, 21. 290.)

100 pts absolute methyl alcohol dissolve 16.4 pts. at 19.75°; 100 pts. absolute ethyl alcohol dissolve 4.43 pts. at 19.75°. (de Bruyn, Z. phys. Ch. 10. 783.)

Somewhat sol. in alcohol. (Adams, Am. Ch. J. 1902, 28. 204.)

**Hydroxylamine mercuric chloride,  $\text{NH}_2\text{OH}, \text{HgCl}_2$ .**

Very sol. in  $\text{H}_2\text{O}$  and alcohol Less sol. in ether. (Adams, Am. Ch. J. 1902, 28. 213.)

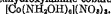
$5(\text{NH}_2\text{OH})_2, \text{HCl}, 2\text{HgCl}_2$ . Sol. in cold  $\text{H}_2\text{O}$ , alcohol and ether. More easily sol. in methyl alcohol. Sol. in  $\text{HCl}$ . The slightest trace of alkali causes decomp. (Adams.)

**Hexahydroxylamine cobaltic bromide,**

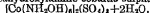

(Werner, B. 1905, 38. 897.)

**Hexahydroxylamine cobaltic chloride,**


Very stable toward  $\text{HCl}$ . (Werner, B. 1905, 38. 895.)

**Hexahydroxylamine cobaltic nitrate,**


(Werner.)

**Hexahydroxylamine cobaltic sulphate,**


Easily sol. in  $\text{H}_2\text{O}$ . (Werner.)

**Hydroxylamine columbate,  $\text{CoO}_2\text{N}_2\text{H}_6$ .**

Explosive. Sl. sol. in  $\text{H}_2\text{O}$ . (Hofmann, Z. anorg. 1898, 16. 473.)

**Hydroxylamine dithionate,  $(\text{NH}_2\text{OH})_2\text{H}_2\text{S}_2\text{O}_6$ .**

Sol. in  $\text{H}_2\text{O}$ ; decomp. on heating the aq. solution. (Sabanejeff, Z. anorg. 1898, 17. 485.)

**Hydroxylamine fluosilicate,  $(\text{NH}_2\text{OH})_2\text{H}_2\text{SiF}_6 + 2\text{H}_2\text{O}$** 

Easily sol. in  $\text{H}_2\text{O}$ . Nearly insol in methyl and abs ethyl alcohol. (Ehler, J. pr. 1908, (2), 78. 338.)

**Hydroxylamine fluoritanate,  $(\text{NH}_2\text{OH})_2\text{H}_2\text{TiF}_6$** 

Sol. in  $\text{H}_2\text{O}$ . Sl sol in methyl alcohol. (Ehler, J. pr. 1908, (2) 78. 340.)

**Hydroxylamine hypophosphite,  $(\text{NH}_2\text{OH})_2\text{H}_2\text{P}_2\text{O}_4$ .**

Very sol. in  $\text{H}_2\text{O}$  (Sabanejeff, Z. anorg. 1898, 17. 483.)

Sol. in  $\text{H}_2\text{O}$  and absolute alcohol. Insol. in ether. (Hofmann and Kohlschütter, Z. anorg. 1898, 16. 469.)

**Hydroxylamine potassium hypophosphite,  $(\text{H}_2\text{PO}_2)_2(\text{NH}_2\text{OH})_2\text{K}_2$ .**

Easily sol. in  $\text{H}_2\text{O}$ , decomp on heating; sol in hot abs. alcohol. (Hofmann and Kohlschütter, Z. anorg. 1898, 16. 468.)

**Hydroxylamine hypophosphate,  $(\text{NH}_2\text{OH})_2\text{H}_2\text{P}_2\text{O}_6$ .**

Easily sol in  $\text{H}_2\text{O}$ . (Sabanejeff, Z. anorg 1898, 17. 489.)

**Hydroxylamine iodide,  $\text{NH}_2\text{OH}, \text{HI}$ .**

Hygroscopic, sol in methyl alcohol. Very explosive (Wolfenstein and Groll, B. 1901, 34. 2419.)

**Dihydroxylamine iodide,  $(\text{NH}_2\text{OH})_2, \text{HI}$ .**

Deliquescent. More sol. in  $\text{H}_2\text{O}$ , methyl and ethyl alcohol than the tri compound. Is decomp. when recryst. from these solvents. Insol. in ether. (Dunstan, Chem. Soc. 1896, 69. 841.)

**Trihydroxylamine iodide,  $(\text{NH}_2\text{OH})_3, \text{HI}$ .**

Deliquescent in moist air. Sol. in  $\text{H}_2\text{O}$ , methyl and ethyl alcohol. Insol. in ether. (Dunstan.)

**Hydroxylamine nitrate,  $\text{NH}_2(\text{OH})\text{NO}_3$ .**

Very sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Lossen.)

**Hydroxylamine orthophosphate,  $(\text{NH}_2\text{OH})_3\text{PO}_4$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ . (Lossen.)

Only sl. sol. in  $\text{H}_2\text{O}$ . (Hofmann, A. 1899, 307. 330.)

Moderately sol. in  $\text{H}_2\text{O}$ . (Ross, Chem. Soc. 1906, 90, (2) 19.)

**Solubility in  $\text{H}_2\text{O}$** 

1 g of aqueous solution contains at

0°	10°
0.012	0.015 g hydroxylamine phosphate,
20°	30°
0.019	0.027 g. hydroxylamine phosphate,
40°	50°
0.040	0.065 g. hydroxylamine phosphate,
60°	70°
0.077	0.102 g. hydroxylamine phosphate,
80°	90°
0.133	0.168 g hydroxylamine phosphate,

(Adams, Am. Ch. J. 1902, 28. 204.)

$(\text{NH}_2\text{OH})\text{H}_2\text{PO}_4$ . Hygroscopic. Aq. solution is decomp on heating. (Sabanejeff, B. 1897, 30. 287.)

**Hydroxylamine phosphite,  $(\text{NH}_2\text{OH})_2\text{HPO}_3$ .**

Sol in  $\text{H}_2\text{O}$  and absolute alcohol. (Hofmann and Kohlschütter, Z. anorg. 1898, 16. 467.)

$(\text{NH}_2\text{OH})\text{H}_2\text{PO}_3$ . Sol. in  $\text{H}_2\text{O}$ . Insol in alcohol (Sabanejeff, Chem. Soc. 1900, 78, (2), 14.)

**Hydroxylamine phosphite ammonia,  $(\text{NH}_2\text{OH})_2\text{H}_2\text{PO}_3, \text{NH}_3$ .**

Sol in  $\text{H}_2\text{O}$ . (Sabanejeff, Chem. Soc. 1900, 78, (2) 14.)

**Hydroxylamine sodium,  $\text{NaONH}_2$** 

Very hygroscopic. (de Bruyn, R. t. c. 1892, 11. 18.)

**Hydroxylamine sulphate,  $(\text{NH}_2\text{OH})_2\text{SO}_4$ .**

Easily sol in  $\text{H}_2\text{O}$ . Precipitated from concentrated aqueous solution by alcohol. (Lossen.)

Sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in alcohol and ether. (Preibisch, J. pr. 1873, (2) 7. 480.)

Not deliquescent. Sol in  $\frac{1}{4}$  of its wt of  $\text{H}_2\text{O}$  at 20° (Divers and Haga, Chem. Soc. 1896, 69. 1665.)

1 g. of aqueous solution contains at	
-8°	0° +10°
0.307	0.329 0.366 g hydroxylamine sulphate,
20°	30° 40°
0.413	0.441 0.482 g. hydroxylamine sulphate,
50°	60° 90°
0.522	0.560 0.685 g. hydroxylamine sulphate.

(Adams, Am. Ch. J. 1902, 28. 203.)

Dry hydroxylamine sulphate is insol. in abs. and almost insol in 95% alcohol. (Adams.)

For double salts, see under sulphuric acid.  $\text{NH}_2\text{OH}, \text{H}_2\text{SO}_4$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1895, 67. 226.)

**Hydroxylamine tungstate,  $4\text{NH}_2\text{OH}, 3\text{WO}_3 + 3\text{H}_2\text{O}$ .**

Moderately sol. in  $\text{H}_2\text{O}$ . (Allen and Gottschalk, Am. Ch. J. 1902, 27. 338.)

# Hydroxylamine uranate, $\text{UO}_4(\text{NH}_2\text{O})_2 + \text{H}_2\text{O}$ .

Decomp. by heat. (Hofmann, Z. anorg. 1897, 15. 78.)

# Hydroxylamine uranate ammonia,

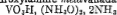


Decomp. by  $\text{H}_2\text{O}$  (Hofmann, Z. anorg. 1897, 15. 79.)

# Hydroxylamine metavanadate, $\text{VO}_3\text{N}_5\text{H}_{16}$

Decomp. by moisture. (Hofmann, Z. anorg. 1898, 16. 472.)

# Hydroxylamine metavanadate ammonia,



Easily decomp. by  $\text{H}_2\text{O}$  and  $\text{HCl}$  (Hofmann, Z. anorg. 1898, 16. 471.)

# Hydroxylamine monosulphonic acid,



"Sulphazidic acid" of Fremy

"Sulphidroxylamide acid" of Claus.

Sol in  $\text{H}_2\text{O}$ . Slowly decomp. on boiling. (Raschig, A. 241. 161.)

# Ammonium hydroxylamine monosulphonate,



(Sabanéjoff, Z. anorg. 1898, 17. 491.)

# Monobarium ———, $(\text{HONHSO}_3)_2\text{Ba} + \text{H}_2\text{O}$ .

Easily sol in  $\text{H}_2\text{O}$  (Divers and Haga, Chem. Soc. 55. 760.)

# Dibarium ———, $\text{Ba}(\text{HONSO}_3)_2\text{Ba} + \text{H}_2\text{O}$ .

Nearly insol in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (Divers and Haga, Chem. Soc. 55. 760.)

# Potassium ———, $\text{HONH}(\text{SO}_3\text{K})$ .

"Potassium sulphidroxylamide" of Claus

"Potassium sulphazidate" of Fremy.

Sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in hot  $\text{H}_2\text{O}$  without decomp. Insol. in alcohol. (Raschig, +  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 55. 760.)

# Hydroxylamine disulphonic acid,

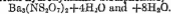


"Disulphidroxazotic acid" of Claus

"Sulphazotic acid" of Fremy.

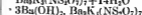
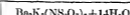
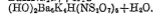
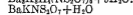
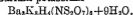
Not known in free state. (Raschig, A. 241. 161.)

# Barium hydroxylamine disulphonate,



Practically insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Divers, Chem. Soc. 1894, 65. 559.)

# Barium potassium ———.



Above salts are all ppts. (Divers, Chem. Soc. 1894, 65. 561.)

# Barium sodium hydroxylamine disulphonate,



Above salts are ppts. (Divers.)

# Potassium ———, $\text{HON}(\text{SO}_3\text{K})_2 + 2\text{H}_2\text{O}$ .

"Potassium disulphidroxylazotate" of Claus (A. 168. 75) Insol. in cold  $\text{H}_2\text{O}$ .

Very unstable. Very difficultly sol. in  $\text{H}_2\text{O}$ , more easily in dil  $\text{KOH} + \text{Aq}$ . (Raschig, A. 241. 161.)

$\text{HON}(\text{SO}_3\text{K})_2, \text{KON}(\text{SO}_3\text{K})_2 + \text{H}_2\text{O}$ . True composition of potassium sulphazotate of Fremy. (Divers and Haga, Chem. Soc. 1900, 77. 432.)

# Potassium sodium ———.

$3\text{K}_2\text{NS}_2\text{O}_7, 2\text{Na}_2\text{NS}_2\text{O}_7 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

$6\text{K}_2\text{NS}_2\text{O}_7, \text{Na}_2\text{NS}_2\text{O}_7, \text{H}_2\text{NS}_2\text{O}_7 + 20\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$

$\text{K}_2\text{Na}_2\text{H}_4(\text{NS}_2\text{O}_7)_2 + 5\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than the others.

$\text{K}_2\text{Na}_2\text{H}_4(\text{NS}_2\text{O}_7)_2 + 9\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ .

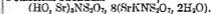
$\text{KNa}_2\text{H}(\text{NS}_2\text{O}_7)_2 + \text{H}_2\text{O}$ . Readily sol. in  $\text{H}_2\text{O}$ .

$\text{K}_2\text{NaH}_2(\text{NS}_2\text{O}_7)_2 + 2\text{H}_2\text{O}$ . Moderately sol. in  $\text{H}_2\text{O}$ .

$\text{KNaHNS}_2\text{O}_7 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

(Divers, Chem. Soc. 1894, 65. 552.)

# Potassium strontium ———.



Ppt. (Divers.)

# Potassium hydroxylamine disulphonate nitrite, $\text{HON}(\text{SO}_3\text{K})_2, \text{KNO}_2$ .

Very sl. in  $\text{H}_2\text{O}$  (Divers and Haga, Chem. Soc. 1900, 77. 433.)

$\text{K}_2\text{H}(\text{NS}_2\text{O}_7)_2, 3\text{KNO}_2 + \text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . (Divers and Haga.)

$2\text{KON}(\text{SO}_3\text{K})_2, \text{KNO}_2 + 1.4\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  which decomp. it into its constituent salts (Divers and Haga.)

$+ 6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  which decomp. it into its constituent salts (Divers and Haga.)

$2\text{K}_2\text{H}(\text{NS}_2\text{O}_7)_2, 7\text{KNO}_2 + 3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Divers and Haga.)

$3\text{K}_2\text{H}(\text{NS}_2\text{O}_7)_2, 7\text{KNO}_2$ . Decomp. by  $\text{H}_2\text{O}$ . (Divers and Haga.)

# Potassium hydroxylamine disulphonate sodium chloride, $5\text{K}_2\text{HNS}_2\text{O}_7, 8\text{NaCl} + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1894, 65. 551.)

**Sodium hydroxylamine disulphonate,**  
 $\text{HON}(\text{SO}_2\text{Na})_2$ .

Sol. in somewhat more than its own wt. of  $\text{H}_2\text{O}$  at  $14^\circ$ . (Divers, Chem. Soc. 1891, 65. 546.)

$\text{Na}_2\text{HNS}_2\text{O}_7$ ,  $2\text{Na}_2\text{NS}_2\text{O}_7 + 3\text{H}_2\text{O}$ . Sol. in less than 1.5 pts  $\text{H}_2\text{O}$  at  $14^\circ$ . (Divers)

**Hydroxylamine isomonosulphonic acid,**  
 $\text{NH}_2$ , O,  $\text{SO}_2$ , OH.

Very hygroscopic. Sol. in water; sol. in alcohol. (Sommer, B. 1914, 47. 1226.)  
[Compare Raschig, A. 1887, 241. 161.]

**Hydroxylamine isodisulphonic acid.****Ammonium hydroxylamine isodisulphonate,**  
 $(\text{SO}_2\text{NH}_2)_2\text{ONH}(\text{SO}_2\text{NH}_2)$ .

3 pts. are sol. in 2 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . Apt to form supersat solutions. (Haga, Chem. Soc. 1906, 89. 246.)

**Dipotassium ———,  $\text{K}_2\text{HS}_2\text{O}_7\text{N}$ .**

Only sl. sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in boiling  $\text{H}_2\text{O}$ . Decomp. by hot dil HCl. (Raschig, B. 1906, 39. 246.)

6.44 pts. are sol in 100 pts  $\text{H}_2\text{O}$  at  $16.4^\circ$ .  
7.18 " " " " 100 "  $\text{H}_2\text{O}$  "  $17.8^\circ$ .  
8.05 " " " " 100 "  $\text{H}_2\text{O}$  "  $20^\circ$ .

(Haga, Chem. Soc. 1906, 39. 243.)

**Tripotassium ———,  $(\text{SO}_2\text{K})\text{ONK}(\text{SO}_2\text{K}) + 2\text{H}_2\text{O}$ .**

Very sol in  $\text{H}_2\text{O}$ ; ppt. by alcohol. (Haga.)

**Disodium ———,  $(\text{SO}_2\text{Na})\text{ONa}(\text{SO}_2\text{Na})$ .**

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol by which it is ppt from aqueous solution. (Haga.)

**Trisodium ———,  $(\text{SO}_2\text{Na})\text{ONNa}(\text{SO}_2\text{Na}) + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ , ppt. by alcohol. (Haga.)  
 $+ 3\text{H}_2\text{O}$ . Sol. in 1.3 pts  $\text{H}_2\text{O}$  at  $20^\circ$ . Less sol in  $\text{NaOH} + \text{Aq}$ . (Divers, Chem. Soc. 1894, 65. 546.)

**Hydroxylamine trisulphonic acid.****Ammonium hydroxylamine trisulphonate,**  
 $2(\text{SO}_2\text{NH}_2)\text{ON}(\text{SO}_2\text{NH}_2)_2 + 3\text{H}_2\text{O}$ .

Sol. in 0.61 pts  $\text{H}_2\text{O}$  at  $16^\circ$ . (Haga, Chem. Soc. 1904, 85. 84.)

**Potassium ———,  $2(\text{SO}_2\text{K})\text{ON}(\text{SO}_2\text{K})_2 + 3\text{H}_2\text{O}$ .**

1 pt. is sol. in 25.37 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Haga.)

**Sodium ———,  $(\text{SO}_2\text{Na})\text{ON}(\text{SO}_2\text{Na})_2 + 2\text{H}_2\text{O}$ .**

Sol. in 2.84 pts.  $\text{H}_2\text{O}$  at  $21.5^\circ$ .

**Dihydroxylamine sulphonic acid,**  
 $(\text{HO})_2\text{N}(\text{SO}_3\text{H})$ .

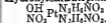
"Sulphazinous acid" of Fremy.  
Known only in its salts. (Raschig, A. 241. 161.)

**Potassium *d*-hydroxylamine sulphonate,**  
 $(\text{HO})_2\text{NSO}_3\text{K}$ .

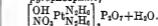
Not obtained in pure state; forms basic salt  $\text{KO} \cdot \text{NSO}_3\text{K}$ , which is quite sol. in  $\text{H}_2\text{O}$ , and corresponds to "sulfazite de potasse" of Fremy (A. ch (3) 15. 421).  
Sol in  $\text{H}_2\text{O}$ ; msol. in alcohol and ether. (Fremy.)

**Hydroxylidoplatinamine sulphate,**  
 $(\text{OH})\text{IPt}(\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{O}$ .

Very sl sol, even in boiling  $\text{H}_2\text{O}$ . (Carl-gren, Sv. V. A. F. 47. 312.)

**Hydroxylonitratoplatinamine nitrate,**

Sl. sol in cold, more easily in hot  $\text{H}_2\text{O}$ .  
Very sl sol in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ . (Cleve.)

**——— pyrophosphate,**

Very sl sol in  $\text{H}_2\text{O}$ . (Cleve.)

**Hydroxyloptinamine hydroxide,**  
 $(\text{OH})_2\text{Pt}(\text{NH}_2\text{OH})_2$ .

Insol in  $\text{H}_2\text{O}$ . Easily sol. in dil acids, even  $\text{HCl} + \text{H}_2\text{O}_2 + \text{Aq}$ . Not decomp. by boiling  $\text{KOH} + \text{Aq}$ . (Gerhardt, Compt. Chem. 1849. 490.)

**Hydroxyloptinamine nitrate,**  
 $(\text{OH})_2\text{Pt}(\text{NH}_2\text{NO}_2)_2 + 2\text{H}_2\text{O}$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ ; not attacked by cold  $\text{HCl} + \text{Aq}$ . (Cleve.)

**——— oxalate,  $(\text{OH})_2\text{Pt}(\text{NH}_2)_2\text{C}_2\text{O}_4 + \text{H}_2\text{O}$ .**

Sol. in hot  $\text{H}_2\text{O}$ .

**——— sulphate,  $(\text{OH})_2\text{Pt}(\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{O}$ .**  
Difficultly sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Hydroxyloptinamine bromide,**  
 $(\text{OH})_2\text{Pt}(\text{NH}_2)_2\text{Br}_2$ .

Sl. sol., even in boiling  $\text{H}_2\text{O}$ . (Carl-gren, Sv. V. A. F. 47. 320.)

**——— chloride,  $(\text{OH})_2\text{Pt}(\text{NH}_4)_2\text{Cl}_2$ .**

Sol. in 206 pts. cold, and 49 pts. boiling  $\text{H}_2\text{O}$ . (Carl-gren, Sv. V. A. F. 47. 316.)

**——— chromate,  $(\text{OH})_2\text{Pt}(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ .**

Very sl. sol. in cold or hot  $\text{H}_2\text{O}$ . (Carl-gren, Sv. V. A. F. 47. 319.)

**Hydroxyloplatindiamine iodide,**  
 $(\text{OH})_2\text{Pt}(\text{NH}_3)_4\text{I}_2$ .

Sl. sol. in hot or cold  $\text{H}_2\text{O}$ . (Carligen)

— **nitrate,**  $(\text{OH})_2\text{Pt}(\text{NH}_3)_4(\text{NO}_3)_2$ .

Sl. sol. in cold, moderately sol. in hot  $\text{H}_2\text{O}$ .  
 (Gerhardt, A 76. 315)

Sol. in 343 pts. cold, and 38 pts. boiling  
 $\text{H}_2\text{O}$  (Carligen, Sv. V. A. F. 47. 318.)

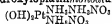
— **nitrite,**  $(\text{OH})_2\text{Pt}(\text{NH}_3)_4(\text{NO}_2)_2$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Carligen.)

— **sulphate,**  $(\text{OH})_2\text{Pt}(\text{NH}_3)_4\text{SO}_4$ .

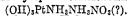
Very sl. sol. in boiling  $\text{H}_2\text{O}$ . (Cleve.)  
 $+4\text{H}_2\text{O}$ . Efflorescent. (Carligen, Sv. V.  
 A. F. 47. 313)

**Hydroxyloplatindiamine nitrate,**



Very easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Hydroxyloplatindiamine nitrate,**



Easily sol. in  $\text{H}_2\text{O}$ . (Cleve)

— **sulphate,**



Sol. in hot  $\text{H}_2\text{O}$ .

**Hydroxyloplatindiamine chloride,**



Extremely sl. sol. in  $\text{H}_2\text{O}$ .

— **dichromate,**  $(\text{OH})_2\text{Pt}_2(\text{N}_2\text{H}_5)_4(\text{Cr}_2\text{O}_7)_2$ .

Ppt (Cleve)

— **nitrate,**  $(\text{OH})_2\text{Pt}_2(\text{N}_2\text{H}_5)_4(\text{NO}_3)_4$ .

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .  
 (Cleve.)

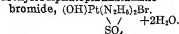
— **phosphate,**  $(\text{OH})_2\text{Pt}_2(\text{N}_2\text{H}_5)_4(\text{PO}_4\text{H})_2$ .

Ppt

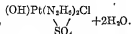
— **sulphate,**  $(\text{OH})_2\text{Pt}_2(\text{N}_2\text{H}_5)_4(\text{SO}_4)_2 + 2\text{H}_2\text{O}$

Ppt. Nearly insol. in  $\text{H}_2\text{O}$ .

**Hydroxylosulphatoplatindiamine**



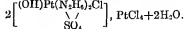
Easily sol. in  $\text{H}_2\text{O}$ . (Cleve)



— **chloride,**

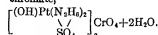
Moderately sol. in cold, very sol. in hot  
 $\text{H}_2\text{O}$ .

**Hydroxylosulphatoplatindiamine chloroplati-**  
**nate,**



Ppt.

— **chromate,**

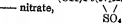


Sl. sol. in  $\text{H}_2\text{O}$ .

— **dichromate,**  $\left[ (\text{OH})\text{Pt}(\text{N}_2\text{H}_5)_2 \begin{array}{c} \text{SO}_4 \\ \text{SO}_4 \end{array} \right]_2 \text{Cr}_2\text{O}_7$ .

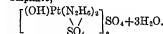
Sl. sol. in  $\text{H}_2\text{O}$ .

— **nitrate,**  $(\text{OH})\text{Pt}(\text{N}_2\text{H}_5)_2\text{NO}_3$ .



Sol. in hot  $\text{H}_2\text{O}$ .

— **sulphate,**



Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Hypoantimonic acid.**

**Calcium hypoantimonate (?)**,  $\text{Ca}_2\text{Sb}_2\text{O}_4$ .

Min. Romeite. Insol. in acids.

**Potassium hypoantimonate**,  $\text{K}_2\text{Sb}_2\text{O}_4$ .

Sol. in hot  $\text{H}_2\text{O}$ . Sol. in 425 pts boiling  
 $\text{H}_2\text{O}$  (Brandes) Sol. in boiling  $\text{KOH} + \text{Aq}$   
 (Berzelius).

$\text{K}_2\text{Sb}_2\text{O}_4$ . Ppt.

**Hypoboric acid.**

**Sodium hypoborate**,  $\text{NaOBH}_4$ .

Deliquescent, decomp. in aq. solution at  
 room temp. Decomp. by acids. Sl. sol. in  
 alcohol with decomp. (Stock, B. 1914, 47.  
 821.)

**Hypobromous acid**,  $\text{HBrO}$ .

Known only in aqueous solution.

Solution containing 6.21 pts Br as  $\text{HBrO}$   
 in 100 cem  $\text{H}_2\text{O}$  decomposes at  $30^\circ$ . If dilute  
 solution is distilled in vacuo, an acid contain-  
 ing 0.736 pt. Br as  $\text{HBrO}$  in 100 cem is ob-  
 tained at first, but the distillate slowly grows  
 weaker. Dil. solution, stable at ordinary  
 temp., decomp by heating over  $60^\circ$ . (Dancer  
 A. 126. 237.)

**Barium hypobromite.**

Known only in solution

**Calcium hypobromite bromide.**

Deliquescent, and sol in  $H_2O$  with partial decomp. (Beilchus.)

**Potassium hypobromite,  $KBrO$ .**

Known only in solution.

**Sodium hypobromite.**

Known only in solution.

**Strontium hypobromite.**

Known only in solution.

**Hypochlorous acid,  $HClO$ .**

Miscible with  $H_2O$ . Decomposes at  $0^\circ$  in the dark, more rapidly at higher temp. or in light. The stronger the solution the more rapid the decomposition. Moderately strong acid may be distilled without any considerable decomp., a stronger acid distilling over at first, and afterwards an acid weaker than the original acid. Very conc. or very dil. acids decomp. by distillation.

**Ammonium hypochlorite.**

Known only in aqueous solution, which decomposes at once

**Barium hypochlorite.**

Known only in solution

**Calcium hypochlorite,  $Ca(OCl)_2 + 4H_2O$ .**

Deliquescent, and sol in  $H_2O$ . (Kinzett, Chem. Soc. (2) 13. 404.)

**Calcium hypochlorite chloride, etc. (bleaching powder),  $Ca(OCl)_2$ ,  $CaCl_2$ ,  $Ca(OH)_2 + H_2O$ .**

Not deliquescent. Sol. in  $H_2O$ . Alcohol does not dissolve out  $CaCl_2$ . Sol. in 20 pts.  $H_2O$  with a slight residue.

Correct formula is  $CaOCl_2$  (Lunge and Schappi; Kraut, A. 214. 354),  $Ca \overset{O}{\underset{OH}{|}} Cl$  (Stahlschmidt, B. 8. 899),  $CaOCl$ ,  $Cl$  (Oding).

$CaCl_2$  is dissolved out by alcohol. Formula =  $2Ca \overset{OH}{\underset{OCl}{|}} Cl + 2H_2O$ . (Dreyfuss, Bull. Soc. (2) 41. 600.)

**Didymium hypochlorite,  $D_2(OCl)_2$ .**

Difficultly sol. in  $H_2O$ . Easily sol. in acids. (Frerichs and Smith, A. 191. 348.)

**Lanthanum hypochlorite,  $La(OCl)_2$ .**

Easily sol. in  $H_2O$ . (Frerichs and Smith.)

**Lithium hypochlorite,  $LiClO$ .**

Known only in solution. (Kraut, A. 1882, 214. 356.)

**Magnesium hypochlorite.**

Known only in solution.

**Potassium hypochlorite,  $KClO$ .**

Known only in solution.

**Silver hypochlorite,  $AgClO$ .**

Very sol. in  $H_2O$ , and decomp. very quickly. (Sta., Acad. R. de Belg. 35. 103.)

**Sodium hypochlorite,  $NaClO$ .**

Known only in solution

**Hypoiodic acid,  $I_2O_4$ .**

See Iodine tetroxide.

**Hypoiodous acid,  $HOI$ .**

Known only in solution which decomp. on standing. (Taylor, C. N. 1897, 76. 97.)

**Calcium hypiodite iodide,  $Ca(OI)_2$ ,  $CaI_2$ .**

Not very unstable (Lunge and Shoch, B. 15. 1883.)

**Hyponitric acid,  $N_2O_4$ .**

See Nitrogen tetroxide.

**Hyponitrous acid,  $HNO$ , or better  $H_2N_2O_2$ .**

Known only in aqueous solution. Solution is quite stable (van der Plaats, B. 10. 1507.)

Very deliquescent, sol. in  $H_2O$  and alcohol; sol. in ether, chloroform, benzene, sl. sol. in petroleum ether. (Hantzsch and Kaufmann, A. 1896, 292. 323.)

**Ammonium hyponitrite,  $(NH_4)_2N_2O_2$ .**

Sol. in  $H_2O$  and in alcohol. (Jackson, C. N. 1893, 68. 266.)

**Ammonium hydrogen hyponitrite,  $NH_4HN_2O_2$ .**

Easily sol. in  $H_2O$ . The solid salt slowly decomp. at ord temp. into ammonia,  $H_2O$  and  $N_2O$ . (Hantzsch and Kaufmann, A. 1896, 292. 328.)

**Barium hyponitrite,  $BaN_2O_2$ .**

Nearly insol. in, but gradually decomp. by  $H_2O$ . Sol. in conc. acids with evolution of  $N_2O$ , but sol. in dil.  $HC_2H_3O_2 + Aq$  without decomp. (Zorn, B. 15. 1007.)

+  $4H_2O$ . Sl. sol. in  $H_2O$ ; insol. in alcohol and ether. (Kirschner, Z. anorg. 1898, 16. 424.)

+  $xH_2O$ . Efflorescent. (Maquenne, C. R. 108. 1303.)

**Barium hydrogen hyponitrite,  $BaH_2(N_2O_2)_2$ .**

Easily sol. in  $H_2O$ . (Zorn, B. 1882, 15. 1011.)

**Calcium hyponitrite,  $CaN_2O_2 + 4H_2O$ .**

Nearly insol. in  $H_2O$ ; easily sol. in dil. acids. (Maquenne, C. R. 108. 1303.)

Sl. sol. in  $H_2O$ , insol. in alcohol. (Kirschner, Z. anorg. 1898, 16. 426.)

**Cupric hyponitrite**, basic,  $\text{Cu}_2\text{N}_2\text{O}_3$ ,  $\text{Cu}(\text{OH})_2$

Insol in  $\text{H}_2\text{O}$ ; not decomp. by hot  $\text{H}_2\text{O}$ . Sol in dil acids and in ammonia. Decomp by  $\text{NaOH}$ . (Divers, Chem. Soc. 1899, 75. 121.)

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil acids and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Kirschner, Z. anorg. 1898, 16. 430.)

**Cuprous hyponitrite**,  $\text{Cu}_2\text{N}_2\text{O}_3 + 2\text{H}_2\text{O}$

Ppt. (Kolotow, C. C. 1891, I. 1859.)

Cannot be formed. (Divers, Chem. Soc. 1899, 75. 121.)

**Lead hyponitrite**, basic,  $\text{PbN}_2\text{O}_3$ ,  $\text{PbO}$ .

Insol in  $\text{H}_2\text{O}$ . Sol. in dil acids from which it may be pptd. by  $\text{NaOH} + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Kirschner, Z. anorg. 1898, 16. 430.)

**Lead hyponitrite**,  $\text{PbN}_2\text{O}_3$ .

Insol in  $\text{H}_2\text{O}$ ; sol in dil acids from which it may be pptd. by  $\text{NaOH} + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Kirschner)

**Mercuric hyponitrite**, basic,  $3\text{HgO}$ ,  $\text{HgN}_2\text{O}_3 + 3\text{H}_2\text{O}$ .

Ppt. Sl sol even in boiling dil.  $\text{HNO}_3$ . Scarcely sol in conc. very sol. in warm dil  $\text{HCl}$ . (Ray, Chem. Soc. 1897, 71. 349)

**Mercurous hyponitrite**,  $\text{Hg}_2\text{N}_2\text{O}_3$ .

Sol. in dil.  $\text{HNO}_3$  with slow decomp. (Ray, Chem. Soc. 1907, 91. 1404.)

**Mercuric hyponitrite**,  $\text{HgN}_2\text{O}_3$

Sol. in  $\text{HCl}$ , and in  $\text{NaCl} + \text{Aq}$ .

Sl. sol. in very dil alkali. (Divers, Chem. Soc. 1899, 75. 119.)

**Potassium hyponitrite**,  $\text{K}_2\text{N}_2\text{O}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (van der Plaats.)

Stable when dry

Sol. in 90% alcohol, and sl. sol. in abs alcohol. (Divers, Chem. Soc. 1899, 75. 103.)

**Silver hyponitrite** (nitrosyl silver),

$\text{Ag}_2\text{N}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Decomp. by  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{S}$ , and boiling  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (van der Plaats.)

Insol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Divers, C. N. 23. 206)

Sol in dil  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  and in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ ; decomp. by  $\text{HCl}$ . (Kirschner, Z. anorg. 1898, 16. 431.)

**Sodium hyponitrite**,  $\text{Na}_2\text{N}_2\text{O}_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (van der Plaats.)

**Strontium hyponitrite**,  $\text{SrN}_2\text{O}_3$

Easily sol. in  $\text{H}_2\text{O}$ . (Roederer, Bull. Soc. 1906, (3) 35. 715.)

+  $5\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ ; easily sol.

in dil. acids. (Maquenne, C. R. 108. 1303.)

Sl. sol in  $\text{H}_2\text{O}$ , insol in alcohol (Kirschner, Z. anorg. 1898, 16. 426.)

**Hypophosphomolybdic acid**,  $\text{Mo}_2\text{O}_5$ ,

$7\text{H}_2\text{PO}_4 + 31\text{H}_2\text{O}$ .

Very sl sol. in cold  $\text{H}_2\text{O}$ . Scarcely sol. in cold dil  $\text{H}_2\text{SO}_4$ . Sol in cold conc.  $\text{H}_2\text{SO}_4$ .

Sol. in warm conc.  $\text{HCl}$ . Warm  $\text{HNO}_3$  oxidizes forming clear solution. (Mawrow, Z. anorg. 1901, 28. 164.)

**Ammonium hypophosphomolybdate**,

$2(\text{NH}_4)_2\text{O}$ ,  $2\text{H}_2\text{PO}_4$ ,  $8\text{MoO}_3 + 2\text{H}_2\text{O}$ .

Not very sol in cold  $\text{H}_2\text{O}$ , readily in hot  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 3. 402.)

**Hypophosphoric acid**,  $\text{H}_4\text{P}_2\text{O}_6$ .

Very deliquescent, and sol. in the least amount of  $\text{H}_2\text{O}$ . (Joly, C. R. 101. 1058.)

100 cc.  $\text{H}_4\text{P}_2\text{O}_6 + \text{Aq}$ , containing 4.1%  $\text{P}_2\text{O}_5$  has sp. gr. = 1.036.

100 cc.  $\text{H}_4\text{P}_2\text{O}_6 + \text{Aq}$ , containing 12.3%  $\text{P}_2\text{O}_5$  has sp. gr. = 1.122.

(Salzer, A. 1878, 194. 28.)

+  $\text{H}_2\text{O}$  (Sanger, A. 232. 14.)

Does not exist. (Joly.)

+  $2\text{H}_2\text{O}$  Appears to be the only stable hydrate between  $0^\circ$  and  $60^\circ$ .

Singer's hydrate,  $\text{H}_4\text{P}_2\text{O}_6 + \text{H}_2\text{O}$ , and Joly's anhydride could not be obtained. (Rosenheim, B. 1908, 41. 2711)

**Aluminum hypophosphate**,  $\text{Al}_3(\text{P}_2\text{O}_6)_4 +$

$23\text{H}_2\text{O}$ .

Easily sol in mineral acids. Sol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ . (Palm, Dissertation, Rostock, 1890.)

**Ammonium hypophosphate**,  $(\text{NH}_4)_2\text{P}_2\text{O}_6 +$

$\text{H}_2\text{O}$

Sol. in 30 pts.  $\text{H}_2\text{O}$ . (Salzer, A. 194. 32.)

**Ammonium hydrogen hypophosphate**,

$(\text{NH}_4)_2\text{H}_2\text{P}_2\text{O}_6$ .

Sol. in 14 pts cold, and 4 pts. boiling  $\text{H}_2\text{O}$ . (Salzer, A. 194. 32.)

**Ammonium trihydrogen hypophosphate**,

$\text{NH}_4\text{H}_3\text{P}_2\text{O}_6$ .

Sol. in  $\text{H}_2\text{O}$  (Salzer, A. 211. 1.)

**Ammonium magnesium hypophosphate**,

$(\text{NH}_4)_2\text{MgP}_2\text{O}_6 + 6\text{H}_2\text{O}$ .

Precipitate. (Salzer, A. 232. 114.)

**Barium hypophosphate**,  $\text{Ba}_2\text{P}_2\text{O}_6$ .

Very slightly sol, but not wholly insol. in  $\text{H}_2\text{O}$ . Very slightly sol in acetic acid, but

more soluble in hydrochloric, and hypophosphoric acids. (Salzer, A. 194. 34.)

**Barium hydrogen hypophosphate**,  $\text{BaH}_2\text{P}_2\text{O}_6 +$

$2\text{H}_2\text{O}$

Soluble in about 1000 pts  $\text{H}_2\text{O}$ . Solution decomposes by heating. (Salzer, A. 194. 34.)

**Bismuth hypophosphate**,  $\text{Bi}_4(\text{P}_2\text{O}_6)_3 + 8\frac{1}{2}\text{H}_2\text{O}$ .

Completely sol. in  $\text{HCl} + \text{Aq}$ , also in warm  $\text{HNO}_3 + \text{Aq}$ . Insol. in boiling dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sl. sol. by long boiling with conc.  $\text{H}_2\text{SO}_4$ . (Palm, Rostock, 1890.)

**Cadmium hypophosphate**,  $\text{Cd}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil acids (Draue, B. 21. 3403.)

**Cadmium potassium hydrogen hypophosphate**,  $\text{CdK}_2(\text{H}_2\text{P}_2\text{O}_6)_2 + 2\frac{1}{2}\text{H}_2\text{O}$   
(Bausa, Z. anorg. 1894, 6. 147.)

**Cadmium sodium hypophosphate**,  $\text{CdNa}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby. Sol. in dil. acids (Draue.)

**Calcium hypophosphate**,  $\text{Ca}_3\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in  $\text{HCl} + \text{H}_2\text{O}_2$ ; easily sol. in  $\text{H}_2\text{P}_2\text{O}_6$ , or  $\text{HCl} + \text{Aq}$ . (Salzer, A. 194. 36.)

**Calcium hydrogen hypophosphate**,  
 $\text{CaH}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$ .

Sol. in 60 pts.  $\text{H}_2\text{O}$  (Salzer, A. 232. 114)

**Chromic hypophosphate**,  $\text{Cr}_4(\text{P}_2\text{O}_6)_3 + 34\text{H}_2\text{O}$ .

Sol. in  $\text{HCl} + \text{Aq}$  on sl. warming, also in  $\text{HNO}_3 + \text{Aq}$ . Not completely sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but completely sol. in conc.  $\text{H}_2\text{SO}_4$ . (Palm, Dissertation, Rostock, 1890.)

**Cobaltous hypophosphate**,  $\text{Co}_2\text{P}_2\text{O}_6 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids (Draue, B. 21. 3403.)

**Cobaltous potassium hypophosphate**,  
 $\text{CoK}_3\text{P}_2\text{O}_6 + 5\text{H}_2\text{O}$ .

Ppt. (Bausa, Z. anorg. 1894, 6. 156)

**Cobaltous potassium hydrogen hypophosphate**,  $\text{CoH}_2\text{P}_2\text{O}_6 \cdot 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$

**Cobaltous sodium hypophosphate**,  $\text{CoNa}_2\text{P}_2\text{O}_6 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby. Sol. in dil. acids. (Draue, B. 21. 3403)

**Cupric hypophosphate**,  $\text{Cu}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Draue, B. 21. 3403.)

Ppt. (Bausa, Z. anorg. 1894, 6. 145.)

**Cupric potassium hydrogen hypophosphate**,  
 $\text{CuH}_2\text{P}_2\text{O}_6 \cdot 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$ .

Ppt. (Bausa, Z. anorg. 1894, 6. 152.)

**Glucinum hypophosphate**,  $\text{Gl}_2\text{P}_2\text{O}_6 + 7\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Moderately sol. in all mineral acids. (Palm, Rostock, 1890.)  
 $+ 3\text{H}_2\text{O}$ . (Rammelsberg.)

**Iron (ferrous) hypophosphate**,  $\text{Fe}_2\text{P}_2\text{O}_6 + 4\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in cold  $\text{HCl} + \text{Aq}$ . Decomp. by hot  $\text{HNO}_3 + \text{Aq}$  into  $\text{Fe}_2(\text{P}_2\text{O}_7)_3$ . Insol. in  $\text{HNO}_3 + \text{Aq}$ . Insol. in boiling dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Somewhat sol. in cold  $\text{H}_2\text{SO}_4$ , but a ppt. separates out on heating. (Palm, Rostock, 1890.)

**Iron (ferric) hypophosphate**,  $\text{Fe}_4(\text{P}_2\text{O}_6)_3 + 20\text{H}_2\text{O}$ .

Easily sol. in  $\text{HCl} + \text{Aq}$ . Wholly insol. in  $\text{HNO}_3$ , and dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Completely sol. in conc.  $\text{H}_2\text{SO}_4$  by warming a short time, but a ppt. separates out on boiling. (Palm.)

**Lead hypophosphate**,  $\text{Pb}_2\text{P}_2\text{O}_6$ .

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl} + \text{H}_2\text{O}_2$ , or  $\text{H}_2\text{P}_2\text{O}_6 + \text{Aq}$ ; sol. in dil.  $\text{HNO}_3 + \text{Aq}$  (Salzer)

**Lithium hypophosphate**,  $\text{Li}_4\text{P}_2\text{O}_6 + 7\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Salzer, A. 194. 28.) Sol. in 120 pts.  $\text{H}_2\text{O}$  at ord. temp. (Rammelsberg, J. pt. (2) 45. 153)

$\text{Li}_2\text{H}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$  Deliquescent. (Rammelsberg.)

**Magnesium hypophosphate**,  $\text{Mg}_2\text{P}_2\text{O}_6 + 12\text{H}_2\text{O}$ .

Sol. in 15,000 pts.  $\text{H}_2\text{O}$ ; sl. sol. in acetic, easily in hypophosphoric, or mineral acids. (Salzer, A. 232. 114.)  
 $+ 24\text{H}_2\text{O}$  (Rammelsberg.)

**Magnesium hydrogen hypophosphate**,  
 $\text{MgH}_2\text{P}_2\text{O}_6 + 4\text{H}_2\text{O}$

Sol. in 200 pts.  $\text{H}_2\text{O}$ . (Salzer, A. 232. 114.)

**Manganese hypophosphate**,  $\text{Mn}_2\text{P}_2\text{O}_6 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in mineral acids, insol. in acetic acid. (Palm, Dissertation, Rostock, 1890.)

**Manganous potassium hydrogen hypophosphate**,  $\text{MnH}_2\text{P}_2\text{O}_6 \cdot \text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 3\text{H}_2\text{O}$

Ppt. (Bausa, Z. anorg. 1894, 6. 150.)

**Manganous sodium hypophosphate**,  $\text{Mn}_2\text{P}_2\text{O}_6 \cdot \text{Na}_4\text{P}_2\text{O}_6 + 11\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , sol. in mineral acids. (Palm.)

**Nickel hypophosphate**,  $\text{Ni}_2\text{P}_2\text{O}_6 + 12\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; Sol. in dil. acids (Draue, B. 21. 3401)

**Nickel potassium hypophosphate**,  
 $\text{NiK}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$ .

Ppt. (Bausa, Z. anorg. 1894, 6. 155.)

**Nickel potassium hydrogen hypophosphate**,  
 $\text{NiH}_2\text{P}_2\text{O}_6 \cdot 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$ .

Ppt (Bausa, Z. anorg. 1894, 6. 144.)

**Nickel sodium hypophosphate**,  $\text{NiNa}_2\text{P}_2\text{O}_6 + 12\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , but decomp. thereby. Easily sol. in dil. acids. (Draue)

**Potassium hypophosphate**,  $\text{K}_4\text{P}_2\text{O}_6 + 8\text{H}_2\text{O}$

Sol in  $\frac{1}{4}$  pt.  $\text{H}_2\text{O}$ , insol in alcohol. (Salzer, A. 211. 1.)

**Potassium hydrogen hypophosphate**,  $\text{K}_3\text{HP}_2\text{O}_6 + 3\text{H}_2\text{O}$ .

Sol. in  $\frac{1}{2}$  pt.  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Potassium dihydrogen hypophosphate**,  $\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 3\text{H}_2\text{O}$ , and  $+2\text{H}_2\text{O}$ .

Sol. in 3 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Potassium trihydrogen hypophosphate**,  $\text{KH}_3\text{P}_2\text{O}_6$ .

Sol. in  $1\frac{1}{2}$  pts. cold, and  $\frac{1}{2}$  pt. hot  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Potassium pentahydrogen dihypophosphate**,  $\text{K}_3\text{H}_5(\text{P}_2\text{O}_6)_2 + 2\text{H}_2\text{O}$ .

Sol. in  $2\frac{1}{2}$  pts. cold, and  $\frac{1}{2}$  pt. boiling  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Potassium sodium hypophosphate**,  $\text{Na}_2\text{K}_2\text{P}_2\text{O}_6 + 9\text{H}_2\text{O}$

Sol. in about 25 pts. cold, and 3 pts. hot  $\text{H}_2\text{O}$ . (Bausa, Z. anorg. 1894, 6. 158.)

**Potassium zinc hydrogen hypophosphate**,  $\text{ZnH}_2\text{P}_2\text{O}_6 \cdot 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$ .

Ppt. (Bausa, Z. anorg. 1894, 6. 148.)

**Silver hypophosphate**,  $\text{Ag}_3\text{P}_2\text{O}_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . Very sl. sol. in  $\text{H}_3\text{P}_2\text{O}_6 + \text{Aq}$  (Salzer, A. 232. 114.)

**Sodium hypophosphate**,  $\text{Na}_4\text{P}_2\text{O}_6 + 10\text{H}_2\text{O}$ .

Sol. in about 30 pts. cold, much more easily in hot  $\text{H}_2\text{O}$ . (Salzer)

**Sodium hydrogen hypophosphate**,  $\text{Na}_3\text{HP}_2\text{O}_6 + 9\text{H}_2\text{O}$ .

Sol. in 22 pts.  $\text{H}_2\text{O}$ . (Salzer)

**Sodium dihydrogen hypophosphate**,  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$ .

Sol. in 45 pts. cold, and 5 pts. boiling  $\text{H}_2\text{O}$ . More sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in alcohol. (Salzer, A. 187. 331.)

**Sodium trihydrogen hypophosphate**,  $\text{NaH}_3\text{P}_2\text{O}_6$ .

Sol. in  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Sodium trihydrogen dihypophosphate**,

Very efflorescent. Sol. in 15 pts. cold  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Thallium hypophosphate**,  $\text{Tl}_4\text{P}_2\text{O}_6$

Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. in sunlight. (Joly, C. R. 1894, 118. 650.)

**Thallium hydrogen hypophosphate**,  $\text{Tl}_3\text{H}_2\text{P}_2\text{O}_6$ .

Sol. in  $\text{H}_2\text{O}$ . (Joly.)

**Zinc hypophosphate**,  $\text{Zn}_3\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Draue, B. 21. 3403.)

**Hypophosphorosemolybdic acid**.

**Barium hypophosphorosemolybdate**,

$\text{BaO}$ ,  $\text{Mo}_2\text{O}_7$ ,  $3\text{H}_3\text{PO}_4 + 12\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  and  $\text{BaCl}_2 + \text{Aq}$ . (Mawrow, Z. anorg. 1902, 29. 156.)

**Hypophosphorous acid**,  $\text{H}_3\text{PO}_2$ .

Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Rose.)

**Aluminum hypophosphite**.

Not deliquescent, but very sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 86.)

**Ammonium hypophosphite**,  $\text{NH}_4\text{H}_2\text{PO}_2$ .

Sol. in  $\text{H}_2\text{O}$ , less deliquescent than the potassium salt. (Wurtz, A. ch. (3) 7. 193.)

Very sol. in absolute alcohol. (Dulong.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Insol. in acetone (Edmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

**Barium hypophosphate**,  $\text{Ba}(\text{H}_2\text{PO}_4)_2 + \text{H}_2\text{O}$ .

Sol. in 35 pts. cold, and 3 pts. boiling  $\text{H}_2\text{O}$ . Insol. in alcohol. (Wurtz, A. 43. 323.)

**Bismuth hypophosphite**,  $\text{Bi}(\text{H}_2\text{PO}_2)_3$ .

Ppt (Vannino, J. pr. 1906, (2) 74. 150.)

$+ \text{H}_2\text{O}$  Sol. in acid  $\text{Bi}(\text{NO}_3)_3 + \text{Aq}$ . (Haga, Chem. Soc. 1895, 67. 229.)

**Cadmium hypophosphite**.

Sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 91.)

**Calcium hypophosphite**,  $\text{Ca}(\text{PH}_2\text{O}_2)_2$ .

Sol. in 6 pts. cold, and not much more sol. in hot  $\text{H}_2\text{O}$ . Insol. in strong, very sol. in weak alcohol (Rose, Pogg. 9. 361.)

**Calcium cobaltous hypophosphite**.

$2\text{Ca}(\text{PH}_2\text{O}_2)_2$ ,  $\text{Co}(\text{PH}_2\text{O}_2)_2 + 2\text{H}_2\text{O}$ .

Efflorescent. (Rose, Pogg. 12. 295.)

**Calcium ferrous hypophosphite**.

Sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 294.)

**Cerous hypophosphite**,  $\text{Ce}(\text{PH}_2\text{O}_2)_3 + \text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  (Rammelsberg, B. A. B. 1872. 437.)

**Chromium hypophosphite**,  $\text{Cr}_2(\text{OH})_2(\text{H}_2\text{PO}_2)_4$ .

*Anhydrous* Insol in  $\text{H}_2\text{O}$  or dil. acids.  
+  $3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Wurtz, A. ch. (3) 16. 196.)

**Cobaltous hypophosphite**,  $\text{Co}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$ .

Efflorescent. Easily sol. in  $\text{H}_2\text{O}$  (Rose, Pogg. 12. 87.)

**Cupric hypophosphite**,  $\text{Cu}(\text{PH}_2\text{O}_2)_2$ .

Very sol in  $\text{H}_2\text{O}$ , but very easily decomp on heating. (Wurtz, A. ch. (3) 16. 199)

**Glucinum hypophosphite**

Sol in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 86.)

**Iron (ferrous) hypophosphite**,  $\text{Fe}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 294)

**Iron (ferrie) hypophosphite**.

Difficultly sol in  $\text{H}_2\text{O}$  or acids. Decomp. on boiling. Sl sol. in  $\text{H}_3\text{PO}_2 + \text{Aq}$ . (Rose.)

**Lead hypophosphite**,  $\text{Pb}(\text{PH}_2\text{O}_2)_2$ .

Difficultly sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rose, Pogg. 12. 288)

**Lithium hypophosphite**,  $\text{LiH}_2\text{PO}_2 + \text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  (Rammelsberg, B. A. B. 1872. 416)

**Magnesium hypophosphite**,  $\text{Mg}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$ .

Efflorescent in dry air. Sol. in  $\text{H}_2\text{O}$  (Rose)

**Manganous hypophosphite**,  $\text{Mn}(\text{H}_2\text{PO}_2)_2 + \text{H}_2\text{O}$ .

Permanent. Very sol. in  $\text{H}_2\text{O}$ . (Wurtz, A. ch. (3) 16. 195.)

**Mercurous hypophosphite nitrate**,

$\text{HgH}_2\text{PO}_2, \text{HgNO}_3 + \text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  with rapid decomp.

Sol. in hot conc  $\text{HNO}_3$ . (Haga, Chem. Soc 1895, 67. 227)

**Nickel hypophosphite**,  $\text{Ni}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$

Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 5. 494.)

**Nickel hypophosphite ammonia**,

$\text{Ni}(\text{H}_2\text{PO}_2)_2, 6\text{NH}_3$ .

(Ephraim, B. 1913, 46. 3111.)

**Platinous hypophosphite**  $\text{Pt}(\text{PH}_2\text{O}_2)_2$ .

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4 + \text{Aq}$ , etc. Sol. in  $\text{HNO}_3 + \text{Aq}$ . Insol. in alcohol. (Engel, C. R. 91. 1068)

**Potassium hypophosphite**,  $\text{KH}_2\text{PO}_2$ .

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$ . sol. in weak, less in absolute alcohol. Insol in ether. (Wurtz, A. ch. (3) 7. 192)  
Sl sol in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

**Sodium hypophosphite**,  $\text{NaH}_2\text{PO}_2 + \text{H}_2\text{O}$ .

Very deliquescent. Somewhat less sol. than the K salt. Very sol. in absolute alcohol. (Dulong)

Very sol in  $\text{H}_2\text{O}$ , and somewhat less sol in alcohol (Rammelsberg, B. A. B. 1872. 412.)  
Sl sol in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

**Strontium hypophosphite**,  $\text{Sr}(\text{PH}_2\text{O}_2)_2$

Very easily sol. in  $\text{H}_2\text{O}$ . (Dulong.)  
Insol in alcohol (Wurtz.)

**Thallous hypophosphite**,  $\text{TlH}_2\text{PO}_2$ .

Sol in  $\text{H}_2\text{O}$  (Rammelsberg, B. A. B. 1872. 492)

**Uranyl hypophosphite**,  $\text{UO}_2(\text{H}_2\text{PO}_2)_2 + \text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg, Chem. Soc. (2) 11. 1.)

**Vanadyl hypophosphite**,  $\text{V}_2\text{O}_5(\text{H}_2\text{PO}_2)_4 + 2\text{H}_2\text{O}$ .

Insol. in cold, sl sol. in hot  $\text{H}_2\text{O}$ .  
Sol in hot dil  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  and in warm conc.  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ .  
Insol in oxalic acid. (Mawrow, Z. anorg. 1907, 55. 147)

**Zinc hypophosphite**,  $\text{Zn}(\text{H}_2\text{PO}_2)_2 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ .  
+  $6\text{H}_2\text{O}$ . Efflorescent. (Wurtz, A. ch. (3) 16. 195.)

**Zirconium hypophosphite**,  $\text{Zr}(\text{OPH}_2\text{O})_4 + \text{H}_2\text{O}$ .

Sensitive to light. Insol in alcohol, by which it is pptd. from aqueous solution. (Hauser, Z. anorg. 1913, 84. 93.)

**Hypophosphotungstic acid**.

**Potassium hypophosphotungstate**,  $4\text{K}_2\text{O}, 6\text{H}_2\text{PO}_2, 18\text{WO}_3 + 7\text{H}_2\text{O}$ .

Precipitate. Sol in hot, very sl. sol. in cold  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 5. 361.)

**Hyposulpharsenious acid**.

**Hyposulpharsenites**,  $\text{As}_2\text{S}_2, \text{M}_2\text{S}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . (Berzelius.)  
Do not exist. (Nilson, B. 4. 989)

**Hyposulphuric acid**,  $\text{H}_2\text{S}_2\text{O}_6$ .

See Dithionic acid.

**Hyposulphurous acid,  $\text{H}_2\text{S}_2\text{O}_3$ .***See* Thiosulphuric acid.**Hyposulphurous (Hydrosulphurous) acid,  $\text{H}_2\text{SO}_2$** 

Known only in dil. aqueous solution, which decomposes rapidly.

Correct formula is  $\text{H}_2\text{S}_2\text{O}_3$ , according to Bernthsen (A. 211. 285.)More sol. in alcohol than in  $\text{H}_2\text{O}$  (Rossler, Arch. Pharm. (3) 25. 845.)**Ammonium hyposulphite,  $(\text{NH}_4)_2\text{S}_2\text{O}_4$ .**

Known only in solution. (Prudhomme, Bull. Soc. 1899, (3) 21. 326.)

**Ammonium hydrogen hyposulphite,  $\text{NH}_4\text{HS}_2\text{O}_4$** 

Known only in solution. (Prudhomme, Bull. Soc. 1899, (3) 21. 326.)

**Calcium hyposulphite,  $\text{CaS}_2\text{O}_4 + 1.5\text{H}_2\text{O}$** Difficultly sol. in  $\text{H}_2\text{O}$ . (Bazlen, B. 1905, 38. 1059.)**Magnesium hyposulphite,  $\text{MgS}_2\text{O}_4$** 

(Billy, C. R. 1905, 140. 936.)

**Potassium hyposulphite,  $\text{K}_2\text{S}_2\text{O}_4 + 3\text{H}_2\text{O}$ .**

Easily decomp.

Insol. in alcohol. (Bazlen, B. 1905, 38. 1058.)

**Sodium hyposulphite,  $\text{Na}_2\text{S}_2\text{O}_4$ .***Anhydrous.* Stable in dry air (Bazlen, B. 1905, 38. 1061.)100 g.  $\text{H}_2\text{O}$  dissolve 24.1 g. of the anhydrous salt at  $20^\circ$ . (Jellinek, Z. anorg. 1911, 70. 130.) $+2\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$ 

11.6 g. of the solution contain at:

 $20^\circ$  1.91 g.  $\text{Na}_2\text{S}_2\text{O}_4$  $10^\circ$  1.67 g. " $1^\circ$  1.49 g. "

(Jellinek, Z. anorg. 1911, 70. 128.)

Insol. in alcohol. (Bazlen, B. 1905, 38. 1058.)

**Sodium zinc hyposulphite,  $\text{Na}_2\text{S}_2\text{O}_4, \text{ZnS}_2\text{O}_4$ .**Less sol. in  $\text{H}_2\text{O}$  than  $\text{ZnS}_2\text{O}_4$ . (Bazlen, B. 1905, 38. 1060.)**Strontium hyposulphite,  $\text{SrS}_2\text{O}_4$ .**Sol. in  $\text{H}_2\text{O}$ . (Moissan, C. R. 1902, 135. 653.)**Zinc hyposulphite,  $\text{ZnS}_2\text{O}_4$ .**Easily sol. in  $\text{H}_2\text{O}$ ; about 1 pt. in 7 pts.  $\text{H}_2\text{O}$ . Forms supersat. solutions readily. (Bazlen, B. 1905, 38. 1060.)**Hypovanadic acid,  $\text{V}_2\text{O}_5(\text{OH})_4$ .***See* Vanadium tetrhydroxide.**Hypovanadic acid,  $\text{H}_2\text{V}_4\text{O}_6$ .***See* Vanadous acid.**Hypovanadic acid with vanadic acid.***See* Vanadicovanadic acid.**Imidodimetaarsenic acid.****Ammonium imidodimetaarsenate,** $(\text{NH}_4\text{O}_2\text{As}_2\text{O}_7\text{NH})$ .

(Rosenheim and Jacobsohn, Z. anorg. 1907, 50. 307.)

**Imidochromic acid.****Ammonium imidochromate,** $\text{NHCrO}(\text{ONH}_4)_2$ .Very sol. in  $\text{H}_2\text{O}$  with decomp. (Rosenheim and Jacobsohn, Z. anorg. 1906, 50. 299.)**Ammonium potassium imidochromate,** $\text{NH}_4\text{KCrO}_5\text{NH}$ Decomp. on solution in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1906, 50. 302.)**Imidodimidochromic acid.****Ammonium imidodimido chromate,** $\text{NH}[\text{CrO}(\text{NH})\text{ONH}_4]_2$ .

(Rosenheim and Jacobsohn, Z. anorg. 1906, 50. 303.)

**Imidomolybdic acid.****Potassium imidomolybdate,  $\text{NKM}_2\text{O}(\text{OK})_2$ .**

Unstable in air.

Very hygroscopic. Very sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1906, 50. 305.)**Diimidodiphosphormonamic acid,** $\text{HO}-\text{PO} < \begin{smallmatrix} \text{NH} \\ \text{NH} \end{smallmatrix} > \text{PO}-\text{NH}_2$ 

Correct formula for pyrophosphotriamic acid of Gladstone. (Mente, A. 248. 241.)

**Imidodiphosphoric acid,** $\text{HO}-\text{PO} < \begin{smallmatrix} \text{O} \\ \text{NH} \end{smallmatrix} > \text{PO}-\text{OH}$ .

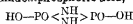
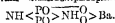
Correct name for pyrophosphamic acid. (Mente, A. 248. 251.)

**Barium imidodiphosphate,  $\text{Ba} \begin{smallmatrix} \text{O} \\ \text{O} \end{smallmatrix} \text{PO} > \text{PO} > \text{NH}$ .**Sl. sol. in  $\text{H}_2\text{O}$ . (Mente, A. 248. 243.)**Barium imidodiphosphate, basic,** $\text{Ba} \begin{smallmatrix} \text{O} \\ \text{O} \end{smallmatrix} \text{PO} > \text{PO} > \text{N}-\text{Ba}-\text{N} \begin{smallmatrix} \text{PO}-\text{O} \\ \text{PO}-\text{O} \end{smallmatrix} \text{Ba} +$  $2\text{H}_2\text{O}$ 

Ppt. (Mente.)

**Ferric imidodiphosphate.**

Sl. sol. in conc. acids. (Mente, A. 248. 241.)

**Silver imidodiphosphate,  $\text{Ag}_3\text{H}_2\text{P}_2\text{NO}_6$ .**Insol. in  $\text{H}_2\text{O}$ . (Stokes, Am. Ch. J. 1896, 18. 660.) $\text{Ag}_3\text{H}_2\text{P}_2\text{NO}_6$ . Ppt. (Stokes.)**Diimidodiphosphoric acid,**Correct name for *pyrophosphodiamic acid* (Mente, A. 248. 241.)**Barium diimidodiphosphate,**

Sl. sol. in dil. acids. (Mente, A. 248. 244.)

**Sodium diimidodiphosphate, basic,**Sl. sol. in  $\text{H}_2\text{O}$ . (Mente, A. 248. 245.)**Diimidotriphosphoric acid,****Silver diimidotriphosphate,  $\text{Ag}_5\text{H}_4\text{P}_3\text{N}_2\text{O}_{10}$ .**Insol. in  $\text{H}_2\text{O}$ . Very sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
Rather sl. sol. in dil.  $\text{HNO}_3$ . (Stokes, Am. Ch. J. 1896, 18. 657.) $\text{Ag}_5\text{H}_4\text{P}_3\text{N}_2\text{O}_{10}$ . Insol. in  $\text{H}_2\text{O}$ . Very sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
Decomp. by  $\text{HNO}_3$ . (Stokes.)**Trisodium diimidotriphosphate,**Sol. in  $\text{H}_2\text{O}$ .

Insol. in alcohol. (Stokes.)

**Triimidotetraphosphoric acid.****Silver triimidotetraphosphate.**

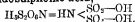
Ppt. (Stokes, Am. Ch. J. 1898, 20. 755.)

**Sodium triimidotetraphosphate,**Easily sol. in  $\text{H}_2\text{O}$ ; insol. in sodium acetate solution and dil. alcohol. (Stokes, Am. Ch. J. 1898, 20. 754.)**Imidosulphamide,  $\text{NH}_2\text{SO}_2\text{NH}\cdot\text{SO}_2\text{NH}_2$** 

"Sulphamide" of Traube.

Very sol. in  $\text{H}_2\text{O}$  with decomp. appreciably sol. in cold, easily sol. in hot methyl and ethyl alcohol. Insol. in  $\text{C}_2\text{H}_5$  and  $\text{CHCl}_3$ . Sl. sol. in ether, cold and hot acetic ether and glacial acetic acid. Moderately stable toward alkalis. (Hantzsch and Stuer, B. 1905, 38. 1022.)**Ammonium imidosulphamide,**

(Hantzsch and Stuer.)

**Imidosulphonic acid,**

Ammoniosulphonic acid of Claus. Known only in aqueous solution (Divers and Haga, Chem. Soc. 61. 943.)

Very unstable (Berglund, B. 9. 252.)

**Ammonium imidosulphonate, basic,**Sol. in 9 pts. of  $\text{H}_2\text{O}$ . Solution is stable.

Insol. in alcohol.

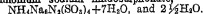
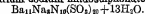
Sl. sol. in warm conc.  $\text{H}_2\text{SO}_4$  without decomp. (Rose, Pogg. 1834, 32. 81.)

Much less sol. than the neutral salt (Berglund, B. 9. 255.)

= "P-rasulphatammon"

+  $\text{H}_2\text{O}$ . Gradually efflorescent. Sol. in  $\text{H}_2\text{O}$  with subsequent decomp. (Divers and Haga.)**Ammonium imidosulphonate,  $\text{HN}(\text{SO}_2\text{NH}_4)_2$ .**Sol. in  $\text{H}_2\text{O}$ . (Raschig, A. 241. 161.)**Ammonium barium imidosulphonate,**Very sl. sol. in  $\text{H}_2\text{O}$ . (Divers and Haga.) $(\text{NH}_4)_2\text{BaN}_4(\text{SO}_4)_4 + 8\text{H}_2\text{O}$ . (D. and H.)**Ammonium calcium imidosulphonate.**

(Divers, Chem. Soc. 1892, 61. 968.)

**Ammonium sodium imidosulphonate,**Very sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Divers and Haga.)**Ammonium sodium imidosulphonate nitrate,  $\text{HN}(\text{SO}_2\text{NH}_4)_2\text{NaNO}_3$ .**Very sol. in  $\text{H}_2\text{O}$ . (Divers and Haga.)**Barium imidosulphonate,  $\text{Ba}[\text{N}(\text{SO}_2)_2\text{Ba}]_2 + 5\text{H}_2\text{O}$ .**Sl. sol. in  $\text{H}_2\text{O}$ . (Berglund, B. 9. 255.)Sol. in dil.  $\text{HNO}_3 + \text{Aq}$  without decomp. (Divers and Haga.) $\text{HN}(\text{SO}_2)_2\text{Ba} + \text{H}_2\text{O}$ . Moderately sol. in  $\text{H}_2\text{O}$ . (D. and H.)**Barium mercury imidosulphonate,**Almost insol. in cold  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 1892, 61. 977.)**Barium sodium imidosulphonate,**Sparingly sol. in  $\text{H}_2\text{O}$ . Readily sol. in  $\text{HNO}_3$  or  $\text{HCl}$ . (Divers, Chem. Soc. 1892, 61. 967.)

Calcium imidosulphonate,  $\text{Ca}[\text{N}(\text{SO}_3)_2\text{Ca}]_2 + 6\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  (Berglund.)

Calcium mercury imidosulphonate,  $\text{N}_2\text{Hg}[(\text{SO}_3)_2\text{Ca}]_2$ .

Very sol. in  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 1896, 69. 1629.)

Calcium mercury imidosulphonate chloride,  $(\text{NS}_2\text{O}_6\text{Ca})_2\text{Hg}_2\text{Cl} + 12\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 1896, 69. 1629.)

Calcium sodium imidosulphonate,  $\text{NaN}(\text{SO}_3)_2\text{Ca} + 3\text{H}_2\text{O}$

Sl. sol. in cold  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 61. 968.)

Lead imidosulphonate,  $(\text{PbOH}(\text{SO}_3)_2)_2\text{NPbOH}$ .

Ppt. (Berglund)

Insol. in  $\text{H}_2\text{O}$  (Divers and Haga)

$(\text{PbOH})_2\text{N}(\text{SO}_3)_2$ , PbO. Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil  $\text{HNO}_3$  + Aq. (D. and H.)

Mercurous imidosulphonate, basic,  $[\text{Hg}_2\text{N}(\text{SO}_3)_2\text{Hg}_2]\text{O} + 6\text{H}_2\text{O}$ .

Much more sol. in dil  $\text{HNO}_3$  than mercuric salt. Sol. in cold conc.  $\text{KI} + \text{Aq}$ , leaving half Hg as metal. (Divers and Haga, Chem. Soc. 1896, 69. 1631)

Mercuric imidosulphonate, basic,  $\text{NH}(\text{SO}_3)_2\text{Hg}(\text{O})_2\text{Hg}$ .

Easily decomp. (Divers and Haga)

Mercurimercuric imidosulphonate,  $[\text{Hg}_2\text{N}(\text{SO}_3)_2\text{Hg}]_2\text{O} + 3\text{H}_2\text{O}$ .

(Divers and Haga.)

$[\text{Hg}_2\text{N}(\text{SO}_3)_2\text{Hg}]_2\text{O}$ ,  $[\text{Hg}_2\text{N}(\text{SO}_3)_2\text{Hg}_2]$ ,  $\text{Hg}_2\text{N}(\text{SO}_3)_2\text{Hg}]_2\text{O} + 6\text{H}_2\text{O}$ . (Divers and Haga.)

Mercury sodium imidosulphonate, basic,  $\text{Hg}_2\text{ON}(\text{SO}_3)_2\text{Na} + 2\text{H}_2\text{O}$

Slightly efflorescent. Decomp. by long washing with  $\text{H}_2\text{O}$ . Much more readily sol. in  $\text{HCl}$  than in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  and is wholly decomp. thereby. (Divers and Haga, Chem. Soc. 1892, 61. 983.)

Mercury sodium imidosulphonate,  $\text{Hg}_2\text{N}_4(\text{SO}_3\text{Na})_4 + 6\text{H}_2\text{O}$ .

Sparingly sol. in cold  $\text{H}_2\text{O}$ .

Readily sol. in  $\text{HNO}_3$  and in  $\text{HCl}$ .

Decomp. by  $\text{HCl}$  immediately, but not by  $\text{HNO}_3$ . (Divers and Haga, Chem. Soc. 1892, 61. 981.)

Potassium imidosulphonate, basic,  $\text{KN}(\text{SO}_3)_2\text{K} + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Raschig, A. 241. 161.)

Less sol. than neutral salt. (Berglund.)

Potassium imidosulphonate,  $\text{HN}(\text{SO}_3)_2\text{K}$ .

Sol. in  $\text{H}_2\text{O}$ . (Raschig, A. 241. 161.)

= Potassium ammoniumsulphonate of Claus.

Difficultly sol. in cold  $\text{H}_2\text{O}$ , sol. in 64 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ . (Piemy.) Gradually decomp. by boiling (Claus)

Sl. sol. in  $\text{H}_2\text{O}$ . (Berglund, B. 9. 255)

Potassium mercury imidosulphonate,

$\text{N}_2\text{Hg}(\text{SO}_3)_2\text{K} + 4\text{H}_2\text{O}$ .

See Mercurimidosulphonic acid.

Silver imidosulphonate,  $\text{AgN}(\text{SO}_3)_2\text{Ag}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Berglund.)

Silver sodium imidosulphonate,

$\text{NaN}(\text{SO}_3)_2\text{Ag}$

Sl. sol. in  $\text{H}_2\text{O}$ . (Divers and Haga.)

$\text{AgN}_2\text{N}(\text{SO}_3)_2$ . Sl. sol. in  $\text{H}_2\text{O}$ , but more sol. than the two preceding salts. (D. and H.)

Sodium imidosulphonate,  $\text{HIN}(\text{SO}_3)_2\text{Na} + 2\text{H}_2\text{O}$

Not efflorescent. Very sol. in  $\text{H}_2\text{O}$  (Diver and Haga)

$\text{NaN}(\text{SO}_3)_2\text{Na} + 12\text{H}_2\text{O}$ . Efflorescent. Sl. sol. in cold  $\text{H}_2\text{O}$ , but very sol. in hot  $\text{H}_2\text{O}$ . Sol. in 54 pts  $\text{H}_2\text{O}$  at  $27.5^\circ$ . (Divers and Haga)

Sodium strontium imidosulphonate,

$\text{SrNaNS}_2\text{O}_6 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  (Divers, Chem. Soc. 1896, 69. 1625)

Strontium imidosulphonate,

$\text{Sr}[\text{N}(\text{SO}_3)_2\text{Sr}]_2 + 6\text{H}_2\text{O}$

Sl. sol. in  $\text{H}_2\text{O}$  (Berglund)

$+ 12\text{H}_2\text{O}$  Somewhat sol. in hot  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1896, 69. 1623)

Imidotrisulphoorthophosphoric acid,  $\text{NH}_4\text{P}(\text{SH})_3$ .

Insol. in  $\text{CS}_2$  and readily decomp. by  $\text{H}_2\text{O}$ . (Stock, B. 1906, 39. 1991)

Ammonium imidotrisulphoorthophosphate,  $\text{NHP}(\text{SNH})_3$ .

Very hygroscopic.

Loses  $\text{NH}_3$  in the air.

Somewhat sol. in liquid  $\text{NH}_3$ .

Decomp. by any other solvent in which it is sol. (Stock, B. 1906, 39. 1983.)

Diammonium hydrogen imidotrisulphoorthophosphate,  $\text{SHP}(\text{SNH})_3\text{NH}$ .

(Stock, B. 1906, 39. 1983.)

Ammonium dihydrogen ———,  $\text{SNH}_4\text{P}(\text{SH})_2\text{NH}$ .

(Stock.)

**Disodium hydrogen imidotrisulphocarthophosphate**,  $\text{SHP}(\text{SNa})_2\text{NH}$ .

Very easily sol in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Somewhat sol. in methyl and ethyl alcohol (Stock.)

**Diimidopentasilphopyrophosphoric acid**,  $\text{P}_2\text{S}_5\text{N}_2\text{H}_6$ .

Not known in pure state (Stock, B. 1906, 39. 1967.)

**Ammonium diimidopentasilphopyrophosphate**,  $\text{S}[\text{P}(\text{SNH})_2\text{NH}]_2$ .

Very hygroscopic. Sol in cold  $\text{H}_2\text{O}$  with decomp. (Stock, B. 1906, 39. 1978.)

**Inidosulphurous acid**.

**Ammonium imidosulphite**,  $\text{HN}(\text{SO}_2\text{NH}_2)_2$ .

Somewhat deliquescent. Very unstable. Easily sol in  $\text{H}_2\text{O}$  with decomp. into thiosulphate and amidosulphate. Insol. in alcohol. (Divers and Ogawa, Chem. Soc. 1901, 79. 1100.)

**Ammonium barium imidosulphite**,  $\text{Ba}(\text{SO}_2\text{NHSO}_2\text{NH}_2)_2$ .

Sol in  $\text{H}_2\text{O}$  (Divers, Chem. Soc. 1901, 79. 1102.)

**Potassium imidosulphite**,  $\text{NH}(\text{SO}_2\text{K})_2$ .

(Divers and Owaga, Proc. Chem. Soc. 1900, 16. 113.)

Very sol. in  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1901, 79. 1101.)

**Imidosulphuryl amide**,  $\text{S}_2\text{O}_4\text{N}_2\text{H}_4 =$



Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by conc.  $\text{HCl}$ . Insol. in alcohol sat. with  $\text{NH}_3$ . (Mente, A. 248. 265.)

**Indic acid**.

**Magnesium indate**,  $\text{MgIn}_2\text{O}_4 + 3\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . Sol in  $\text{HCl} + \text{Aq}$ . (Renz, B. 1901, 34. 2764.)

**Indium, In**

Does not decomp. hot  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$  and  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Decomp. by conc.  $\text{H}_2\text{SO}_4$ . Easily sol in  $\text{HNO}_3 + \text{Aq}$ . Insol. in acetic acid. Insol. in  $\text{KOH} + \text{Aq}$  (Winkler, J. pr. 102. 273.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

$\frac{1}{2}$  cc. oleic acid dissolves 0.0039 g. In m 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

**Indium monobromide**,  $\text{InBr}$

Decomp. by hot  $\text{H}_2\text{O}$ . Easily sol. in acids. Easily sol. in cold conc.  $\text{HCl}$ . (Thiel, Z. anorg. 1901, 40. 328.)

**Indium dibromide**,  $\text{InBr}_2$ .

Decomp. by hot  $\text{H}_2\text{O}$ . Easily sol. in acids. (Thiel, Z. anorg. 1904, 40. 329.)

**Indium tribromide**,  $\text{InBr}_3$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$

**Indium monochloride**,  $\text{InCl}$

Deliquescent. Decomp. by  $\text{H}_2\text{O}$  into  $\text{InCl}_3$  and  $\text{In}$ . (Nilson and Pettersson, Chem. Soc. 43. 820.)

**Indium dichloride**,  $\text{InCl}_2$ .

Deliquescent in moist air; decomp. by  $\text{H}_2\text{O}$  into  $\text{InCl}_3$  and  $\text{In}$ . (Nilson and Pettersson, Chem. Soc. 43. 818.)

**Indium trichloride**,  $\text{InCl}_3$ .

Very deliquescent; sol in  $\text{H}_2\text{O}$  with hissing and great evolution of heat

**Indium lithium chloride**.

Extremely deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Meyer, A. 150. 144.)

**Indium potassium chloride**,  $3\text{KCl}, \text{InCl}_3 + 1\frac{1}{2}\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Meyer.)

**Indium trifluoride**,  $\text{InF}_3 + 3\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ ; readily decomp. (Thiel, B. 1904, 37. 175.)

1 l.  $\text{H}_2\text{O}$  dissolves 86 g. at  $25^\circ$ . Decomp. on boiling. (Thiel, Z. anorg. 1904, 40. 331.)

+  $9\text{H}_2\text{O}$ . Sl. sol in cold  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  and in  $\text{HNO}_3$ . Insol. in alcohol and ether. (Chabré, C. R. 1905, 140. 90.)

**Indium hydrosulphide**.

Decomp. by acids. (Meyer.)

**Indium hydroxide**,  $\text{In}_2\text{O}_3\text{H}_6$ .

Sol. in acids, also in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  but the solution clouds up on standing or boiling, with separation of  $\text{In}_2\text{O}_3\text{H}_6$ . Insol. in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Renz, B. 1904, 37. 2110.)

Sl. sol in alkylamines but completely ppt. by addition of the hydrochloride of the base. (Renz, B. 1903, 36. 2754.)

**Indium monoiodide**,  $\text{InI}$ .

Slowly decomp. in moist air. Not attacked by boiling  $\text{H}_2\text{O}$

Sol. in dil.  $\text{HNO}_3$  in presence of  $\text{AgNO}_3$ . Very slowly sol. in cold, more rapidly sol. in

hot acids with evolution of  $H_2$ . Very sol in sulphurous acid.

Insol. in alcohol, ether and chloroform. (Thiel, Z. anorg. 1910, 66. 302.)

**Indium diiodide,  $IndI_2$**

(Thiel, Z. anorg. 1910, 66. 302.)

**Indium triiodide,  $IndI_3$**

Deliquescent. (Meyer.)

Sol in  $CHCl_3$ . Decomp. by xylene. (Thiel, Z. anorg. 1904, 40. 330.)

**Indium nitride,  $IndN$**

Decomp. by heat (Franz Fischer, B. 1910, 43. 1469.)

**Indium monoxide,  $IndO$**

Gradually sol. in  $HCl + Aq$ . (Winkler, J. pr. 94. 1.)

**Indium sesquioxide,  $Ind_2O_3$**

Slowly sol. in cold, easily in hot acids.

Four modifications:

(1) Yellow Amorphous. Sol. in acids. Its hydroxide is insol. in ammonia and  $NH_4Cl$ .

(2) White Amorphous. Insol. in acids.

(3) White Amorphous. Sol. in acids. Its hydroxide is sol. in ammonia, but pptd. by  $NH_4Cl$ .

(4) Crystallized. Crystalline modification is insol. in acids. (Renz, B. 1904, 37. 2112.) Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

**Indium oxide,  $Ind_2O_3 = 3IndO, 2Ind_2O_3 (?)$**

(Winkler)

$Ind_2O_3 = 2IndO, Ind_2O_3 (?)$ . (Winkler.)

**Indium oxybromide (?)**

Not decomp. by hot acids or alkalis.

(Meyer, A. 150. 137.)

**Indium oxychloride,  $IndOCl$**

Very sl. sol. in  $H_2O$ . (Thiel, B. 1904, 37. 176.)

Very sl. sol. in cold or hot dil. acids. Quickly sol. in hot conc. acids. (Thiel, Z. anorg. 1904, 40. 327.)

**Indium triselenide,  $Ind_2Se_3$**

Sol. in strong acids with evolution of  $H_2Se$ . (Thiel, Z. anorg. 1910, 66. 315.)

**Diindium sulphide,  $Ind_2S$**

Sol. in acids. (Thiel, Z. anorg. 1904, 40. 326.)

**Indium monosulphide,  $IndS$**

Easily sol. in  $HCl$  with evolution of  $H_2S$ . Sol. in  $HNO_3$  with evolution of oxides of nitrogen. (Thiel, Z. anorg. 1910, 66. 314.)

**Indium sesquisulphide,  $Ind_2S_3$**

Partially sol. in  $(NH_4)_2S + Aq$

**Indium potassium sulphide,  $Ind_2S_3, K_2S$**

Insol. in  $H_2O$ ; decomp. by weak acids with separation of  $Ind_2S_3$ , sol. in conc. acids. (Schneider, J. pr. (2) 9. 200.)

**Indium silver sulphide,  $Ind_2S_3, Ag_2S$**

Insol. in  $H_2O$ . (Schneider, l. c.)

**Indium sodium sulphide,  $Ind_2S_3, Na_2S + 2H_2O$**

Insol. in  $H_2O$ . (Schneider, l. c.)

**Indium monotelluride,  $IndTe$**

Sol. in  $HNO_3$ ; insol. in  $HCl + Aq$ . (Thiel, Z. anorg. 1910, 66. 318.)

**Infusible white precipitate.**

**Diiodamine,  $NHI_2$**

Decomp. by  $H_2O$ .

**Iodammonium iodide,  $NIH_3I$**

Decomp. by  $H_2O$ , caustic alkalis, and acids. Sol. in  $KI + Aq$ , alcohol, ether,  $CS_2$ ,  $CHCl_3$ . (Guthrie, Chem. Soc. (2) 1. 239.)

**Iodauric acid,  $HAuI_4 (?)$**

Not known with certainty

**Ammonium iodaureate.**

Deliquescent. Decomp. by  $H_2O$ . (Johnston, Phil. Mag. (3) 9. 266.)

**Barium iodaureate.**

Sol. in  $BaI_2 + Aq$

**Cæsium iodaureate,  $CsAuI_4$**

(Gupta, J. Am. Chem. Soc. 1914, 36. 748.)

**Ferrous iodaureate.**

Sol. in  $H_2O$ . (Johnston.)

**Potassium iodaureate,  $KAuI_4$**

Decomp. by  $H_2O$ . Sol. in  $KI$ , and  $HI + A$ . (Johnston.)

**Sodium iodaureate.**

Very deliquescent (Johnston.)

**Iodauricyanhydric acid,  $HAu(CN)_2I_2$**

Known only in its salts.

**Barium iodauryanide,  $Ba[Au(CN)_2I_2]_2 + 10H_2O$**

Sl. sol. in cold, easily in hot  $H_2O$ . Easily sol. in alcohol. (Lundbom, Lund. Univ. Arsk. 12. No. 6.)

Calcium iodaurycyanide,  $\text{Ca}[\text{Au}(\text{CN})_2\text{I}_2]_2 + 10\text{H}_2\text{O}$ .

Not stable. (L.)

Cobalt iodaurycyanide,  $\text{Co}[\text{Au}(\text{CN})_2\text{I}_2]_2 + 10\text{H}_2\text{O}$ .

Most insol. of all iodaurycyanides, and only sl. sol in warm  $\text{H}_2\text{O}$ . Easily sol. in alcohol.

Potassium iodaurycyanide,  $\text{KAu}(\text{CN})_2\text{I}_2 + \text{H}_2\text{O}$ .

Sl. sol. in cold, easily sol. in warm  $\text{H}_2\text{O}$  and alcohol. (L.)

Strontium iodaurycyanide,  $\text{Sr}[\text{Au}(\text{CN})_2\text{I}_2]_2 + 10\text{H}_2\text{O}$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

### Iodhydric Acid, III.

Very easily and quickly absorbed by  $\text{H}_2\text{O}$ , with evolution of much heat.

Solution is decomp. on exposure to the air. 1 vol.  $\text{H}_2\text{O}$  absorbs 450 vols. HI at  $10^\circ$ . (Thomson.)

1 vol.  $\text{H}_2\text{O}$  absorbs 425 vols. HI at  $10^\circ$ . (Berthelot, C. R. 76, 679.)

Weak or strong solutions when boiled in an atmosphere of H leave a residue of constant composition, which distils unchanged at  $126^\circ$  (de Luynes), at  $127^\circ$  (Roscoe, Chem. Soc. 13, 146; Naumann; Topsoe), at  $128^\circ$  (Bineau, A. ch. (3) 7, 266); and has a sp. gr. of 1.67 (Naumann), of 1.70 (Bineau, de Luynes), of 1.708 (Topsoe); and contains 56.26 % HI (Bineau), 57.0 % HI (Roscoe), 57.75 % HI (Topsoe.)

By conducting dry H gas through the aqueous solution of HI, a constant residue is obtained, containing 60.3-60.7 % HI if temp. is  $15-19^\circ$ , and 58.2-58.5 % HI if temp. is  $100^\circ$ . (Roscoe.)

Solubility of HI in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% HI	Solid Phase
-10	20.3	Ice
-20	29.3	
-30	35.1	
-40	39	
-50	42	
-60	44.4	Ice + HI, $4\text{H}_2\text{O}$
-70	46.2	
-80	47.9	
-90	52.6	
-40	59	
-35.5	64	HI, $4\text{H}_2\text{O}$
-40	65.5	
-49	66.3	
-48	70.3	
-56	73.6	
-52	74	HI, $3\text{H}_2\text{O}$ + HI, $2\text{H}_2\text{O}$

(Pickering, B. 1893, 26, 2307)

Solution in  $\text{H}_2\text{O}$  sat. at  $0^\circ$  has sp. gr. = 1.99 (de Luynes, A. ch. (4) 2, 385); 2.0 (Vigier).

Sp. gr. of HI + Aq.

Sp. gr.	% HI	Temp.
1.017	2.286	$13.5^\circ$
1.0524	7.019	$13.5$
1.077	10.15	$13.5$
1.095	12.21	$13$
1.102	13.09	$13.5$
1.126	15.73	$13.5$
1.164	19.97	$13.5$
1.191	22.63	$13.8$
1.225	25.80	$13.8$
1.2535	28.41	$13.5$
1.274	30.20	$13.5$
1.309	33.07	$13$
1.347	36.07	$13$
1.382	38.68	$13$
1.413	40.45	$13$
1.451	43.39	$13$
1.4855	45.71	$13$
1.528	48.22	$13$
1.542	49.13	$13.5$
1.5727	50.75	$13$
1.603	52.43	$12.5$
1.630	53.93	$14$
1.674	56.15	$13.7$
1.696	57.28	$13$
1.703	57.42	$12.5$
1.706	57.64	$13.7$
1.708	57.74	$12$

(Topsoe, B. 3, 403)

Sp. gr. of HI + Aq at  $15^\circ$ .

% HI	Sp. gr.	% HI	Sp. gr.	% HI	Sp. gr.
1	1.008	21	1.175	41	1.414
2	1.015	22	1.185	42	1.420
3	1.022	23	1.195	43	1.444
4	1.029	24	1.205	44	1.459
5	1.037	25	1.216	45	1.475
6	1.045	26	1.227	46	1.491
7	1.053	27	1.238	47	1.508
8	1.061	28	1.249	48	1.525
9	1.069	29	1.260	49	1.543
10	1.077	30	1.271	50	1.561
11	1.085	31	1.283	51	1.579
12	1.093	32	1.295	52	1.597
13	1.102	33	1.307	53	1.615
14	1.110	34	1.320	54	1.634
15	1.118	35	1.333	55	1.654
16	1.127	36	1.346	56	1.674
17	1.137	37	1.359	57	1.694
18	1.146	38	1.372	58	1.713
19	1.155	39	1.386	..	...
20	1.165	40	1.400	..	...

(Topsoe, calculated by Gerlach, Z. anal. 27, 316.)

Sp. gr. of HI + Aq at 15°.

% HI	Sp. gr.	% HI	Sp. gr.	% HI	Sp. gr.
5	1.045	25	1.239	45	1.538
10	1.091	30	1.296	50	1.650
15	1.138	35	1.361	52	1.700
20	1.187	40	1.438		..

Only a "moderate degree of accuracy" is claimed for this table. (Wright, C. N. 23. 253.)

+2H<sub>2</sub>O. Mpt.—43°. (Pickering, B. 1893, 28. 2308.)

+3H<sub>2</sub>O. Mpt.—48°. (Pickering.)

+4H<sub>2</sub>O. Mpt.—36.5°. (Pickering.)

### Iodic acid, HIO<sub>3</sub>.

Very sol. in H<sub>2</sub>O and alcohol.

100 g. H<sub>2</sub>O dissolve 286 g. HIO<sub>3</sub> at 13.5°.

Sp. gr. of HIO<sub>3</sub> + Aq. = 2.4256.

100 g. H<sub>2</sub>O dissolve 293 g. HIO<sub>3</sub> at 18°.

Sp. gr. of HIO<sub>3</sub> + Aq. = 2.4711.

(Groschuff, Z. anorg. 1905, 47. 337.)

Solubility of HIO<sub>3</sub> in H<sub>2</sub>O at t°.

Solid phase	t°	G HIO <sub>3</sub> in 100 g. of the solution	G I <sub>2</sub> O <sub>5</sub> in 100 g. of the solution
ice	— 0.30	1.78	1.69
"	— 0.67	4.35	4.13
"	— 1.01	7.17	6.81
"	— 1.90	17.66	16.75
"	— 2.38	27.65	26.22
"	— 4.72	54.19	51.42
"	— 6.32	60.72	57.61
"	— 12.25	71.04	67.40
"	— 13.5	72.2	68.5
"	— 15	73.8	70.0
"	— 19	76.2	72.3
ice + HIO <sub>3</sub>	— 14	72.8	69.1
HIO <sub>3</sub>	0	74.1	70.3
"	+ 16	75.6	71.7
"	40	77.7	73.7
"	60	80.0	75.9
"	80	82.5	78.3
"	85	83.0	78.7
"	101	85.2	80.8
HIO <sub>3</sub> + HI <sub>2</sub> O <sub>5</sub>	110	86.5	82.1
HI <sub>2</sub> O <sub>5</sub>	125	87.2	82.7
"	140	88.3	83.8
"	160	90.5	85.9

(Groschuff, Z. anorg. 1905, 47. 343.)

Sat. solution has sp. gr. 2.842 at 12.5° and boils at 104°. (Ditte, B. 6. 1533.) Sat. solution has sp. gr. 2.1629 (1.874 pts. I<sub>2</sub>O<sub>5</sub> in 1 pt. H<sub>2</sub>O) at 13° and boils at 100°. (Kammerer, Pogg. 138. 400.)

Sp. gr. of HIO<sub>3</sub> + Aq at 15°.

% I <sub>2</sub> O <sub>5</sub>	Sp. gr.	% I <sub>2</sub> O <sub>5</sub>	Sp. gr.
1	1.0053	35	1.4428
5	1.0263	40	1.5371
10	1.0525	45	1.6315
15	1.1223	50	1.7356
20	1.2093	55	1.8689
25	1.2773	60	1.9954
30	1.3484	65	2.1260

(Kammerer.)

According to Thomsen (B. 7. 71) solutions of HIO<sub>3</sub> have sp. gr.—

HIO<sub>3</sub> + 10H<sub>2</sub>O = 1.6609.

HIO<sub>3</sub> + 20H<sub>2</sub>O = 1.3860.

HIO<sub>3</sub> + 40H<sub>2</sub>O = 1.1945.

HIO<sub>3</sub> + 80H<sub>2</sub>O = 1.1004.

HIO<sub>3</sub> + 160H<sub>2</sub>O = 1.0512.

HIO<sub>3</sub> + 320H<sub>2</sub>O = 1.0258.

H<sub>2</sub>SO<sub>4</sub> at nearly boiling temp. dissolves 1/4 its weight of iodic acid. (Millon.)

Solubility in HNO<sub>3</sub> containing 27.73% HNO<sub>3</sub>.

100 g. of the sat. solution contain at:

0°	20°	40°	60°
18	21	27	38 g. HIO <sub>3</sub> .

Solubility in HNO<sub>3</sub> containing 40.88% HNO<sub>3</sub>.

100 g. of the sat. solution contain at:

0°	20°	40°	60°
9	10	14	18 g. HIO <sub>3</sub> .

(Groschuff, Z. anorg. 1905, 47. 344.)

Less sol. in HNO<sub>3</sub> than H<sub>2</sub>O; nearly insol. in anhydrous HNO<sub>3</sub>. (Groschuff, Z. anorg. 1905, 47. 347.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 830.)

Unattacked and undissolved by liquid NO<sub>2</sub>. (Frankland, Chem. Soc. 1901, 79. 1362.)

Insol. in absolute alcohol. Alcohol of 35° B. dissolves half its weight in HIO<sub>3</sub>. (Kammerer.)

+4 1/2 H<sub>2</sub>O.  
HIO<sub>3</sub>, I<sub>2</sub>O<sub>5</sub>. (Groschuff, Z. anorg. 1905, 47. 343.)

### Iodates.

The alkali iodates are sol. in H<sub>2</sub>O, the others are sl. sol. or insol. therein.

Aluminum iodate, Al(IO<sub>3</sub>)<sub>3</sub> (?).

Deliquescent. (Berzelius.)

Ammonium iodate, NH<sub>4</sub>IO<sub>3</sub>.

Sl. sol. in H<sub>2</sub>O. Sol. in 38.5 pts. H<sub>2</sub>O at 15°, 6.9 pts. at 100°. (Rammelsberg, Pogg. 44. 555.)

Solubility of  $\text{NH}_4\text{IO}_3$  in  $\text{HIO}_3$  + Aq at 30°.

% $\text{HIO}_3$ in the solution	% $\text{NH}_4\text{IO}_3$ in the solution	Solid phase
0	4.20	$\text{NH}_4\text{IO}_3$
2.54	3.89	"
4.52	3.83	$\text{NH}_4\text{IO}_3 + \text{NH}_4\text{IO}_3 \cdot 2\text{HIO}_3$
4.51	3.86	"
4.56	3.75	"
4.73	3.53	$\text{NH}_4\text{IO}_3 \cdot 2\text{HIO}_3$
6.57	1.94	"
8.45	1.09	"
9.12	0.89	"
24.00	0.62	"
36.01	0.41	"
44.43	0.30	"
58.12	0.37	"
76.35	0.31	$\text{NH}_4\text{IO}_3 \cdot 2\text{HIO}_3 + \text{HIO}_3$
76.70	0	$\text{HIO}_3$

(Meerburg, Z. anorg. 1905, 45, 341.)

+  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 21, 146.)Ammonium diiodate,  $\text{NH}_4\text{H}(\text{IO}_3)_2$ .Sl. sol. in cold  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 21, 145.)Ammonium triiodate,  $\text{NH}_4\text{H}_2(\text{IO}_3)_3$ .Sol. in  $\text{H}_2\text{O}$ . (Blomstrand, J. pr. (2) 42, 335.)See also solubility in  $\text{HIO}_3$ , under Ammonium iodate. (Meerburg.)

## Ammonium cobalt iodate.

Decomp. by  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rammelsberg.)Ammonium manganic iodate,  $\text{Mn}(\text{IO}_3)_4 \cdot 2\text{NH}_4\text{IO}_3$ .Ppt. Insol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HIO}_3$ . (Berg, C. R. 1899, 128, 675.)

## Ammonium oxydimercuri ammonium iodate.

See Oxydimercuri ammonium ammonium iodate.

## Ammonium tellurium iodate.

See Iodotellurate, ammonium.

## Ammonium iodate selenate.

See Iodoselenate, ammonium.

Barium iodate,  $\text{Ba}(\text{IO}_3)_2$ .Anhydrous salt is sol. in 1746 pts.  $\text{H}_2\text{O}$  at 15°, and 600 pts.  $\text{H}_2\text{O}$  at 100° (Rammelsberg, Pogg. 44, 577); in 3018 pts.  $\text{H}_2\text{O}$  at 13.5°, and 681 pts.  $\text{H}_2\text{O}$  at 100°. (Kremers, Pogg. 84, 27.)Solubility of  $\text{Ba}(\text{IO}_3)_2$  in  $\text{H}_2\text{O}$ . 100 g. sat.  $\text{Ba}(\text{IO}_3)_2$  + Aq at t° contain g. anhydrous  $\text{Ba}(\text{IO}_3)_2$ .

t°	Grams $\text{Ba}(\text{IO}_3)_2$	t°	Grams $\text{Ba}(\text{IO}_3)_2$	t°	Grams $\text{Ba}(\text{IO}_3)_2$
Below the point -0.016° ± 0.002°	0.008	30°	0.031	70°	0.093
+10°	0.014	40°	0.041	80°	0.115
20°	0.022	50°	0.056	90°	0.141
25°	0.028	60°	0.071	*90 2°	0.197

\*Bpt. at 735 mm pressure = about 100° at 760 mm pressure.

(Anschutz, Z. phys. Ch. 1906, 56, 241.)

1 l. sat. aq. solution contains 0.284 g.  $\text{Ba}(\text{IO}_3)_2$  at room temp. (Hill and Zink, J. Am. Chem. Soc. 1900, 31, 44.)1 l.  $\text{H}_2\text{O}$  dissolves 0.3845 g.  $\text{Ba}(\text{IO}_3)_2$  at 25°. (Harkins and Winninghof, J. Am. Chem. Soc. 1911, 33, 1828.)Easily sol. in cold  $\text{HCl}$  + Aq; difficultly sol. in warm  $\text{HNO}_3$  + Aq. (Rammelsberg.)Insol. in  $\text{H}_2\text{SO}_4$ . (Ditte.)  
100 cc.  $\text{NH}_4\text{OH}$  + Aq (sp. gr. = 0.90) dissolve 0.0199 g.  $\text{Ba}(\text{IO}_3)_2$ . (Hill and Zink.)

## Solubility in salts + Aq at 25°.

C = concentration of salt in salt solution expressed in equivalents per l.

S = solubility of  $\text{Ba}(\text{IO}_3)_2$  in salts + Aq expressed in equivalents per l.

Salt	C	S
$\text{Ba}(\text{NO}_3)_2$	0.001	0.001362
	0.002	0.001212
	0.005	0.0009753
	0.020	0.0008744
	0.050	0.0008131
	0.100	0.0005659
	0.200	0.0005580
$\text{KNO}_3$	0.002	0.001624
	0.010	0.001820
	0.050	0.002640
	0.200	0.003190
$\text{KIO}_3$	0.00010608	0.001510
	0.0005304	0.001242
	0.0010608	0.0009418

(Harkins and Winninghof, J. Am. Chem. Soc. 1911, 33, 1829.)

## Insol. in alcohol

100 cc. 95% alcohol dissolve 0.0011 g.  $\text{Ba}(\text{IO}_3)_2$  at room temp. (Hill and Zink.)

Insol. in acetone. (Eidmann, C. C. 1899, II 1014.)

+  $\text{H}_2\text{O}$ . Sol. in 3333 pts.  $\text{H}_2\text{O}$  at 18°, and 625 pts.  $\text{H}_2\text{O}$  at 100° (Gay-Lussac, A. ch. 91, 5.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

**Barium manganic iodate**,  
 $Mn(IO_3)_4, Ba(IO_3)_2$ .  
 Insol in  $H_2O$ .  
 Insol in  $HIO_3$ . (Berg, C. R. 1899, 128.  
 675.)

**Bismuth iodate, basic**.  
 Insol in  $H_2O$ . Very difficultly sol. in  
 $HNO_3 + Aq$  (Rammelsberg, Pogg. 44. 568.)  
 $Bi(IO_3)_3 + 1\frac{1}{2}H_2O$ . Insol in  $H_2O$ .

**Cadmium iodate,  $Cd(IO_3)_2$** .  
 Very sl. sol. in  $H_2O$ . Easily sol. in  $HNO_3$ ,  
 or  $NH_4OH + Aq$ . Sol. in  $Cd(C_2H_3O_2)_2 + Aq$   
 (Rammelsberg, Pogg. 44. 566.)  
 $+H_2O$ . Sl. sol. in  $H_2O$ . Very sol. in dil.  
 $HNO_3 + Aq$ . (Ditte, A. ch. (8) 21. 145.)

**Cadmium iodate ammonia,  $Cd(IO_3)_2, 2NH_3$** .  
 Insol. in  $H_2O$ ; sol. in  $NH_4OH + Aq$ . (Ditte.)  
 A. ch. (8) 21. 145.)  
 $Cd(IO_3)_2, 2NH_3 + H_2O$  As above. (Ditte.)

**Cassium iodate,  $CsIO_3$** .  
 100 pts  $H_2O$  dissolve 2.6 pts.  $CsIO_3$  at  $24^\circ$ .  
 Insol in alcohol. (Wheeler, Sil. Am. J. 144.  
 123.)  
 $2CsIO_3, I_2O_5$ . 100 pts  $H_2O$  dissolve 2.5 pts.  
 at  $21^\circ$ . Not decomp. by hot  $H_2O$  (Wheeler.)  
 $2CsIO_3, I_2O_5, 2HIO_3$ . Sl. sol. in cold  $H_2O$   
 and decomp thereby into  $2CsIO_3, I_2O_5$   
 (Wheeler.)

**Cassium iodate chloride,  $CsCl, HIO_3$** .  
 Decomp. by  $H_2O$  into  $2CsIO_3, I_2O_5$ .  
 (Wheeler)

**Cassium hydrogen iodate periodate**,  
 $HCsIO_5, IO_4 + 2H_2O$ .  
 Ppt. Sol. in dil.  $HNO_3$ . (Wells, Am. Ch.  
 J. 1901, 26. 280.)

**Calcium iodate,  $Ca(IO_3)_2$** .  
 100 pts dissolve 0.22 pt. at  $18^\circ$  and  
 0.986 pt. at  $100^\circ$ . (Gay-Lussac.) Sol. in  
 conc.  $HCl + Aq$ . (Filhol.) Much more sol.  
 in  $HNO_3 + Aq$  than in  $H_2O$ . (Rammelsberg)  
 Insol. in  $H_2SO_4$ . (Ditte.) Scarcely sol. in  
 sat.  $KIO_3 + Aq$ . (Sonstadt, C. N. 29. 209.)

$+H_2O$ . Sat. solution contains at:  

$21^\circ$	$35^\circ$	$40^\circ$	$45^\circ$
0.37	0.48	0.52	0.54% $Ca(IO_3)_2$
$50^\circ$	$60^\circ$	$80^\circ$	$100^\circ$
0.59	0.65	0.79	0.94% $Ca(IO_3)_2$

 (Mylius and Funk, B. 1897, 30. 1724.)

$+6H_2O$ . Efflorescent.  
 Sol. in 253 pts  $H_2O$  at  $15^\circ$ , and 75 pts. at  
 $100^\circ$ . (Rammelsberg.)

Sat. solution contains at:  

$0^\circ$	$10^\circ$	$18^\circ$	$30^\circ$
0.1	0.17	0.25	0.42% $Ca(IO_3)_2$
$40^\circ$	$50^\circ$	$54^\circ$	$60^\circ$
0.61	0.89	0.14	1.36% $Ca(IO_3)_2$

 (Mylius and Funk, B. 1897, 30. 1724.)

Much more sol. in  $HNO_3 + Aq$ . Pptd. by  
 alcohol from  $Ca(IO_3)_2 + Aq$ .  
 Insol. in  $H_2SO_4$ . (Ditte.)  
 Pptd. by alcohol from aqueous solution.  
 (Henry.)

**Cerous iodate,  $Ce(IO_3)_2 + 2H_2O$** .  
 Sl. sol. in cold, easily sol. in hot  $H_2O$  and in  
 acids. (Holzmann, J. pr. 75. 321.)  
 Solubility in  $H_2O$  100 cc. of the sat.  
 solution contain 0.1456 g. at  $25^\circ$  (Rimbach,  
 Z. phys. Ch. 1909, 67. 199.)  
 Calc. from electrical conductivity of  
 $Ce(IO_3)_2 + Aq$ , 100 cc of the sat. solution  
 contain 0.1636 g.  $Ce(IO_3)_2$  at  $25^\circ$ . (Rim-  
 bach, Z. phys. Ch. 1909, 67. 199.)

**Ceric iodate,  $Ce(IO_3)_4$** .  
 Slightly hydrolyzed by  $H_2O$ .  
 0.34 g is sol. in 100 cc hot conc.  $HNO_3$ .  
 (Barbier, Chem. Soc 1907, 92. (2) 487.)

**Cobaltous iodate,  $Co(IO_3)_2$** .  
*Anhydrous*. Sol. in warm dil  $H_3PO_4$ , or  
 $H_2SO_4 + Aq$ . (Ditte, A. ch. (8) 21. 14.)

Solubility in  $H_2O$

Form	Temp.	$\frac{g}{100}$ $Co(IO_3)_2$	Mols of water free salt to 100 mols $H_2O$
$Co(IO_3)_2 + 4H_2O$	$0^\circ$	0.54	0.028
	$18^\circ$	0.83	0.038
	$30^\circ$	1.03	0.046
	$50^\circ$	1.46	0.065
	$60^\circ$	1.88	0.084
$Co(IO_3)_2 + 2H_2O$	$65^\circ$	2.17	0.098
	$0^\circ$	0.32	0.014
	$18^\circ$	0.45	0.020
	$30^\circ$	0.52	0.023
	$50^\circ$	0.67	0.030
$Co(IO_3)_2$	$75^\circ$	0.84	0.038
	$100^\circ$	1.02	0.045
	$18^\circ$	1.03	0.046
	$30^\circ$	0.89	0.040
	$50^\circ$	0.85	0.036
	$75^\circ$	0.75	0.033
	$100^\circ$	0.69	0.031

(Meusser, B. 1901, 34. 2435.)

$+H_2O$ . Sol. in 148 pts.  $H_2O$  at  $15^\circ$  and  
 90 pts. at  $100^\circ$ . Sol. in  $NH_4OH + Aq$ . (Ram-  
 melsberg, Pogg. 44. 561.)  
 Does not exist. (Meusser, B. 1901, 34.  
 2434.)  
 $+2H_2O$ . (Meusser.)  
 $+4H_2O$ . (Meusser.)

**Cupric iodate, basic,  $6\text{CuO}, 3\text{I}_2\text{O}_5 + 2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Millon, A. ch. (3) 9. 400.)

Mixture of  $\text{CuO}$  and  $\text{Cu}(\text{IO}_3)_2$ . (Ditte, A. ch. (6) 21. 175.)

$2\text{CuO}, \text{I}_2\text{O}_5 + 1\frac{1}{2}\text{H}_2\text{O}$ . Slowly sol. in dil.  $\text{H}_2\text{SO}_4$ . (Granger and de Schulten, Bull. Soc. 1904, (3) 31. 1027.)

**Cupric iodate,  $\text{Cu}(\text{IO}_3)_2$ .**

1 l.  $\text{H}_2\text{O}$  dissolves  $3.32 \times 10^{-3}$  mol.  $\text{Cu}(\text{IO}_3)_2$  at  $25^\circ$ . (Spencer, Z. phys. Ch. 1913, 83. 295.)

Solubility in  $\text{CuSO}_4 + \text{Aq} = 3.28 \times 10^{-4}$  mol per l. at  $25^\circ$

Solubility in  $\text{KIO}_3 + \text{Aq} = 3.29 \times 10^{-3}$  mol per l. at  $25^\circ$ . (Spencer)

+  $\text{H}_2\text{O}$  (Ditte.)

+  $2\text{H}_2\text{O}$  Sol in 302 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 154 pts. at  $100^\circ$ . Sol. in  $\text{HCl} + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Millon)

**Cupric iodate ammonia,  $\text{Cu}(\text{IO}_3)_2, 2\text{NH}_3 + \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 21. 145.)  $\text{Cu}(\text{IO}_3)_2, 4\text{NH}_3 + 2\text{H}_2\text{O}$ . Ppt. (Ephraim, B. 1915, 48. 52.)

+  $3\text{H}_2\text{O}$ . Partially sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in alcohol. (Rammelsberg.)

$\text{Cu}(\text{IO}_3)_2, 5\text{NH}_3$ . (Ephraim.)

$\text{Cu}(\text{IO}_3)_2, 8\text{NH}_3 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in alcohol. (Ditte, A. ch. (6) 21. 145.)

**Decipium iodate,  $\text{Dp}(\text{IO}_3)_3 + 3\text{H}_2\text{O} (?)$ .**

Precipitate; scarcely sol. in  $\text{H}_2\text{O}$ . (Dela-fontaine.)

**Didymium iodate,  $\text{Di}(\text{IO}_3)_3 + 2\text{H}_2\text{O}$**

Ppt (Cleve)

**Erbium iodate,  $\text{Er}(\text{IO}_3)_3 + 3\text{H}_2\text{O}$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . (Hoglund.)

**Glucinum iodate.**

Deliquescent.

**Indium iodate,  $\text{In}(\text{IO}_3)_3$ .**

1 pt. is sol. in 1500 pts.  $\text{H}_2\text{O}$  at  $20^\circ$

1 pt. is sol. in 150 pts.  $\text{HNO}_3$  (1.5) at  $80^\circ$ .

Sol. in  $\text{HCl}$  with decomp. Sol. in dil.  $\text{H}_2\text{SO}_4$ . (Mathers, J. Am. Chem. Soc. 1908, 30. 213.)

**Iodine iodate,  $\text{I}(\text{IO}_3)_2$ .**

Decomp. by  $\text{H}_2\text{O}$  or by alcohol. (Fichter, Z. anorg. 1915, 91. 142.)

**Iron (ferrous) iodate.**

Ppt. Sl. sol. in  $\text{H}_2\text{O}$ ; more sol. in  $\text{FeSO}_4 + \text{Aq}$ . (Geiger, Mag Pharm. 29. 252.)

**Iron (ferric) iodate,  $\text{Fe}_2\text{O}_3, \text{I}_2\text{O}_5$ .**

Insol in acids. (Ditte, A. ch. (6) 21. 145.)

$\text{Fe}_2\text{O}_3, 2\text{I}_2\text{O}_5 + 8\text{H}_2\text{O}$  Sol in 500 pts  $\text{H}_2\text{O}$ . Difficulty sol. in  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{FeCl}_3 + \text{Aq}$ . (Geiger)

$3\text{Fe}_2\text{O}_3, 5\text{I}_2\text{O}_5 + 15\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg.)

**Lanthanum iodate,  $\text{La}(\text{IO}_3)_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . Very sol. in warm  $\text{HCl} + \text{Aq}$ . (Holzmann, J. pr. 75. 349.)

100 cc of the sat. solution in  $\text{H}_2\text{O}$  contain 0.1681 g at  $25^\circ$  (Rimbach, Z. phys. Ch. 1909, 87. 199.)

Calc from electrical conductivity of  $\text{La}(\text{IO}_3)_3 + \text{Aq}$ , 100 cc of the sat. solution contain 0.1871 g.  $\text{La}(\text{IO}_3)_3$  at  $25^\circ$ . (Rimbach)

**Lead iodate, basic,  $3\text{PbO}, \text{Pb}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$ .**

Ppt. (Stromholm, Z. anorg. 1904, 38. 442.)

**Lead iodate,  $\text{Pb}(\text{IO}_3)_2$ .**

Very sl. sol. in  $\text{H}_2\text{O}$  (Pleschl), and difficultly sol. in  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg.)

Insol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Very sl. sol. in  $\text{HNO}_3 + \text{Aq}$ , and wholly insol therein after being heated to  $100^\circ$ . (Ditte, A. ch. (6) 21. 169.)

Sl. sol. in  $\text{H}_2\text{O}$   $1.83 \times 10^{-2}$  are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

1 l.  $\text{H}_2\text{O}$  dissolves 19 mg.  $\text{Pb}(\text{IO}_3)_2$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

17.8 mg. are dissolved in 1 l. sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1903, 64. 168.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0307 g.  $\text{Pb}(\text{IO}_3)_2$  at  $25^\circ$ . (Harkins, J. Am. Chem. Soc. 1911, 33. 1830.)

Solubility of  $\text{Pb}(\text{IO}_3)_2$  in salts +  $\text{Aq}$  at  $25^\circ$ .

C = concentration of salt in salt solution expressed in equivalents per l.

S = solubility of  $\text{Pb}(\text{IO}_3)_2$  in salt solution expressed in equivalents per l.

Salt	C	S
$\text{Pb}(\text{NO}_3)_2$	0.0001	0.0000870
	0.001	0.0000411
	0.010	0.0000185
	0.100	0.000016
	0.500	0.000028
	3.0	0.000015
$\text{KNO}_3$	0.002	0.0001141
	0.010	0.0001334
	0.050	0.0002037
	0.200	0.0002544
$\text{KIO}_3$	0.00005304	0.0000697
	0.0001061	0.0000437

(Harkins and Winnighof, J. Am. Chem. Soc. 1911, 33. 1830.)

Insol in liquid  $\text{NH}_3$  (Gore, Am. Ch. J. 1898, 20. 828.)

**Lithium iodate,  $\text{LiIO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .**

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ .

Sol. in 2 pts. cold, and not much less hot  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rammelsberg, Pogg. 44. 555.)

Sp. gr. of solution sat at  $18^\circ = 1.568$ , containing 44.6%  $\text{LiIO}_3$ . 100 g.  $\text{H}_2\text{O}$  dissolve 80.3 pts.  $\text{LiIO}_3$ . (Mylius and Funk, B. 1897, 30. 1718.)

Insol in methyl acetate. (Naumann, B. 1900, 42. 3790.)

+ $\text{H}_2\text{O}$ . Very deliquescent. (Ditte, A. ch. (6) 21. 145.)

**Magnesium iodate,  $\text{Mg}(\text{IO}_3)_2$ .**

*Anhydrous.* Insol. in  $\text{H}_2\text{O}$ . (Millon, A. ch. (3) 9. 422.)

+ $4\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Ditte.)

Sol. in 0.43 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 3.04 pts. at  $100^\circ$ . (Berzelius.) Very sl. sol. in  $\text{H}_2\text{O}$ . (Serullus, A. ch. 45. 279.) Easily sol. in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Ditte.)

Sat. solution contains at.

$0^\circ$	$10^\circ$	$20^\circ$
6.8	6.4	7.7% $\text{Mg}(\text{IO}_3)_2$ ,
$35^\circ$	$63^\circ$	$100^\circ$
8.9	12.6	19.3% $\text{Mg}(\text{IO}_3)_2$

(Mylius and Funk, B. 1897, 30. 1722.)

Sat. aq. solution at  $18^\circ$  contains 6.44%  $\text{Mg}(\text{IO}_3)_2$  or 6.88 g. are sol. in 100 g.  $\text{H}_2\text{O}$ . Sp. gr. of sat. solution = 1.078. (Mylius and Funk, B. 1897, 30. 1718.)

+ $10\text{H}_2\text{O}$ . Sat. aq. solution contains at:

$0^\circ$	$20^\circ$	$30^\circ$	$35^\circ$	$50^\circ$ (m pt.).
3.1	10.2	17.4	21.9	67.5% $\text{Mg}(\text{IO}_3)_2$ .

(Mylius and Funk, B. 1897, 30. 1723.)

**Manganous iodate,  $\text{Mn}(\text{IO}_3)_2 + \text{H}_2\text{O}$ .**

Sol. in about 200 pts.  $\text{H}_2\text{O}$ . (Rammelsberg.)

Insol. in  $\text{H}_2\text{O}$  and  $\text{HNO}_3 + \text{Aq}$ , even on boiling. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Ditte)

**Manganous manganic iodate,**

$\text{Mn}(\text{IO}_3)_4, \text{Mn}(\text{IO}_3)_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Berg, C. R. 1899, 128. 675.)

**Manganic potassium iodate,**

$\text{Mn}(\text{IO}_3)_4, 2\text{KIO}_3$ .

Insol. in and only sl. attacked by  $\text{H}_2\text{O}$ .

Insol. in  $\text{HIO}_3$ . (Berg, C. R. 1899, 128. 674.)

**Mercurous iodate,  $\text{Hg}_2(\text{IO}_3)_2$ .**

Insol. in boiling  $\text{H}_2\text{O}$ , or cold  $\text{HNO}_3 + \text{Aq}$ . Easily sol. in dil.  $\text{HCl} + \text{Aq}$ . Sol. in very

conc  $\text{HIO}_3 + \text{Aq}$ . (Lefort, J. Pharm. 1846. 5.)

**Mercuric iodate,  $\text{Hg}(\text{IO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$  or alcohol (Millon, A. ch. (3) 18. 367.) Sol. in  $\text{H}_2\text{O}$  (Berzelius.) Sol. in dil.  $\text{HCl} + \text{Aq}$  (Rammelsberg.)

Nearly insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$ ,  $\text{HBr}$ , or  $\text{HI} + \text{Aq}$ ; very sl. sol. in  $\text{HNO}_3 + \text{Aq}$ ; insol. in  $\text{HF}$ ,  $\text{H}_2\text{SiF}_6$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Sol. in alkali chlorides, bromides, iodides, cyanides, and cyanates +  $\text{Aq}$ ; also in  $\text{Na}_2\text{S}_2\text{O}_3$ , dil.  $\text{MnCl}_2$ , and  $\text{ZnCl}_2 + \text{Aq}$ . Insol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ ,  $\text{Na}_2\text{S}$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ ,  $\text{Na}_2\text{HPO}_4$ , and the alkali chlorates, bromates, and iodates +  $\text{Aq}$ . (Cameron, C. N. 33. 253.)

**Nickel iodate,  $\text{Ni}(\text{IO}_3)_2$ .**

Solubility in  $\text{H}_2\text{O}$ .

Form	Temp	Percent of $\text{Ni}(\text{IO}_3)_2$ in solution	Mols. water free salt to 100 mols. $\text{H}_2\text{O}$
$\text{Ni}(\text{IO}_3)_2 + 4\text{H}_2\text{O}$	$0^\circ$	0.73	0.033
	$18^\circ$	1.01	0.045
	$30^\circ$	1.41	0.063
$\alpha\text{Ni}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$	$0^\circ$	0.53	0.023
	$18^\circ$	0.68	0.030
	$30^\circ$	0.86	0.039
$\beta\text{Ni}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$	$50^\circ$	1.78	0.080
	$8^\circ$	0.52	0.023
	$18^\circ$	0.55	0.0245
"	$50^\circ$	0.81	0.035
	$75^\circ$	1.03	0.045
	$100^\circ$	1.12	0.049
$\text{Ni}(\text{IO}_3)_2$	$30^\circ$	1.135	0.050
	$50^\circ$	1.07	0.046
	$75^\circ$	1.02	0.045
"	$100^\circ$	0.983	0.044

(Meusser, B. 1901, 34. 2440.)

+ $\text{H}_2\text{O}$  Sol. in 120.3 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 77.35 pts. at  $100^\circ$  (Rammelsberg, Pogg. 44. 562.)

Sol. in  $\text{HNO}_3$ , and dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Ditte.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Does not exist (Meusser.)

+ $2\text{H}_2\text{O}$ . See Meusser above.

+ $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ .

(Ditte, A. ch. 1890, (6) 21. 160.)

+ $4\text{H}_2\text{O}$ . See Meusser above.

**Nickel iodate ammonia,  $\text{Ni}(\text{IO}_3)_2, 4\text{NH}_3$ .**

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol. in alcohol. (Rammelsberg, Pogg. 44. 562.)

$\text{Ni}(\text{IO}_3)_2, 5\text{NH}_3$ . Ppt. (Ephraim, B. 1915, 48. 53.)

+ $3\text{H}_2\text{O}$ . (Ephraim.)

**Potassium iodate,  $\text{KIO}_3$ .**

1 pt.  $\text{KIO}_3$  dissolves in 13 pts.  $\text{H}_2\text{O}$  at  $14^\circ$ . (Gay-Lussac.)

# IODATE, POTASSIUM HYDROGEN

1 pt.  $\text{KIO}_3$  dissolves at:

0° in 21	11 pts. $\text{H}_2\text{O}$
20° "	12 " "
40° "	7 " "
60° "	5.40 "
80° "	4.02 "
100° "	3.10 "

Sat. solution boils at 102°. (Kremers, Pogg. 97. 5.)

Sp. gr. of  $\text{KIO}_3 + \text{Aq}$  containing:

1	2	3	4	5	% $\text{KIO}_3$
1.010	1.019	1.027	1.035	1.044	
6	7	8	9	10	% $\text{KIO}_3$
1.052	1.061	1.071	1.080	1.090	

(Kremers, Pogg. 96. 62.)

Stable at 10° in  $\text{H}_2\text{O}$  or potassium acetate + Aq. (Eakle, C. C. 1896, 11. 649.)

Solubility of  $\text{KIO}_3$  in  $\text{HIO}_3 + \text{Aq}$  at 30°.

% $\text{HIO}_3$ in the solution	% $\text{KIO}_3$ in the solution	Solid phase
0	9.51	$\text{KIO}_3$
0.64	9.48	$\text{KIO}_3 + \text{KIO}_3, \text{HIO}_3$
0.66	9.52	"
0.65	9.46	"
0.65	8.90	$\text{KIO}_3, \text{HIO}_3$
0.07	6.6	"
1.14	4.57	"
1.69	3.63	"
2.02	3.10	"
3.34	2.14	"
5.00	1.32	"
7.00	1.0	"
8.04	0.85	$\text{KIO}_3, \text{HIO}_3 + \text{KIO}_3, 2\text{HIO}_3$
3.47	3.57	$\text{KIO}_3, 2\text{HIO}_3$ (labile)
4.80	2.80	"
6.45	1.35	"
9.35	0.04	$\text{KIO}_3, 2\text{HIO}_3$
12.04	0.44	"
17.50	0.30	"
31.20	0.52	"
53.64	0.68	"
62.52	0.72	"
76.40	0.80	$\text{KIO}_3, 2\text{HIO}_3 + \text{HIO}_3$
76.70	0	$\text{HIO}_3$

(Meerburg, Z. anorg. 1905, 45. 330.)

More sol. in  $\text{KI} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . Sol. in warm  $\text{H}_2\text{SO}_4 + \text{Aq}$ .  
 Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)  
 Insol. in alcohol.  
 Insol. in methyl acetate (Naumann, B. 1900, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)  
 +  $\frac{1}{2}\text{H}_2\text{O}$ . (Ditte, C. R. 70. 621.)

Potassium hydrogen iodate,  $\text{KH}(\text{IO}_3)_2$ .

Sol. in 18.65 pts.  $\text{H}_2\text{O}$  at 17°. (Meineke, A. 261. 360.)

Sol. in 75 pts.  $\text{H}_2\text{O}$  at 15°. Insol. in alcohol. (Serullas, A. ch. 22. 181.)  
 See also Meerburg under  $\text{KIO}_3$ .

Potassium dihydrogen iodate,  $\text{KH}_2(\text{IO}_3)_3$ .

Sol. in 25 pts.  $\text{H}_2\text{O}$  at 15°. (Serullas, A. ch. 43. 117.)  
 See also Meerburg under  $\text{KIO}_3$ .

Potassium tellurium iodate.

See Iodotellurate, potassium.

Potassium uranyl iodate,

$\text{KUO}_2(\text{IO}_3)_3 + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ , dil. salt solutions and  $\text{UO}_2(\text{NO}_3)_2 + \text{Aq}$ . (Artmann, Z. anorg. 1913, 79. 340.)

Potassium iodate chloride,  $\text{KH}(\text{IO}_3)_2, 2\text{KCl}$ .

Sol. in 19 pts.  $\text{H}_2\text{O}$  at 15° with decomp. Cold alcohol dissolves out  $\text{KCl}$ .

Potassium iodate molybdate,  $\text{KIO}_3, \text{MoO}_3 + 2\text{H}_2\text{O}$

See Molybdatiodate, potassium.

Potassium iodate selenate.

See Iodoselenate, potassium.

Potassium iodate sulphate,  $\text{KIO}_3, \text{KHSO}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Marnagac, J. B. 1856. 209.)  
 $\text{K}'\text{HIO}_3, \text{KHSO}_4$ . More sol. in  $\text{H}_2\text{O}$  than  $\text{KHIO}_3$ . (Serullas.)

Potassium iodate tungstate.

See Tungstoidate, potassium.

Rubidium iodate,  $\text{RbIO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 2.1 pts.  $\text{RbIO}_3$  at 23°. Easily sol. in cold  $\text{HCl} + \text{Aq}$  (Wheeler Sill. Am. J. 144. 123.)

Rubidium hydrogen iodate,  $\text{RbH}(\text{IO}_3)_2$ .

Sl. sol. in cold, more readily in hot  $\text{H}_2\text{O}$ ,  $\text{RbIO}_3$  separating on cooling. Insol. in alcohol. (Wheeler.)

$\text{RbH}_2(\text{IO}_3)_3$ . As above. (Wheeler.)

Rubidium iodate chloride,  $\text{RbIO}_3, \text{HCl}$ , or  $\text{HIO}_3, \text{RbCl}$ .

Decomp. by cold  $\text{H}_2\text{O}$ . (Wheeler.)  
 $3\text{RbCl}, 2\text{HIO}_3$ . Sol. in  $\text{H}_2\text{O}$ , from which  $\text{RbIO}_3$  separates. (Wheeler.)

Rubidium iodate selenate.

See Iodoselenate, rubidium.

Samarium iodate,  $\text{Sm}(\text{IO}_3)_3 + 6\text{H}_2\text{O}$ .

Precipitate. (Cleve.)

Scandium iodate,  $\text{Sc}(\text{IO}_3)_3 + 10, 13, 15$ , and  $18\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Crookes, Phil. Trans. 1910, 210, A, 361.)

Silver iodate,  $\text{AgIO}_3$ .

$1.89 \times 10^{-4}$  moles or  $5.38 \times 10^{-2}$  g.  $\text{AgIO}_3$  are sol in 1 liter  $\text{H}_2\text{O}$  at  $25^\circ$ . (Noyes and Kohl, Z. phys. Ch. 1903, 42, 338.)

Sl. sol in  $\text{H}_2\text{O}$ .  $4.35 \times 10^{-2}$  g. are dissolved in 1 liter of sat. solution at  $20^\circ$  (Böttger, Z. phys. Ch. 1903, 46, 603.)

1 l.  $\text{H}_2\text{O}$  dissolves 40 mg.  $\text{AgIO}_3$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50, 356.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0275 g.  $\text{AgIO}_3$  at  $9.43^\circ$ ; 0.039 g. at  $18.4^\circ$ ; 0.0539 g. at  $26.6^\circ$ . Solubility increases rapidly with temp. (Kohlrausch, Z. phys. Ch. 1908, 64, 168.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.039 g.  $\text{AgIO}_3$  at  $20^\circ$ . (Whitby, Z. anorg. 1910, 67, 108.)

Not completely insol. in  $\text{H}_2\text{O}$ . (Rose.) Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ . (Naquet, J. B. 1860, 201.) Sol. in conc.  $\text{KI} + \text{Aq}$ . (Ladenburg, A. 136, 1.)

Sol. in 27,700 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ ; in 42.4 pts.  $5\%$   $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ ; in 2.1 pts.  $10\%$   $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ ; in 104.3 pts.  $35\%$   $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.21) at  $25^\circ$ . (Long, Gazz. ch. it. 13, 87.)

Solubility in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$ .

Normality $\text{HNO}_3$	G. $\text{AgIO}_3$ dissolved per l
0.000	0.0503
0.125	0.0864
0.250	0.1075
0.500	0.1414
1.00	0.2067
2.00	0.3319
4.00	0.6985
8.00	1.5875

(Hill and Summons, Z. phys. Ch. 1909, 67, 602.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 829.)

Insol. in methyl acetate. (Bezold, Dissert. 1906; Naumann, B. 1909, 42, 3790); ethyl acetate. (Hamers, Dissert. 1906; Naumann, B. 1910, 43, 314.)

Silver iodate ammonia,  $2\text{AgIO}_3, 3\text{NH}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Very sol. in cold  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 21, 145.)

$\text{AgIO}_3, 2\text{NH}_3$ .  
Sl. sol. in conc  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rosenheim, A. 1899, 308, 52.)

Sodium iodate,  $\text{NaIO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 7.25 pts.  $\text{NaIO}_3$  at  $14.5^\circ$ . (Gay-Lussac.) 100 pts.  $\text{H}_2\text{O}$  dissolve 2.52 pts. at  $0^\circ$ ; 9.07 pts. at  $20^\circ$ ; 14.39 pts. at  $60^\circ$ ; 27.7 pts. at  $80^\circ$ ; 33.9 pts. at  $100^\circ$ . (Krem-

ers, Pogg. 97, 5.) Sat. solution boils at  $102^\circ$  (Kremers),  $105^\circ$  (Ditte).

Sol. in warm  $\text{H}_2\text{SO}_4 + \text{Aq}$  diluted with  $\frac{1}{2}$  vol.  $\text{H}_2\text{O}$ . Crystallizes out on standing over  $\text{H}_2\text{SO}_4$ . (Ditte.)

Solubility of  $\text{NaIO}_3$  in  $\text{HIO}_3 + \text{Aq}$  at  $30^\circ$ .

% $\text{HIO}_3$ in the solution	% $\text{NaIO}_3$ in the solution	Sol. phase
0	9.36	$\text{NaIO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$
1.98	9.52	"
4.89	10.22	"
5.89	11.04	"
7.40	11.60	"
9.73	14.73	" } labile
6.76	11.18	$\text{NaIO}_3 + 1\frac{1}{2}\text{H}_2\text{O} + \text{Na}_2\text{O}, 2\text{I}_2\text{O}_5$
6.66	11.28	"
7.80	10.30	$\text{Na}_2\text{O}, 2\text{I}_2\text{O}_5$
9.15	9.00	"
9.93	8.71	"
11.20	7.54	"
11.89	7.21	$\text{Na}_2\text{O}, 2\text{I}_2\text{O}_5 + \text{NaIO}_3, 2\text{HIO}_3$
11.75	7.18	"
14.62	5.65	$\text{NaIO}_3, 2\text{HIO}_3$
23.23	3.69	"
32.68	2.91	"
40.91	2.64	"
46.62	2.67	"
55.48	2.12	"
65.47	1.83	"
76.19	1.42	$\text{NaIO}_3, 2\text{HIO}_3 + \text{HIO}_3$
76.70	0	$\text{HIO}_3$

(Meerburg, Z. anorg. 1905, 45, 334.)

Insol. in alcohol. Sol. in dil.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ .

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)  
 $+ 1\frac{1}{2}\text{H}_2\text{O}$ . See Meerburg above.

Sodium diiodate,  $\text{Na}_2\text{O}, 2\text{I}_2\text{O}_5$ .

See Meerburg under  $\text{NaIO}_3$ .

Sodium triiodate,  $\text{NaIO}_3, 2\text{HIO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Blomstrand, J. pr. (2) 42, 337.)

See also Meerburg under  $\text{NaIO}_3$ .

Sodium iodate bromide,  $\text{NaIO}_3, 2\text{NaBr} + 9\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

Sodium iodate chloride,  $\text{NaIO}_3, \text{NaCl} + 4\text{H}_2\text{O}$ , and  $2\text{NaIO}_3, 3\text{NaCl} + 18\text{H}_2\text{O}$ .

Cold  $\text{H}_2\text{O}$  dissolves out  $\text{NaCl}$ .

Sodium iodate iodide,  $\text{NaIO}_3, \text{NaI}$ .

Hot  $\text{H}_2\text{O}$  or alcohol dissolves out  $\text{NaI} + 8\text{H}_2\text{O}$ .

$+ 10\text{H}_2\text{O}$ .  
 $2\text{NaIO}_3, 3\text{NaI} + 20\text{H}_2\text{O}$ . (Peanny, A. 37, 202.)

Stable in a solution of  $\text{NaI} + \text{NaOH} + \text{Aq.}$  (Eakle, C. C. 1896, II. 650.)

### Strontium iodate, $\text{Sr}(\text{IO}_3)_2$ .

*Anhydrous.* Insol. in  $\text{H}_2\text{SO}_4$  (Ditte), easily sol. in cold  $\text{HCl} + \text{Aq.}$  (Rammelsberg, Pogg. 44. 575.)

+  $\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$   
+  $6\text{H}_2\text{O}$ . Sol. in 416 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 138 pts. at  $100^\circ$  (Gay-Lussac); 342 pts. at  $15^\circ$ , and 110 pts. at  $100^\circ$ . Difficultly sol. in warm  $\text{HNO}_3 + \text{Aq.}$  (Rammelsberg, Pogg. 44. 575.)

### Thalious iodate, $\text{ThIO}_3$ .

Difficultly sol. in warm  $\text{H}_2\text{O}$  (Oettinger.) Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in  $\text{HNO}_3 + \text{Aq.}$  (Rammelsberg.)

Sl. sol. in  $\text{H}_2\text{O}$ .

$0.58 \times 10^{-1}$  g. are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

$2.12 \times 10^{-2}$  mols = 0.667 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Spencer, Z. phys. Ch. 1912, 80. 707.)

Sol. in a little  $\text{NH}_4\text{OH} + \text{Aq.}$  also in boiling  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq.}$  Insol. in alcohol. (Oettinger.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$  or dil. boiling acids. (Ditte, A. ch. (6) 21. 145.)

### Thallic iodate, basic, $\text{Ti}(\text{OH})(\text{IO}_3)_2 + \text{H}_2\text{O} = \text{Ti}_2\text{O}_3 \cdot 2\text{I}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in cold  $\text{HCl} + \text{Aq.}$  and warm dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Ditte, A. ch. (6) 21. 145.)

### Thallic iodate, $\text{Ti}(\text{IO}_3)_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{HNO}_3 + \text{Aq.}$  Decomp. by alkalis. (Rammelsberg.)

+  $12\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$

Easily sol. in dil. acids (Gewecke, Z. anorg. 1912, 75, 275.)

### Thorium iodate, $\text{Th}(\text{IO}_3)_4$ .

Precipitate. (Cleve.)

### Tin (stannous) iodate.

Ppt. Sol. in  $\text{SnCl}_2 + \text{Aq.}$ ; insol. in  $\text{NaIO}_3 + \text{Aq.}$

### Tin (stannic) iodate.

Ppt.

### Uranous iodate.

Precipitate. Very unstable. (Rammelsberg.)

### Uranyl iodate, $\text{UO}_2(\text{IO}_3)_2$ .

Sol. or insol. in  $\text{HNO}_3$  and  $\text{H}_3\text{PO}_4 + \text{Aq.}$  according to method of preparation. (Ditte.) +  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq.}$  (Rammelsberg.)

### Ytterbium iodate, $\text{Yb}(\text{IO}_3)_3 + 6\text{H}_2\text{O}$ .

Ppt. (Cleve, Z. anorg. 1902, 32. 136.)

### Yttrium iodate, $\text{Y}(\text{IO}_3)_3 + 3\text{H}_2\text{O}$ .

Sol. in 190 pts.  $\text{H}_2\text{O}$ . (Berlin.)

### Zinc iodate, $\text{Zn}(\text{IO}_3)_2$

*Anhydrous.* (Ditte, A. ch. (6) 21. 145.) +  $2\text{H}_2\text{O}$ . Sol. in 114 pts. cold, and 76 pts. hot  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 43. 665.)

Sol. in  $\text{HNO}_3$  and  $\text{NH}_4\text{OH} + \text{Aq.}$

Exists also in a very sol. modification (Mylius and Funk, B. 1897, 30. 1723.)

### Zinc iodate ammonia, $3\text{Zn}(\text{IO}_3)_2 \cdot 8\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  from which it is pptd. by alcohol (Rammelsberg, Pogg. 44. 563.)

$\text{Zn}(\text{IO}_3)_2 \cdot 2\text{NH}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 21. 145.)

$\text{Zn}(\text{IO}_3)_2 \cdot 3\text{NH}_3 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Ditte.)

$\text{Zn}(\text{IO}_3)_2 \cdot 4\text{NH}_3$ . (Ditte, A. ch. 1890, (6) 21. 164.) (Ephraim, B. 1915, 48. 53.)

### Periodic acid.

See Periodic acid.

### Iodides.

The iodides are in general easily sol. in  $\text{H}_2\text{O}$ ; exceptions are  $\text{HgI}_2$ ,  $\text{PbI}_2$ ,  $\text{AgI}$ ,  $\text{Cu}_2\text{I}_2$ , and  $\text{BiI}_3$ , also the iodides of the Pt metals, all of which are insol.  $\text{SnI}_4$ ,  $\text{SbI}_3$ , and  $\text{TiI}_3$  are decomp. by  $\text{H}_2\text{O}$ . Many iodides are more sol. in solutions of salts than in  $\text{H}_2\text{O}$ , and several are sol. in alcohol or ether.

See under each element.

### Iodine, $\text{I}_2$ .

Sol. in 5524 pts.  $\text{H}_2\text{O}$  at  $0-12^\circ$  (Wittstein, J. B. 1857, 123.)

Sol. in 7000 pts.  $\text{H}_2\text{O}$  (Gay-Lussac.)

Sol. in 3800 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Basse.)

Sol. in 500 pts.  $\text{H}_2\text{O}$  (Jacquelin.)

Sol. in 71964 pts.  $\text{BrO}$  at  $18.75^\circ$  (Abl.)

Pure  $\text{H}_2\text{O}$  dissolves 0.01519173 g. I per litre, or I is sol. in 6582 pts.  $\text{H}_2\text{O}$  at  $6.3^\circ$ . (Dossius and Weith, Zest. Ch. 12. 378.)

Sol. in about 4500 pts.  $\text{H}_2\text{O}$ . (Hager, Comm. 1883.)

Sol. in 7000 pts.  $\text{H}_2\text{O}$ . (Cap and Garot, J. Pharm. (3) 26. 80.)

1 l.  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves 0.3387 g.  $\text{I}_2$ . (Jakowkin, Z. phys. Ch. 1895, 18. 590.)

1 l.  $\text{H}_2\text{O}$  dissolves 1.342 millimols of iodine at  $25^\circ$ . (Noyes, Z. phys. Ch. 1898, 27. 359.)

When iodine is shaken with  $\text{H}_2\text{O}$  at  $15^\circ$ , 1 pt. dissolves in 3750 pts.  $\text{H}_2\text{O}$ ; when iodine and  $\text{H}_2\text{O}$  are heated together and then cooled to  $15^\circ$ , 1 pt. iodine dissolves in 3500 pts.  $\text{H}_2\text{O}$ .

At  $30^\circ$  1 pt. is sol. in 2200 pts.  $\text{H}_2\text{O}$ . (Dietz, Chem. Soc. 1899, 76, (2) 150.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.279 grams  $\text{I}_2$  at  $25^\circ$ . (McLauchlan, Z. phys. Ch. 1903, 44. 617.)

Solubility of  $I_2$  in  $H_2O$  at  $t^\circ$ 

$t^\circ$	g $I_2$ per l $H_2O$
18	0.2765
25	0.3395
35	0.4661
45	0.6174
55	0.9222

(Hartley, *Chem. Soc.* 1906, 93, 744.)Solubility of  $I_2$  in  $II_2O$  at  $t^\circ$ .

$t^\circ$	g per l.	millimol per l
0	0.1649	1.30
20	0.2941	2.30
40	0.5684	4.56

(Fedotief, *Z. anorg.* 1910, 69, 30.)

1.32 millimol  $I_2$  are sol. in 1 l.  $H_2O$ . (Bray, *J. Am. Chem. Soc.*, 1910, 32, 933.)

Calculated from electrical conductivity of sat.  $I_2$  + Aq. 1 l.  $H_2O$  dissolves 0.0006383 mols.  $I_2$  at  $0^\circ$ . (Jones, *J. Am. Chem. Soc.* 1915, 37, 256.)

Conc.  $H_2SO_4$ ,  $HCl$ ,  $HNO_3$ ,  $H_3PO_4$ ,  $HC_2H_3O_2$ , tartaric, or citric acids + Aq dissolve I, but give it up to  $CS_2$  on shaking therewith. (Tessier, *Z. anal.* 11, 313.)

Sol. in 150 pts  $H_2SO_4$  on warming, but crystallizes out in part on cooling. (Kraus.)

Much more sol. in  $HBr$  + Aq than in pure  $H_2O$ ;  $HBr$  + Aq of sp. gr. 1.486 dissolves 3-4% (Bineau.)

Sl. sol. in  $HCl$  + Aq. Easily sol. in even dil  $HI$  + Aq.

1 l. 0.001 N- $HCl$  + Aq sat. with  $I_2$  contains 0.338 g.  $I_2$  (Bray and Mackay, *J. Am. Chem. Soc.* 1910, 32, 1619.)

1 l. 0.1 N- $HNO_3$  + Aq sat. with  $I_2$  contains 0.340 g.  $I_2$  (Sammet, *Z. phys. Ch.* 1905, 63, 644.)

1 l. 0.1 N- $H_2SO_4$  + Aq sat. with  $I_2$  contains 0.341 g.  $I_2$ . (Sammet.)

Sol. in  $H_2SO_4$  + Aq with decomp.

1 l. 0.9 N.  $H_2BO_3$  dissolves 0.300 g.  $I_2$  at  $25^\circ$ . (McLauchlan, *Z. phys. Ch.* 1903, 44, 617.)

100 cc. of a 10% solution of  $BaBr_2$  dissolve 0.231 g.  $I_2$  at  $13.5^\circ$ . (Meyer, *Z. anorg.* 1902, 30, 114.)

100 cc. of a 10% solution of  $BaCl_2$  dissolve 0.067 g.  $I_2$  at  $18.5^\circ$ . (Meyer.)

100 cc. of a 10% solution of  $BaI_2$  dissolve 0.541 g.  $I_2$  at  $13.5^\circ$ . (Meyer.)

100 cc. of a 10% solution of  $CaBr_2$  dissolve 0.274 g.  $I_2$  at  $13.5^\circ$ . (Meyer.)

100 cc. of a 10% solution of  $CaCl_2$  dissolve 0.078 g.  $I_2$  at  $18.5^\circ$ . (Meyer.)

100 cc. of a 10% solution of  $CaI_2$  dissolve 0.062 g.  $I_2$  at  $13.5^\circ$ . (Meyer.)

Easily sol. in boiling dil.  $HgCl_2$  + Aq. (Selmi.)

Solubility in  $HgCl_2$  + Aq at  $25^\circ$ .

10 cc. of the solution contain	
millimol $I_2$	millimol $Hg$
0.0134	0
0.1294	0.9444
0.1460	1.2442
0.1806	1.9542
0.2543	3.3460

(Heiz and Paul, *Z. anorg.* 1914, 85, 214.)

Sol. in solutions of soluble iodides.

100 pts.  $KI$  + 200 pts.  $H_2O$  dissolve 153 pts.  $I_2$ ; from this solution  $H_2O$  precipitates  $\frac{1}{2}$  the dissolved  $I$ . 100 pts.  $KI$  + 400 pts.  $H_2O$  dissolve quickly 76.5 pts  $I$ . If more water is present, the solution takes place more slowly. (Baup.)

$CS_2$  extracts the  $I$  from the above solutions

Solubility of  $I$  in  $KI$  + Aq at  $7-7.3^\circ$ 

% $KI$ in $KI$ + Aq	Pts $I$ dissolved	Sp gr of solution
1.802	1.173	1.0234
3.159	2.303	1.0433
4.628	3.643	1.0608
5.935	4.778	1.0881
7.201	6.037	1.1112
8.663	7.368	1.1382
10.036	8.877	1.1637
11.034	9.949	1.1893
11.893	11.182	1.2110
12.643	12.060	1.2293

(Dossius and Weith, *Zett. Ch.* (2) 5, 379.)Solubility of  $I_2$  in  $KI$  + Aq at room temperature,  $14.5^\circ$ - $15.1^\circ$ .

% $KI$	% $I$	$I/KI$
1.80	1.17	0.651
3.16	2.30	0.729
4.63	3.64	0.786
5.93	4.78	0.805
7.20	6.04	0.839
8.66	7.37	0.851
10.04	8.88	0.884
11.03	9.95	0.902
11.89	11.18	0.940
12.64	12.06	0.954

(Weith and Dossius, *Z. phys. Ch.* 1898, 26, 150.)

Solubility of  $I_2$  in KI+Aq at 15°

% KI	gram $I_2$ in 100 g. of the solution	I/KI
10	35.0	35.0
8	27.1	33.9
6	19.7	32.8
4	12.7	31.8
2	6.25	31.2
1	3.04*	30.4

\* Obtained with 1/100-normal iodine.  
(Bruner, Z. phys. Ch. 1898, 26, 151.)

Solubility of  $I_2$  in KI+Aq at 25°.

Millimoles KI per liter	Millimoles dissolved iodine per liter
106.3	55.28
53.15	28.03
26.57	14.68
13.29	8.003
6.645	4.607
3.322	3.052
1.661	2.235
0.8304	1.814

(Noyes and Searles, Z. phys. Ch. 1898, 27, 359)

## Solubility in KI+Aq at 25°.

KI mol/l	I G atoms/l
1.01	3.29
2.85	5.45
4.51	11.52
5.36	17.12
5.55	17.16

(Abegg, Z. anorg. 1906, 50, 427.)

Solubility of  $I_2$  in KI+Aq at 25°.

Millimol KI per l	Millimol $I_2$ dissolved
100	51.35
50	25.77
20	11.13
10	6.185
5	3.728
2	2.266
1	1.788

(Bray and MacKay, J. Am. Chem. Soc. 1910, 32, 919.)

## Solubility in KI+Aq at 25°.

Sp. gr	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I

## (a) In equilibrium with excess of KI.

1.733	60.39	0.0		0.0
1.888	54.415	11.63	84.92	4.05
2.006	49.045	23.085	85.94	6.32
2.216	44.82	31.01	80.46	10.84
2.539	38.065	44.56	78.56	15.23
2.560	37.655	45.55	77.32	16.73
2.665	35.805	49.61		
3.232	29.71	62.81	39.99	56.10
3.246	27.92	66.45	38.78	56.27

## (b) In equilibrium with excess of I.

1.349	16.025	18.49	3.04	85.43
1.516	19.705	26.16	4.48	83.87
1.769	22.88	36.06	3.70	89.33
1.910	23.55	40.515	6.49	83.62
2.403	24.78	53.005	8.02	83.81
2.904	24.995	63.125	4.82	92.41
3.082	25.18	66.04	4.00	94.39

## (c) Invariant point. Excess of KI and I.

3.316	26.05	68.06		
	25.96	68.01	16.14	83.77
	26.04	68.16		
	25.92	68.13	11.32	86.56

(Parsons and Whittemore, J. Am. Chem. 1911, 33, 1934.)

## Solubility in KI+Aq at 0°.

KI+Aq		KI+Aq sat with $I_2$	
Wt. norm.	Sp. gr. 0°/15°	G $I_2$ in 1 g. of solution	Sp. gr. 0°/4°
0.09871	(1.0123)	0.01199	(1.0219)
0.09861	1.01231	0.01199	1.02187
0.04969	(1.0061)	0.006094	(1.0109)
0.04966	1.00610	0.006083	1.01089
0.01992	1.00236	0.002535	1.00429
0.01983	(1.0024)	0.0025325	(1.0044)
0.00998	(1.0011)	0.0013532	(1.0020)
0.00992	(1.0011)	0.0013585	(1.0020)
0.004999	(1.0005)	0.0007609	(1.0010)
0.004991	(1.0005)	0.0007577	(1.0011)
0.002000	(1.0001)	0.0004137	(1.0004)
0.002000	(1.0001)	0.0004015	(1.0004)
0.000999	(0.9999)	0.0002839	(1.0002)
0.000992	(1.0000)	0.00028125	(1.0002)

Values in parentheses are found by interpolation.

(Jones and Hartman, J. Am. Chem. Soc. 1915, 37, 247.)

1 mol. KI in alcohol dissolves 2 atoms  $I_2$ , and the solution does not give up  $I$  to  $CS_2$ .  
(Jørgensen, J. pr. (2) 2, 347.)

## Solubility in KI+60% alcohol at 25°.

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I
(a) In equilibrium with excess KI.				
1.148	30.93	0.0	89.13	0.0
1.191	29.87	4.51	87.30	3.21
1.285	28.30	12.48	86.60	2.27
1.368	28.00	18.60	87.30	3.21
1.427	27.60	21.80	85.75	4.25
1.533	27.00	28.00	84.39	6.05
1.776	25.90	40.52	81.05	10.30
2.250	24.90	52.42	76.21	16.73
2.507	24.40	58.93	73.20	21.04
2.845	22.49	65.75	71.66	24.15
	21.50	68.95	70.04	26.42

## (b) In equilibrium with excess I.

1.134	0.0	23.04	0.0	I
1.530	7.36	43.05	1.40	88.70
1.721	10.60	49.38	2.50	88.21
1.90	12.44	55.33	3.72	87.10
2.11	13.74	59.20	4.41	86.60
2.22	15.20	62.66	5.80	85.20
2.80	17.72	69.10	7.15	85.49
2.99	19.30	71.90	7.45	88.90

## (c) Invariant point Excess KI and I.

3.162	20.11	72.51	21.84	74.64
	20.03	72.46		KI+I
	20.05	72.54		
	19.98	72.44	7.40	89.81 I
	20.08	72.51	20.61	74.09
				KI+I
	20.06	72.44		
	20.05	72.48	33.46	63.19 KI

(Parsons and Corliss, J. Am. Chem. Soc. 1910, 32. 1370.)

## Solubility in KI+40% alcohol at 25°.

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I
(a) In equilibrium with excess KI.				
1.330	42.10	0.0	0.0	0.0
1.377	40.83	3.76	89.21	0.70
1.455	38.94	10.09	88.80	1.90
1.532	37.41	15.71	88.19	3.02
1.605	36.25	20.52	87.04	4.21
1.655	35.38	24.44	86.08	5.11
1.847	33.26	33.62	83.61	8.41
2.024	31.71	39.99	82.06	10.76
2.109	30.59	44.76	80.80	12.35
2.558	28.56	55.30	75.90	18.03
2.784	26.95	60.27	74.77	20.86
...	24.52	65.93	72.98	23.61
...	23.04	69.93	72.45	25.04

Solubility in KI+10% alcohol at 25°.—  
Continued

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I
(b) In equilibrium with excess I.				
0.902	0.0	2.97	0.0	0.0
1.292	8.45	28.70	1.85	84.51
1.581	12.56	40.63	3.41	84.02
	15.20	49.95	4.98	83.81
2.000	16.02	52.05	5.00	82.96
2.173	17.18	57.38	6.61	83.60
1.749	19.20	60.89	8.45	85.16
2.902	20.12	69.10	7.08	88.81
(c) Invariant point. Excess KI and I.				
3.246	22.50	70.79	19.48	76.24
	22.43	70.88	69.37	26.14

(Parsons and Corliss, J. Am. Chem. Soc. 1910, 32. 1372.)

See also under KI.

Sol. in KI+nitrobenzene. (Dawson, Chem. Soc. 1902, 81. 529.)

Solubility in  $\text{KIO}_3 + \text{Aq}$  is the same as in  $\text{H}_2\text{O}$  (Lamm, C. A. 1909. 1622)Solubility of  $\text{I}_2$  in  $\text{KBr} + \text{Aq}$  at 25°.

G. KBr per l.	G. atoms $\text{I}_2$ per l.
60.6	0.0176
106.9	0.0278
175.9	0.0415
220.8	0.0532
281.9	0.0628
330.6	0.0717
377.1	0.0797
411.0	0.0864
461.7	0.0948
509.8	0.1006
548.0	0.1062
567.9 sat.	0.1094

(Bell and Buckley, J. Am. Chem. Soc. 1912, 34. 13)

Solubility in  $\text{NaBr} + \text{Aq}$  at 25°.

G. NaBr per l.	G. atoms $\text{I}_2$ per l.
90.4	0.0266
187.7	0.0425
271.8	0.0538
357.4	0.0598
422.4	0.0638
499.1	0.0648
569.9	0.0644
632.0	0.0622
679.7	0.0595
750.5	0.0551
756.1 sat.	0.0550

(Bell and Buckley, J. Am. Chem. Soc. 1912, 34. 13.)

100 cc. of a 10% solution of  $\text{SrBr}_2$  dissolve 0.270 g.  $\text{I}_2$  at 13.50. (Meyer, Z. anorg. 1903, 30, 114.)

100 cc. of a 10% solution of  $\text{SrCl}_2$  dissolve 0.066 g.  $\text{I}_2$  at 18.5°. (Meyer.)

100 cc. of a 10% solution of  $\text{SrI}_2$  dissolve 6.616 g.  $\text{I}_2$  at 13.5°. (Meyer.)

#### Solubility in salts + Aq at 25°

Salt + Aq	Grams $\text{I}_2$ sol in 1 liter	Salt + Aq	Grams $\text{I}_2$ sol in 1 liter
$\frac{1}{4}$ -N $\text{Na}_2\text{SO}_4$	0.160	N. $\text{NaCl}$	0.575
$\frac{1}{2}$ -N $\text{K}_2\text{SO}_4$	0.238	N. $\text{KCl}$	0.668
$\frac{1}{4}$ -N. $(\text{NH}_4)_2\text{SO}_4$	0.246	N. $\text{NH}_4\text{Cl}$	0.735
N. $\text{NaNO}_3$	0.257	N. $\text{NaBr}$	3.29
N. $\text{KNO}_3$	0.206	N. $\text{KBr}$	3.801
N. $\text{NH}_4\text{NO}_3$	0.375	N. $\text{NH}_4\text{Br}$	4.003

(McLauchlan, Z. phys. Ch. 1903, 44, 617.)

1.14 g. are sol in 100 ccm. liquid  $\text{H}_2\text{S}$ . (Antony, Gazz. ch. it 1905, 35, (1) 206.)

Sol. in liquid  $\text{NH}_3$ . (Franklin, Am. ch. J. 1898, 20, 832.)

Sl. sol. in liquid  $\text{CO}_2$ . (Buchner, Z. phys. Ch. 1906, 54, 674.)

Sol. in liquid  $\text{SO}_2$  (Sestini), and  $\text{SO}_2$  (Weber).

100 pts.  $\text{AsCl}_3$  dissolve 8.42 pts.  $\text{I}$  at 0°; 11.88 pts.  $\text{I}$  at 15°, 36.89 pts.  $\text{I}$  at 96°. (Sloan, C. N. 46, 194.)

Sol. in liquid  $\text{SO}_2$ ,  $\text{AsCl}_3$ ,  $\text{SO}_2\text{Cl}_2$ , and acetaldehyde. (Walden, Z. phys. Ch. 1903, 43, 407.)

Very sol. in liquid  $\text{NO}_2$ . (Frankland, Chem. Soc. 1901, 79, 1301.)

Sol. in 10-12 pts. alcohol. (Wittstein.)

Sol. in wood-spirit. (Playfair.)

Abundantly sol. in amyl (Pelletan), and hexyl alcohol (Bous).  
Iodine is sol in 20 pts. alcohol, 110 pts. oil, 7000 pts.  $\text{H}_2\text{O}$ , 100 pts. glycerine. (Cap and Garot, J. Pharm. (3) 26, 80.)

#### Solubility of $\text{I}_2$ in $\text{C}_2\text{H}_5\text{OH} + \text{Aq}$ at room temperature (14.5°—15.1°).

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O}$	Cen. of 1/10-normal iodine in 5 cc. of the solution
100	61.7
90	29.4
80	16.6
70	9.2
60	4.45
50	3.4
40	1.0
30	0.4
20	0.25
10	0.2
0	0.0

(Bruner, Z. phys. Ch. 1898, 28, 150.)

#### Solubility of $\text{I}_2$ in $\text{C}_2\text{H}_5\text{OH} + \text{Aq}$ at room temperature (14.5°—15.1°).

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O}$	Cen. of 1/10-normal iodine in 5 cc. of the solution
100	58.8
90	36.0
80	23.6
70	16.1
60	10.7
50	6.4
40	3.7
30	1.56
20	0.42
10	0.19
0	.

(Bruner, Z. phys. Ch. 1898, 28, 150.)

#### Solubility in ethyl alcohol + Aq at 25°.

Molecules of $\text{C}_2\text{H}_5\text{OH}$ in 100 molecules $\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O}$	Molecules of $\text{H}_2\text{O}$ in 100 molecules $\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O}$	Normality of the iodine solution
0 0	100	0.0022
0 03	99 7(?)	0.0024
0 06	99 4(?)	0.0024
1 12	98 88	0.0023
1 83	98 27(?)	0.0025
9 40	90 60	0.0059
13 48	86 52	0.0111
23 80	76 20	0.0617
50 80	49 20	0.4326
100	0	1.590

(McLauchlan, Z. phys. Ch. 1903, 44, 627.)

#### Solubility in acetic acid + Aq at 25°

Molecules of $\text{CH}_3\text{COOH}$ in 100 molecules $\text{CH}_3\text{COOH} + \text{H}_2\text{O}$	Molecules of $\text{H}_2\text{O}$ in 100 molecules $\text{CH}_3\text{COOH} + \text{H}_2\text{O}$	Normality of the iodine solution
0 0	100	0.0022
6 98	93 02	0.0049
16.40	83 60	0.0112
31 90	68 10	0.0331
55 70	44 30	0.0882
100	0	0.205

(McLauchlan, Z. phys. Ch. 1903, 44, 627.)

Very sol. in ether, chloroform, and bromoform.

#### Solubility in ether.

100 g. of the sat. solution contain at:

—33° —40° —108°

15.39 14.58 15.09 g.  $\text{I}_2$ .

(Arcetowski, Z. anorg. 1896, 11, 276.)

About as sol. in all fatty oils as in  $\text{CHCl}_3$ , etc. (Grueh, Arch. Pharm. 223, 431.)

Sol. in 56.6 pts. chloroform at 10°. (Duncan, Pharm J. Trans. 51. 544.)

Solubility in  $\text{CHCl}_3$ .

100 g. of the sat. solution contain at  
 $-49^\circ$   $-55^\circ$   $-60^\circ$   $-69.5^\circ$   $-73^\circ$   
 0.188 0.114 0.129 0.089 0.080 g.  $\text{I}_2$   
 (Arctowski, Z. anorg. 1890, 11. 276.)

Very sol. in methylene iodide (Retgers, Z. anorg. 3. 343)

Solubility of  $\text{I}_2$  in  $\text{C}_6\text{H}_6 + \text{CHCl}_3$  at room temperature ( $14.5^\circ$ — $15.1^\circ$ )

Volumes of $\text{C}_6\text{H}_6$ in 100 volumes of $\text{C}_6\text{H}_6 + \text{CHCl}_3$	Gram of 1/10-normal iodine in 5 cc. of the solution
100	41.05
90	38.8
80	34.6
70	30.5
60	27.4
50	24.4
40	21.0
30	19.2
20	17.8
10	16.0
0	14.3

(Bruner, Z. phys. Ch 1898, 26. 147)

Solubility of  $\text{I}_2$  in  $\text{CS}_2 + \text{CHCl}_3$  at room temperature ( $14.5^\circ$ — $15.1^\circ$ ).

Volumes of $\text{CS}_2$ in 100 volumes of $\text{CS}_2 + \text{CHCl}_3$	Gram of 1/10-normal iodine in 5 cc. of the solution
100	69.4
90	62.7
80	55.9
70	47.9
60	42.0
50	35.8
40	30.4
30	25.3
20	20.8
10	17.0
0	14.3

(Bruner.)

Solubility of  $\text{I}_2$  in  $\text{C}_6\text{H}_6 + \text{CCl}_4$  at room temperature ( $14.5^\circ$ — $15.1^\circ$ ).

Volumes of $\text{C}_6\text{H}_6$ in 100 volumes of $\text{C}_6\text{H}_6 + \text{CCl}_4$	Gram of 1/10-normal iodine in 5 cc. of the solution
100	41.05
90	37.2
80	33.6
70	29.6
60	26.1
50	22.4
40	19.25
30	16.1
20	13.4
10	10.75
0	8.1

(Bruner.)

Solubility of  $\text{I}_2$  in  $\text{CS}_2 + \text{CCl}_4$  at room temperature ( $14.5^\circ$ — $15.1^\circ$ ).

Volumes of $\text{CS}_2$ in 100 volumes of $\text{CS}_2 + \text{CCl}_4$	Gram of 1/10-normal iodine in 5 cc. of the solution
100	69.1
90	56.9
80	48.6
70	40.7
60	33.9
50	26.9
40	21.8
30	17.7
20	13.25
10	10.2
0	8.1

(Bruner.)

Solubility of  $\text{I}_2$  in  $\text{C}_2\text{H}_5\text{OH} + \text{CHCl}_3$  at room temperature ( $14.5^\circ$ — $15.1^\circ$ ).

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH} + \text{CHCl}_3$	Gram of 1/10-normal iodine in 5 cc. of the solution
100	61.7
90	37.1
80	34.2
70	30.7
60	27.9
50	26.1
40	24.6
30	22.7
20	19.9
10	17.1
0	14.25

(Bruner.)

Solubility of  $\text{I}_2$  in  $\text{C}_2\text{H}_5\text{OH} + \text{CHCl}_3$  at room temperature ( $14.5^\circ$ — $15.1^\circ$ ).

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH} + \text{CHCl}_3$	Gram of 1/10-normal iodine in 5 cc. of the solution
100	58.8
90	51.9
80	44.2
70	35.4
60	31.8
50	30.8
40	27.9
30	25.3
20	21.8
10	17.8
0	14.25

(Bruner.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328); (Eidmann, C. C. 1909, II. 1014.)

Sol. in methyl acetate (Naumann, B. 1909, 42. 3790), ethyl acetate. (Naumann, B. 1904, 37. 3601)

Sol. in allyl mustard oil, phenyl mustard

oil, phenyl isocyanate, pyridine, and alcohol. (Mathews, J. phys. Chem. 1905, 9, 649.)

Solubility of  $I_2$  in glycerine + Aq at 25°  
 G = g. glycerine in 100 g. glycerine + Aq  
 $I_2$  = g.  $I_2$  in 100 cc. of the solution

G	$I_2$	Sp. gr.
0	0.0304	0.9979
7 15	0.0342	1.0198
20 44	0.0482	1.0471
31 55	0.0621	1.0750
40 95	0.0875	1.0995
48 7	0.135	1.1207
69.2	0.278	1.1765
100	1.223	1.2646

(Heiz and Knoch, Z. anorg. 1905, 45, 209.)

1 l.  $N-NH_4C_2H_5O_2$  + Aq dissolves 0.440 g.  $I_2$  at 25°.

1 l.  $0.7 N-(NH_4)_2CO_3$  + Aq dissolves 0.980 g.  $I_2$  at 25°.

(McLauchlan, Z. phys. Ch. 1903, 44, 617.)

Very sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Solubility in  $CS_2$  at t°.

t°	Grams iodine in 100 p. of sat. solution
-100	0.32
-95	0.37
-90	0.41
-85	0.46
-80	0.51
-75	0.55
-25	3.47
-20	4.14
-15	4.82
-10	5.52
-5	6.58
0	7.89
+5	9.21
10	10.51
15	12.35
20	14.62
25	16.92
30	19.26
36	22.67
40	25.22
42	26.75

(Arcetowski, Z. anorg. 1894, 6, 404.)

1 l.  $CS_2$  dissolves 230 g.  $I_2$  at 25°.

1 l.  $CHBr_3$  dissolves 189.55 g.  $I_2$  at 25°.

1 l.  $CCl_4$  dissolves 30.33 g.  $I_2$  at 25°.

(Jakowkin, Z. phys. Ch. 1895, 18, 590.)

Solubility in  $CS_2$ .

100 g. of the sat. solution contain at:

-80°	-87°	-92.5°	-94°
0.509	0.440	0.391	0.378 g. $I_2$ .

(Arcetowski, Z. anorg. 1896, 11, 274.)

When an aqueous solution of  $I$  is shaken with  $CS_2$ , 400 pts. go into solution in  $CS_2$  for 1 pt. remaining in  $H_2O$ . (Berthelot and Jungfleisch, C. R. 69, 338.)

Abundantly sol. in methane. (Villard, A. ch. 1897, (7) 10, 387.)

Easily sol. in hot, less in cold naphtha. (Pelletier and Walker.)

Sol. in about 8 pts. hot petroleum from Amiano (de Saussure.)

Sol. sol. in cold, more readily in hot benzene (Mansfield.) Easily sol. in benzene. (Morde, A. ch. (3) 39, 452.)

Solubility in benzene.

100 g. of the sat. solution contain at:

4 7°	6 6°	10 5°	13.7°	16.3°
8.08	8.63	9.60	10.44	11.23 g. $I_2$ .

(Arcetowski, Z. anorg. 1896, 11, 276.)

1 l. benzene sat. with iodine at 25° contains 139 g. iodine. Abegg, Z. anorg. 1906, 50, 409.)

1 l. nitrobenzene dissolves 50.62 g.  $I_2$  at 16-17°. (Dawson and Gawler, Chem. Soc. 1902, 81, 524.)

Solubility of  $I_2$  in nitrobenzene + iodides at room temp.

Salt	G per l.	
	Salt	$I_2$
KI	12.35	112.7
"	45.56	295.7
"	115.8	698.2
"	155.2	943.6
NaI	13.55	125
"	57.7	393
"	109.1	738
"	228.	1251
RbI	85.4	421
"	217.5	1080
LiI	84.1	642
CaI	48.2	213
"	223	858
$NH_4I$	69.5	482
"	94.3	669
$SiI_2$	106.5	599
$BaI_2$	42.2	237
"	158.5	809
Aniline hydriodide	164	721
Dimethyl aniline hydriodide	160	626
Tetramethylammonium iodide	49.3	266
"	51.4	280

(Dawson and Goodson, Chem. Soc. 1904, 85, 706.)

Sol. in quinoline (Beckmann and Gabel, Z. anorg. 1906, 51, 236.)

Easily sol. in oil of turpentine, but an explosion soon occurs (Walker.)

Sol. in oil of mandarin. (Luca.)

Sol. in oil of arnica root. (Zeller)

Very sol. in  $\text{CS}_2$ , lignone, furfural, glycerine, aldehyde, chloral, warm retinole, toluene, salicylic acid, methyl nitrate, methyl salicylate, mercaptan, amyl carbamate, ethyl sulphhydrate, allyl iodide, ethyl disulphocarbonate, carbon chloride,  $\text{SCl}_2$ ,  $\text{ICl}_3$ ,  $\text{H}_2\text{S}_2$ , chlorochromic acid, amyl valerianate, valerianic acid, warm butyric acid, croosote, aniline, quinine, methylsulphyleic acid. Quickly sol. in oil of dill, peppermint, sassafras, and tansy. Slowly sol. in oil of cloves, cinnamon, cajuput, and rue. Other essential oils decompose it. (Various authorities.)

Sol. in potassium croconate + Aq. (Gmelin.)

Sol. in potassium antimony tartrate + Aq. 176 pts.  $\text{H}_2\text{O}$  + 6 pts. potassium antimony tartrate dissolve 275 pts. I; 373 pts.  $\text{H}_2\text{O}$  + 6 pts. potassium antimony tartrate dissolve 412 pts. I.

More sol. in tannic acid than in  $\text{H}_2\text{O}$ . 1 pt. I is sol in 450 pts.  $\text{H}_2\text{O}$  with 3.3 pts. tannic acid at  $12^\circ$ ; 1 pt. I is sol in 240 pts.  $\text{H}_2\text{O}$  with 0.015 pt. tannic acid at about  $30^\circ$ . (Koller, Zeit. Ch. 1886. 380.)

200 g.  $\text{H}_2\text{O}$  containing 0.3 g. tannic acid dissolve 1.0 g. I. (Hager, Comm. 1883.)

Sol. in considerable quantity, especially on warming, in resorcin, orcin, or phloroglucin + Aq. without coloration or formation of HI + Aq. These solutions withdraw I from  $\text{CS}_2$  solution, and do not give it up on boiling, but on evaporation in vacuo the I is sublimed in a pure state. (Hlasiwetz, Z. anal. 6. 447.)

Partition coefficient for iodine between  $\text{CS}_2$  and Aq at  $25^\circ\text{C}$ .

A = concentration of the water layer.

C = concentration of the carbon bisulphide layer.

A	C	$h = C/A$
0.2571	167.6	651.8
0.2195	140.2	638.7
0.1947	122.0	626.4
0.1743	108.3	620.0
0.1605	98.27	612.2
0.1229	73.23	595.8
0.1104	65.81	596.0
0.0939	55.29	590.5
0.0518	30.36	586.2

Partition coefficient for iodine between  $\text{CHBr}_3$  and Aq at  $25^\circ\text{C}$ .

A = concentration of the water layer.

C = concentration of the  $\text{CHBr}_3$  layer.

A	C	$\pi = C/A$
0.2736	144.36	527.6
0.1752	85.11	485.7
0.1084	49.93	460.5
0.0757	32.65	431.7
0.0517	22.19	429.3

Partition coefficient for iodine between  $\text{CCl}_4$  and Aq at  $25^\circ\text{C}$ .

A = concentration of the water layer.

C = concentration of the  $\text{CCl}_4$  layer.

A	C	$h = C/A$
0.2913	25.61	87.91
0.1934	16.54	85.51
0.1276	10.88	85.30
0.0818	6.966	85.13
0.0516	4.412	85.77

(Jakowkin, Z. phys. Ch. 1895, 18. 586-588.)

G alcohol in 100 cc of mixture	$\frac{C \text{ aq alcohol}}{\text{CCl}_4} \times 10^3$
30.5	1.29
26.7	0.76
22.9	0.49
19.1	0.34
16.3	0.28
11.4	0.23
7.6	0.20

(Osaka, Chem. Soc. 1905, 88. (2) 811.)

Division of iodine between  $\text{CS}_2$  and  $\text{Na}_2\text{SO}_4$  + Aq at  $25^\circ$ .

A = concentration of I in  $\text{H}_2\text{O}$  layer.

C = concentration of I in  $\text{CS}_2$  layer.

$\text{Na}_2\text{SO}_4$ + Aq	A	C
1-N	0.1518	142.4
$\frac{1}{2}$ -N	0.1809	141.7
$\frac{1}{3}$ -N	0.2022	143.6
$\frac{1}{6}$ -N	0.2138	142.4

Division of iodine between  $\text{CS}_2$  and  $\text{NaNO}_3$  + Aq.

$\text{NaNO}_3$ + Aq	A	C
1-N	0.1923	142.4
$\frac{1}{2}$ -N	0.2090	143.7
$\frac{1}{3}$ -N	0.2164	143.5

(Jakowkin, Z. phys. Ch. 1896, 20. 25.)

Partition between  $\text{CHCl}_3$  and glycerine.

C = millimols iodine in 10 g.  $\text{CHCl}_3$  layer.

W = millimols iodine in 10 g. glycerine layer.

C	W	C/W
0.504	0.244	2.31
0.919	0.397	2.32
0.151	0.500	2.30

(Herz, Z. Elektrochem. 1910, 18. 870.)

Partition of  $I_2$  between  $CHCl_3$  and other solvents.

C = millimols iodine in 10 ccm. of the  $CHCl_3$  layer

W = millimols iodine in 10 ccm. of the other layer.

Other Solvent	C	W	C/W
Water	0.338	0.0025	134.6
	1.510	0.0120	129.0
	2.318	0.0184	126.3
	3.207	0.0242	132.8
	3.439	0.0259	132.8
75% by vol. $H_2O$ + 25% by vol. glycerine	1.217	0.0183	66.32
	1.893	0.0290	65.33
	2.434	0.0367	66.31
	3.219	0.0483	66.65
50% by vol. $H_2O$ + 50% by vol. glycerine	1.217	0.0405	30.0
	1.835	0.0600	30.1
	2.376	0.0782	30.4
	3.294	0.1020	32.2
25% by vol. $H_2O$ + 75% by vol. glycerine	1.188	0.116	10.25
	1.806	0.173	10.45
	2.650	0.249	10.66
	2.859	0.265	10.80
	3.400	0.312	10.93

(Herz, Z. Elektrochem. 1910, 16, 870)

Distribution of  $I_2$  between benzene and glycerine at  $t^\circ$ .

$M_1$  = concentration of  $I_2$  in benzene layer expressed in g.-mol. per l.

$M_2$  = concentration of  $I_2$  in glycerine layer expressed in g.-mol. per l.

$t^\circ$	$M_1$	$M_2$
25°	0.00757	0.001604
	0.01610	0.002664
	0.02719	0.004115
	0.04024	0.005794
	0.06255	0.00834
	0.07923	0.01033
	0.10243	0.01324
	0.12201	0.01559
	0.13342	0.01668
	0.16784	0.02081
40°	0.008545	0.00181
	0.01544	0.002593
	0.04432	0.006242
	0.095004	0.012013
	0.13271	0.01632
	0.18508	0.02193
50°	0.00865	0.00184
	0.01523	0.00253
	0.02683	0.00390
	0.04413	0.00576
	0.0620	0.00744
	0.07832	0.00942
	0.10153	0.01214
	0.12166	0.0145
	0.13199	0.01560
	0.18438	0.02122

(Landau, Z. phys. Ch. 1910, 73, 202.)

Distribution of  $I_2$  between glycerine and  $CCl_4$  at  $t^\circ$ .

$M_1$  = concentration of  $I_2$  in  $CCl_4$  layer expressed in g.-mol. per l.

$M_2$  = concentration of  $I_2$  in glycerine layer expressed in g.-mol. per l.

$t^\circ$	$M_1$	$M_2$
25°	0.002230	0.0014386
	0.0024113	0.0014595
	0.0048227	0.0027014
	0.010452	0.005531
	0.038073	0.019959
	0.04598	0.023948
	0.05820	0.030097
40°	0.00237	0.00127
	0.00239	0.00138
	0.00461	0.00272
	0.01092	0.00482
	0.02540	0.01116
	0.04091	0.01749
	0.06074	0.02701
50°	0.00257	0.00118
	0.00500	0.00225
	0.01363	0.00596
	0.02549	0.01050
	0.04167	0.01693
	0.06309	0.02502

(Landau, Z. phys. Ch. 1910, 73, 203.)

Distribution of  $I_2$  between ether and ethylene glycol at  $t^\circ$ .

$M_1$  = concentration of  $I_2$  in ether layer, expressed in g.-mol. per l.

$M_2$  = concentration of  $I_2$  in  $C_2H_4O_2$  layer, expressed in g.-mol. per l.

$t^\circ$	$M_1$	$M_2$
0°	0.00843	0.00571
	0.03052	0.01713
	0.06551	0.03736
	0.08105	0.04605
	0.12528	0.07148
	0.31511	0.17524
25°	0.00870	0.00571
	0.01677	0.01001
	0.02710	0.01586
	0.03046	0.01713
	0.06385	0.03594
	0.11951	0.06725
	0.30820	0.17524

(Landau, Z. phys. Ch. 1910, 73, 205.)

Iodine monobromide,  $IBr$ .

Slowly sol. in  $H_2O$  with slight decomp. Sol. in  $CHCl_3$ ,  $CS_2$ , ether, and alcohol.

+5 $H_2O$ . (Lewig, Pogg. 14, 485.) Does not exist. (Bornemann, A. 189, 183.)

**Iodine pentabromide,  $\text{IBr}_5$ (?).**

Sol in  $\text{H}_2\text{O}$  with separation of iodine (Lowig, Pogg. 14. 485.)

**Iodine monochloride,  $\text{ICl}$ .**

Decomp. by  $\text{H}_2\text{O}$ ; sol. without decomp. in alcohol, ether, and  $\text{HCl} + \text{Aq.}$

Sol. in  $\text{CS}_2$ .

**Iodine hydrogen chloride,  $\text{ICl}$ ,  $\text{HCl}$ .**

Unstable. Sol. in ether. (Schutzenberger, C. R. 84. 389.)

**Iodine trichloride,  $\text{ICl}_3$ .**

Deliquescent. With  $\text{H}_2\text{O}$ , a part is dissolved without decomp., and the rest is decomp. The aqueous solution contains more unchanged  $\text{ICl}_3$ , the more conc. it is. (Serullas.) Precipitated from aqueous solution by  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{HCl} + \text{Aq.}$  Sol. in warm conc.  $\text{H}_2\text{SO}_4$  without decomp. Sol. in alcohol, and benzene. Decomp. by small amount of  $\text{CS}_2$ . (Christomanos, B. 10. 484.) Ether does not remove it from aqueous solution. (Serullas.)

**Iodine lithium chloride,  $\text{ICl}_3$ ,  $\text{LiCl} + 4\text{H}_2\text{O}$ .**

See Lithium chloriodide.

**Iodine trichloride magnesium chloride,  $2\text{ICl}_3$ ,  $\text{MgCl}_2 + 5\text{H}_2\text{O}$ .**

Very deliquescent and easily decomposed. (Filhol, J. Pharm. 25. 442.)  
 $+ 8\text{H}_2\text{O}$  Hygroscopic (Weinland, Z anorg 1902, 30. 141.)

**Iodine trichloride manganous chloride,  $2\text{ICl}_3$ ,  $\text{MnCl}_2 + 8\text{H}_2\text{O}$ .**

Hygroscopic (Weinland, Z anorg 1902, 30. 139.)

**Iodine trichloride nickel chloride,  $2\text{ICl}_3$ ,  $\text{NiCl}_2 + 8\text{H}_2\text{O}$ .**

Hygroscopic.  $\text{CCl}_4$  dissolves out  $\text{ICl}_3$ . (Weinland, Z. anorg 1902, 30. 138.)

**Iodine monochloride phosphorus pentachloride,  $\text{ICl}$ ,  $\text{PCl}_5$ .**

Very deliquescent; decomp. by  $\text{H}_2\text{O}$ .

**Iodine potassium chloride,  $\text{ICl}_3$ ,  $\text{KCl}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp.

Ether dissolves out  $\text{ICl}_3$ . (Filhol, J. Pharm. 25. 433, 506.)

See Potassium chloriodide.

**Iodine sodium chloride,  $\text{ICl}_3$ ,  $\text{NaCl} + 2\text{H}_2\text{O}$ .**

See Sodium chloriodide.

**Iodine trichloride strontium chloride,  $2\text{ICl}_3$ ,  $\text{SrCl}_2 + 8\text{H}_2\text{O}$ .**

Hygroscopic (Weinland, Z anorg. 1902, 30. 142.)

**Iodine trichloride sulphur tetrachloride,  $\text{ICl}_3$ ,  $\text{SCl}_4$ .**

Very deliquescent in air; decomp. by  $\text{H}_2\text{O}$ . Decomp. with formation of clear solution by dil  $\text{HNO}_3 + \text{Aq.}$  (Weber, Pogg. 128. 459.)

$\text{SCl}_2$ ,  $2\text{ICl}_3$ . (Jaindard, J. B. 1860. 95.)  
 Correct formula is as above. (Weber, l. c.)  
 $2\text{ICl}_3$ ,  $\text{SCl}_4$  Sol. in  $\text{SO}_2$ ,  $\text{CS}_2$ ,  $\text{SOCl}_2$ ,  $\text{POCl}_3$ , warm  $\text{SCl}_2$ , petroleum ether, ligroin,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ ,  $\text{CS}_2$  and abs. ether. (Ruff, B. 1904, 37. 4519.)

**Iodine trichloride zinc chloride,  $2\text{ICl}_3$ ,  $\text{ZnCl}_2 + 8\text{H}_2\text{O}$ .**

Unstable. Hygroscopic (Weinland, Z. anorg 1902, 30. 140.)

**Iodine pentafluoride,  $\text{IF}_5$ .**

Fumes in air; decomp. with  $\text{H}_2\text{O}$ . (Gore, C. N. 24. 291.)

Decomp. by  $\text{H}_2\text{O}$  into iodic acid and  $\text{HF}$ . Decomp. by solutions of the alkalis. (Moissan, C. R. 1902, 135. 504.)

**Iodine trioxide,  $\text{I}_2\text{O}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Ogier, C. R. 85. 957; 86. 722.)

Probably a mixture

**Iodine tetroxide,  $\text{I}_2\text{O}_4$ (?).**

Insol in cold, decomp. by hot  $\text{H}_2\text{O}$ ; insol. in alcohol. Decomp. by  $\text{HNO}_3 + \text{Aq.}$  Sol in  $\text{H}_2\text{SO}_4$ . (Millon, J. pr. 34. 319, 337.)

**Iodine pentoxide,  $\text{I}_2\text{O}_5$ .**

Very sol. in  $\text{H}_2\text{O}$ , and in dil. alcohol. Insol in absolute alcohol, ether,  $\text{CS}_2$ , chloroform, and hydrocarbons.

Forms hydrates, iodic acid  $\text{HIO}_3$ , and  $3\text{I}_2\text{O}_5$ ,  $\text{H}_2\text{O}$ ; insol. in ordinary alcohol.  
 For sp. gr. of aqueous solution, see *iodic acid*.

**Iodine oxides,  $\text{I}_{10}\text{O}_{13}$ ,  $\text{I}_2\text{O}_{12}$ .**

The compounds,  $\text{I}_{10}\text{O}_{13}$  (Millon, J. pr. 34. 336), and  $\text{I}_2\text{O}_{12}$  (Kammerer, J. pr. 83. 81), are probably mixtures.

Millon's oxides are impure  $\text{I}_2\text{O}_5$ . (Kappeler, B. 1911, 44. 3496.)

**Iodine sulphur oxide,  $5\text{I}_2\text{O}_5$ ,  $\text{SO}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Kammerer.)

$\text{I}_2\text{O}_5$ ,  $3\text{SO}_2$ . Decomp. by  $\text{H}_2\text{O}$ ; sl. sol. in hot  $\text{SO}_2$ . (Weber, B. 20. 86.)  
 $= (\text{IO})_2(\text{SO}_4)_3$ . Iodyl sulphate (?).

**Iodine oxyfluoride,  $\text{IOF}_3 + 5\text{H}_2\text{O}$ .**

Fumes in the air. (Weinland, Z. anorg. 1908, 60. 163.)

**Iodine sulphide,  $\text{S}_2\text{I}_2$ .**

Sol. in  $\text{CS}_2$ . (Linebarger, Am. Ch. J. 1895, 17. 57.)

Iodine sulphoxide,  $\text{I}_2\text{SO}_4(?)$

Decomp. by  $\text{H}_2\text{O}$ . (Schultz-Sellack.)

$\text{I}_2(\text{SO}_3)_2(?)$ . Decomp. by  $\text{H}_2\text{O}$ . (Weber, J. pr. (2) 25, 224.)

$\text{I}_2(\text{SO}_3)_2(?)$ . As above. (Weber.)

See also Iodosulphuric anhydride.

Iodiridic acid.

Ammonium iodiridate,  $(\text{NH}_4)_2\text{IrI}_6$ .

Very easily sol. in cold  $\text{H}_2\text{O}$ , decomp. on warming. Insol. in alcohol. (Oppler, J. B. 1857. 263.)

Potassium iodiridate,  $\text{K}_2\text{IrI}_6$ .

Very easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

Sodium iodiridate,  $\text{Na}_2\text{IrI}_6$ .

Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . Easily sol. in acids. (Oppler.)

Iodiridous acid.

Ammonium iodiridite,  $(\text{NH}_4)_4\text{Ir}_2\text{I}_{12} + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ , but decomp. on warming (Oppler.)

Potassium iodiridite,  $\text{K}_4\text{Ir}_2\text{I}_{12}$ .

Insol. in  $\text{H}_2\text{O}$ , or alcohol. Slowly sol. in acids, easily in warm alkalis +  $\text{Ag}$ .

Silver iodiridite,  $\text{Ag}_2\text{Ir}_2\text{I}_{12}$ .

Ppt.

Iodochloroplatin diamine chloride,



Sl. sol. in  $\text{H}_2\text{O}$ .

Iodochromic acid.

Potassium iodochromate,  $\text{KCrO}_2\text{I}$ .

Decomp. by boiling  $\text{H}_2\text{O}$ . (Guyot, C. R. 73. 46.)

See also Chromoiodic acid.

Iodomolybdic acid.

See Molybdoiodic acid.

Iodonitratoplatin monodiamine bromide,



Very sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

Iodonitratoplatin diamine nitrate,



Quite easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

Iodopalladous acid.

Potassium iodopalladite.

Deliquescent. (Lassaigne.)

Iodophosphoric acid.

See Phosphoiodic acid.

Iodoplatinamine iodide,  $\text{I}_2\text{Pt}(\text{NH}_3\text{I})_2$ .

Sol. in  $\text{H}_2\text{O}$ , especially easily if boiling. (Cleve.)

Iodoplatin diamine iodide,  $\text{I}_2\text{Pt}(\text{N}_2\text{H}_4\text{I})_2$ .

Sol. in  $\text{H}_2\text{O}$ , especially when hot (Cleve.)

— mercuric iodide,  $\text{I}_2\text{Pt}(\text{N}_2\text{H}_4\text{I})_2, 2\text{HgI}_2$ .

Extremely difficultly sol. in cold  $\text{H}_2\text{O}$ , partly decomp. by boiling. (Jürgensen, Gin. K. 3. 1214.)

— nitrate,  $\text{I}_2\text{Pt}(\text{N}_2\text{H}_4\text{NO}_2)_2$ .

More sol. in hot than cold  $\text{H}_2\text{O}$ .

— sulphate,  $\text{I}_2\text{Pt}(\text{N}_2\text{H}_4)_2\text{SO}_4$ .

Very sl. sol. in  $\text{H}_2\text{O}$  (Jürgensen, J. pr. (2) 15. 429.)

Iodoplatin semidiamine iodide,



Sl. sol. in  $\text{H}_2\text{O}$  (Jürgensen, J. pr. (2) 16. 345.)

— periodide,  $\text{I}_2\text{Pt}(\text{NH}_3)_2\text{I}, \text{I}_2$ .

Moderately sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

Iododiplatinamine iodide,  $\text{I}_2\text{Pt}_2(\text{N}_2\text{H}_4)_2\text{I}_4$ .

Insol. in  $\text{H}_2\text{O}$ .

Iododiplatin diamine anhydriodide,



Insol. in  $\text{NH}_4\text{OH} + \text{Ag}$ .

— anhydronitrate,  $\text{I}_2\text{Pt}_2(\text{N}_2\text{H}_4)_2\text{O}(\text{NO}_2)_2$ .

Easily sol. in warm  $\text{H}_2\text{SO}_3 + \text{Ag}$ . (Cleve.)

— iodide,  $\text{I}_2\text{Pt}_2(\text{N}_2\text{H}_4)_2\text{I}_4$ .

Ppt.

— nitrate,  $\text{I}_2\text{Pt}_2(\text{N}_2\text{H}_4)_2(\text{NO}_2)_4 + 4\text{H}_2\text{O}$ .

Sl. sol. in cold, moderately sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

— phosphate,  $\text{I}_2\text{Pt}_2(\text{N}_2\text{H}_4)_2[\text{O}_2\text{P}(\text{OH})]_2$ .

Nearly insol. in  $\text{H}_2\text{O}$ .

— sulphate,  $\text{I}_2\text{Pt}_2(\text{N}_2\text{H}_4)_2(\text{SO}_4)_2$ .

Nearly insol. in  $\text{H}_2\text{O}$ .

— platodiamine sulphate,  $\text{I}_2\text{Pt}_2(\text{N}_2\text{H}_4)_2\text{SO}_4$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Carlgren Sv. V. A. F. 47. 308.)

Iodoplatinic acid,  $\text{H}_2\text{PtI}_6 + 9\text{H}_2\text{O}$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ , with decomp. into  $\text{PtI}_4$  and  $\text{HI}$  on standing or warming. (Topsoe.)

**Ammonium iodoplatinate,  $(\text{NH}_4)_2\text{PtI}_6$ .**  
Easily sol. in  $\text{H}_2\text{O}$ . (Topsøe.)  
 $\text{NH}_4\text{I}$ ,  $\text{PtI}_4$ . Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol (Lassaigne, A. ch. (2) 51. 128.)

**Barium iodoplatinate,  $\text{BaPtI}_6$ .**  
Deliquescent, but less so than  $\text{Na}_2\text{PtI}_6$  which it otherwise resembles. (Lassaigne.)

**Calcium iodoplatinate,  $\text{CaPtI}_6 + 12\text{H}_2\text{O}$ .**  
Not so deliquescent as Na salt.

**Cobalt iodoplatinate,  $\text{CoPtI}_6 + 9\text{H}_2\text{O}$ .**  
Very deliquescent.

**Lead tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Pb}$ ,  $\text{Pb}(\text{OH})_2$ .**  
Ppt. (Bellucci, C. C. 1902, I 625)

**Magnesium iodoplatinate,  $\text{MgPtI}_6 + 9\text{H}_2\text{O}$ .**  
Sol. in  $\text{H}_2\text{O}$ .

**Manganese iodoplatinate,  $\text{MnPtI}_6 + 9\text{H}_2\text{O}$ .**  
Very deliquescent.

**Mercuric tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Hg}$ .**  
Ppt. (Bellucci, C. C. 1902, I 625)

**Nickel iodoplatinate,  $\text{NiPtI}_6 + 9\text{H}_2\text{O}$ .**  
Very deliquescent.

**Potassium iodoplatinate,  $\text{K}_2\text{PtI}_6$ .**  
Easily sol. in  $\text{H}_2\text{O}$  Insol. in alcohol. Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ .

**Silver tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Ag}$ .**  
Ppt. (Bellucci, C. C. 1902, I. 625.)

**Sodium iodoplatinate,  $\text{Na}_2\text{PtI}_6 + 6\text{H}_2\text{O}$ .**  
Not deliquescent, but easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Vauquelin.) Deliquescent. (Lassaigne.)

**Thallium tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Tl}$ .**  
Ppt. (Bellucci, C. C. 1902, I 625.)

**Zinc iodoplatinate,  $\text{ZnPtI}_6 + 9\text{H}_2\text{O}$ .**  
Easily sol. in  $\text{H}_2\text{O}$ .

**Iodoplatinocyanhydric acid,  $\text{H}_2\text{Pt}(\text{CN})_4\text{I}_2$ .**  
See Periodoplatinocyanhydric acid.

**Silver iodoplatinocyanide,  $\text{Ag}_2(\text{PtI}_2(\text{CN})_2)_2$ .**  
Ppt. (Miolati, Gazz. ch. it. 1900, 30. 588.)

**Strontium iodoplatinocyanide platinumcyanide,  $\text{SrPt}(\text{CN})_4\text{I}_2$ ,  $10\text{SrPt}(\text{CN})_4 + x\text{H}_2\text{O}$ .**  
(Holst.)

**Iodopurpleochromium chloride,  $\text{ICr}(\text{NH}_3)_3\text{Cl}_2$ .**  
Quite sol. in  $\text{H}_2\text{O}$ . (Jorgensen, J. pr. (2) 25. 83.)

— chloroplatinate,  $\text{ICr}(\text{NH}_3)_3\text{PtCl}_6$ .  
Precipitate. (Jorgensen, l. c.)

— iodide,  $\text{ICr}(\text{NH}_3)_3\text{I}_2$ .  
Difficultly sol. in  $\text{H}_2\text{O}$ . Insol. in III, or  $\text{KI} + \text{Aq}$ ; insol. in alcohol. (Jorgensen, l. c.)

— nitrate,  $\text{ICr}(\text{NH}_3)_3(\text{NO}_3)_2$ .  
Much less sol. in  $\text{H}_2\text{O}$  than the chloride. (Jorgensen, l. c.)

**Iodopurpleocobaltic iodide,  $\text{CoI}(\text{NH}_3)_5\text{I}_2$ .**  
(Claudet.)  
Does not exst. (Jorgensen, J. pr. (2) 25. 94.)

**Iodopurpleorhodium chloride,  $\text{IRh}(\text{NH}_3)_3\text{Cl}_2$ .**  
Relatively easily sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{HCl} + \text{Aq}$  and alcohol. Insol in  $\text{KI} + \text{Aq}$ . (Jorgensen, J. pr. (2) 27. 433)

— fluosilicate,  $\text{IRh}(\text{NH}_3)_3\text{SiF}_6$   
Nearly insol. in cold  $\text{H}_2\text{O}$

— iodoplatinate,  $\text{IRh}(\text{NH}_3)_3\text{PtI}_6$ .  
Ppt.

— iodide,  $\text{IRh}(\text{NH}_3)_3\text{I}_2$ .  
Very sl sol. in cold  $\text{H}_2\text{O}$ ; more sol. in hot  $\text{H}_2\text{O}$ ; insol. in dil.  $\text{HI} + \text{Aq}$ , and alcohol. (Jorgensen, J. pr. (2) 27. 433.)

— nitrate,  $\text{IRh}(\text{NH}_3)_3(\text{NO}_3)_2$ .  
Sl. sol. in  $\text{H}_2\text{O}$ , more easily sol. in hot  $\text{H}_2\text{O}$ ; insol. in dil.  $\text{HNO}_3 + \text{Aq}$ , and alcohol.

— sulphate,  $\text{IRh}(\text{NH}_3)_3\text{SO}_4$ , and  $+3\text{H}_2\text{O}$ .  
Sl. sol. in even hot  $\text{H}_2\text{O}$ . (Jorgensen.)

**Iodoselenic acid.**

**Ammonium iodoselenate,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{SeO}_3 + \text{H}_2\text{O}$ .**  
Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1903, 38. 1400.)  
 $2(\text{NH}_4)_2\text{O}$ ,  $3\text{I}_2\text{O}_5$ ,  $2\text{SeO}_3 + 5\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp.(?). (Weinland.)

**Potassium iodoselenate,  $2\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{SeO}_3 + \text{H}_2\text{O}$ .**  
Decomp. by  $\text{H}_2\text{O}$ . (Weinland.)  
 $2\text{K}_2\text{O}$ ,  $3\text{I}_2\text{O}_5$ ,  $2\text{SeO}_3 + 5\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$  with decomp.(?) (Weinland.)

Rubidium iodoselenate,  $2\text{Rb}_2\text{O}$ ,  $3\text{I}_2\text{O}_5$ ,  $28\text{SeO}_2$   
 $+5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Weinland.)

### Iodostannous acid.

Data concerning solubility of  $\text{SnI}_2$  in  $\text{HI} + \text{Ag}$  indicate formation of this compound. (Young, J. Am. Chem. Soc. 1897, 19, 853.)

### Iodosulphobismuthous acid.

Cuprous iodosulphobismuthite,  $2\text{Cu}_2\text{S}$ ,  $\text{Bi}_2\text{S}_3$ ,  $2\text{BiSI}$

Decomp. by  $\text{H}_2\text{O}$  at ord temp. Decomp. by mineral acids with evolution of  $\text{H}_2\text{S}$  (Ducatte, C. R. 1902, 134, 1213.)

Lead iodosulphobismuthite,  $\text{PbS}$ ,  $\text{Bi}_2\text{S}_3$ ,  $2\text{BiSI}$ .

Insol. in  $\text{H}_2\text{O}$ . Partially decomp. by boiling  $\text{H}_2\text{O}$ . Decomp. by dil. mineral acids with evolution of  $\text{H}_2\text{S}$ . (Ducatte.)

### Iodosulphuric acid.

Ammonium iodosulphate,  $(\text{NH}_4)_2\text{SO}_4\text{I}_2(?)$ .

Very sol. in  $\text{H}_2\text{O}$ . (Zinno, N. Rep. Pharm. 20, 449.)

Mercuric iodosulphate,  $\text{Hg}_2(\text{SO}_4)\text{I}_2$ .

See Mercuric sulphate iodide.

Potassium iodosulphate,  $\text{K}_2\text{SO}_4\text{I}_2(?)$ .

Sol. in 7.14 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Zinno, N. Rep. Pharm. 20, 449.)

Sodium iodosulphate,  $\text{Na}_2\text{SO}_4\text{I}_2 + 10\text{H}_2\text{O}$ .

Sol. in 3.04 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  and in dil. alcohol. (Zinno, N. Rep. Pharm. 20, 449.)

Does not exist. (Michaelis and Koeth, B. 6, 999.)

Iodosulphuric anhydride,  $\text{ISO}_2$ .

Decomp. very violently by  $\text{H}_2\text{O}$ . (Weber, J. pr. (2) 25, 224.)

Diiodosulphuric anhydride,  $\text{I}_2\text{SO}_2$ .

Decomp. with  $\text{H}_2\text{O}$ , but not so violently as  $\text{ISO}_2$ . (Weber, J. pr. (2) 25, 224.)

Iodotrisulphuric anhydride,  $\text{I}(\text{SO}_2)_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weber, J. pr. (2) 25, 224.)

### Iodotelluric acid.

Ammonium iodotellurate,  $(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1901, 28, 52.)

$(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_3 + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Weinland, B. 1900, 33, 1017.)

Cæsium iodotellurate,  $\text{Cs}_2\text{TeI}_4$ .

Insol. in  $\text{CsI}$  or  $\text{HI} + \text{An}$ . Decomp. slowly by cold, rapidly by hot  $\text{H}_2\text{O}$ . (Wheeler, Sill. Am. J. 145, 267.)

Potassium iodotellurate,  $\text{K}_2\text{TeI}_4 + 2\text{H}_2\text{O}$ .

Sl. efflorescent. Somewhat sol. in  $\text{KI} + \text{Aq}$ , and dil.  $\text{HI} + \text{Aq}$ . (Wheeler.)

$\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $\text{TeO}_3 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Partially decomp. on recryst. from  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1901, 28, 53.)

$\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_3 + 6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Weinland.)

Rubidium iodotellurate,  $\text{Rb}_2\text{TeI}_4$ .

Sl. sol. in  $\text{HI}$ , or  $\text{RbI} + \text{Aq}$ . Decomp. by  $\text{H}_2\text{O}$ . Somewhat sol. in alcohol. (Wheeler.)  $\text{Rb}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_3 + 6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Weinland.)

Iodotetramine chromium iodide,

$\text{ICl}(\text{NH}_4)_4\text{I}_2 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol (Cleve.)

Iodotetramine cobaltic sulphate,

$\text{ICo}(\text{NH}_4)_4\text{SO}_4$ .

(Vortmann and Blasberg, B. 22, 2652.)

Iodotungstic acid.

See Tungstic acid.

Iodous acid,  $\text{I}_2\text{O}_3$ .

See Iodine trioxide.

Iodovanadic acid,  $\text{I}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ .

Very easily sol. in  $\text{H}_2\text{O}$ .

$2\text{V}_2\text{O}_5$ ,  $3\text{I}_2\text{O}_5 + 18\text{H}_2\text{O}$ . (Ditte, C. R. 102, 757.)

Ammonium iodovanadate,  $3(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $5\text{I}_2\text{O}_5 + 20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102, 1019.)

Irididiamine compounds,  $\text{Cl}_2\text{Ir}(\text{NH}_3)_4\text{X}_2$ .

See Chloriridiamine compounds.

Iridic acid.

Potassium iridate (?).

Sol. in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$ .

Iridicyanhydric acid,  $\text{H}_3\text{Ir}(\text{CN})_6$ .

Easily sol. in  $\text{H}_2\text{O}$ , still more easily in alcohol, less in ether. (Martius, A. 117, 369.)

Barium iridicyanide,  $\text{Ba}_3[\text{Ir}(\text{CN})_6]_2 + 18\text{H}_2\text{O}$ .

Efflorescent. Easily sol. in hot or cold  $\text{H}_2\text{O}$ . Nearly insol. in alcohol. Not decomp. by acids.

**Cupric iridicyanide ammonia**,  $\text{Cu}_2\text{Ir}_2(\text{CN})_{12}$ ,  $6\text{NH}_3 + 4\text{H}_2\text{O}$   
 Ppt. Decomp. in air. (Rimbach, Z. anorg. 1907, 52. 413.)

**Potassium iridicyanide**,  $\text{K}_3\text{Ir}(\text{CN})_6$ .  
 Easily sol. in  $\text{H}_2\text{O}$ .

**Silver iridicyanide ammonia**,  $\text{Ag}_3\text{Ir}(\text{CN})_6$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$ .  
 Ppt. Decomp. in the light. (Rimbach, Z. anorg. 1907, 52. 414.)

**Iridium, Ir**  
 Insol. in all acids, including aqua regia, except when in finely divided state, as "iridium black," when it is sol. in aqua regia. (Claus, J. pr. 42. 251.)

**Iridium ammonia compounds.**

See—

**Chlorirididiamine comps.**,  $\text{ClIr}(\text{NH}_3)_2\text{X}$ .  
**Iridotriamine** "  $\text{Ir}(\text{NH}_3)_3\text{X}_3$   
**Iridopentamine** "  $\text{Ir}(\text{NH}_3)_5\text{X}_3$   
**Iridotetramine** "  $\text{Ir}(\text{NH}_3)_4\text{X}_3$   
**Iridoquopentamine** "  $\text{Ir}(\text{NH}_3)_5(\text{OH}_2)\text{X}_3$   
**Iridosamine** "  $\text{Ir}(\text{NH}_3)_6\text{X}_3$   
**Iridosodiamine** "  $\text{Ir}(\text{NH}_3)_4\text{X}_2$

**Iridium tribromide**,  $\text{IrBr}_3 + 4\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol or ether. (Birnbbaum.)

**Iridium tetrabromide**,  $\text{IrBr}_4$ , or  $\text{H}_2\text{IrBr}_6$ .  
 Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Birnbbaum.)  
 See Bromiridic acid.

**Iridium hydrogen sesquibromide**,  $3\text{HBr}$ ,  $\text{IrBr}_3 + \text{H}_2\text{O} = \text{H}_3\text{IrBr}_6 + 3\text{H}_2\text{O}$ .  
 See Bromiridous acid.

**Iridium sesquibromide with MBr.**  
 See Bromiridate, M.

**Iridium tetrabromide with MBr.**  
 See Bromiridate, M.

**Iridium phosphorous bromide**,  $\text{IrBr}_3 \cdot 3\text{PBr}_3$ .  
 Partially decomp. by  $\text{H}_2\text{O}$  into a sol., and insol. modification. Sol. in  $\text{PBr}_3$ . (Geisenheimer.)  
 $\text{IrBr}_3 \cdot 2\text{PBr}_3$ . Not easily attacked by  $\text{H}_2\text{O}$ .  
 $\text{IrBr}_4 \cdot 2\text{PCl}_5$ .  
 See Iridium phosphorus chlorobromide.

**Iridium carbide**,  $\text{IrC}_4(?)$ .  
 (Berzelius.)  
 Stable toward  $\text{H}_2\text{O}$ , acids, and alcohol. (Strecker, B. 1909, 42. 1773.)

**Iridium monochloride**,  $\text{IrCl}$ .  
 Insol. in acids and bases (Wohler, B. 1913, 46. 1584.)

**Iridium dichloride**,  $\text{IrCl}_2$ .  
 Insol. in acids and bases (Wohler, B. 1913, 46. 1585.)

**Iridium trichloride**,  $\text{IrCl}_3$ .  
 Insol. in acids or alkalis. (Claus, C. C. 1861. 690.)  
 Insol. in  $\text{H}_2\text{O}$ , acids and alkalis, (Leidie, C. R. 1899, 129. 1251.)  
 $+4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Claus.)

**Iridium tetrachloride**,  $\text{IrCl}_4$ , or  $\text{H}_2\text{IrCl}_6(?)$   
 Deliquescent, and easily sol. in  $\text{H}_2\text{O}$ .

**Iridium trichloride with MCl.**  
 See Chloriridite, M.

**Iridium tetrachloride with MCl.**  
 See Chloriridate, M.

**Iridium chloride with potassium chloride and sulphite.**  
 See Chloriridosulphite, potassium.

**Iridium phosphorus chloride**,  $\text{IrP}_2\text{Cl}_6$ .  
 Insol. in cold  $\text{H}_2\text{O}$ . Sl. decomp. by hot  $\text{H}_2\text{O}$ . (Geisenheimer, A. ch. (6) 23. 254.)  
 $\text{IrP}_2\text{Cl}_6$ . Very sol. in chloroform. (G.)  
 $\text{IrP}_2\text{Cl}_6$ . Easily sol. in  $\text{PCl}_5$  or  $\text{CHCl}_3$ , also in  $\text{CS}_2$  with gradual decomp. Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling into  $\text{IrCl}_3$ ,  $3\text{H}_3\text{PO}_4$ . Sl. sol. in benzene, ligroin and  $\text{CCl}_4$ . (Strecker, B. 1909, 42. 1772.)  
 $+ \text{H}_2\text{O}$  Insol. in  $\text{PCl}_5$  at  $100^\circ$ . Very slowly sol. in boiling  $\text{H}_2\text{O}$ . (Geisenheimer, A. ch. (6) 23. 266.)  
 $\text{IrP}_2\text{Cl}_6$ . Decomp. by  $\text{H}_2\text{O}$  into  $2\text{IrCl}_3$ ,  $3\text{H}_3\text{PO}_3$ ,  $3\text{H}_3\text{PO}_4$ . Violently decomp. by alcohol. Sl. sol. in cold, more in hot  $\text{POCl}_3$ , without decomp. Very sol. in  $\text{PCl}_5$  with decomp. into  $\text{IrP}_2\text{Cl}_6$ ; similarly in  $\text{PBr}_5$ . Sol. in  $\text{AsCl}_3$  with combination. Sol. in  $\text{CS}_2$  with decomp. Sol. in  $\text{SCl}_2$  with combination. Easily sol. in cold  $\text{C}_6\text{H}_6$  with decomp. Insol. in  $\text{CCl}_4$ . Sol. in  $\text{CHCl}_3$  with decomp. (Geisenheimer, A. ch. (6) 23. 254.)

**Iridium phosphorus arsenic chloride**,  $2\text{IrP}_2\text{Cl}_6 \cdot 5\text{AsCl}_3$ .  
 Sol. in  $\text{H}_2\text{O}$  with decomp. into corresponding acid. (Geisenheimer, C. R. 110. 1336.)  
 $\text{IrCl}_3 \cdot 2\text{PCl}_5$ ,  $2\text{AsCl}_3$ . Very sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in  $\text{AsCl}_3$ ; insol. in  $\text{CCl}_4$ . (Geisenheimer.)

**Iridium phosphorus sulphur chloride**,  $\text{IrCl}_3 \cdot 2\text{PCl}_5 \cdot 2\text{SCl}_2$ .  
 Very sol. in sl. aq.  $\text{H}_2\text{O}$ , with decomp. into an acid analogous to chlorophosphuric acid. Sol. in  $\text{SCl}_2$ . (Geisenheimer.)

**Iridium phosphorus chlorobromide, IrBr<sub>4</sub>2PCl<sub>3</sub>**

(Geisenheimer, C. R. 111. 10.)

**Iridium dihydroxide, IrO<sub>2</sub>, 2H<sub>2</sub>O = IrO<sub>2</sub>H<sub>2</sub>**

Insol in dil HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>+Aq. Slowly but completely sol. in HCl+Aq. Sol in KOH, and NaOH+Aq (Claus, J. pr. 39. 101.)

**Iridium sesquihydroxide, Ir<sub>2</sub>(OH)<sub>6</sub>**

Not attacked by acids, except slightly by conc HCl+Aq (Claus, C. C. 1861. 690.)

**Iridium triiodide, IrI<sub>3</sub>.**

Very sl sol. in cold, somewhat more in hot H<sub>2</sub>O. Insol. in alcohol. (Oppler, J. B. 1857. 263.)

**Iridium tetraiodide, IrI<sub>4</sub>.**

Insol. in H<sub>2</sub>O or acids. (Lassagne.)  
Sol. in solutions of iodides (Oppler.)

**Iridium triiodide with MI.**

See Iodiridite, M.

**Iridium tetraiodide with MI.**

See Iodiridate, M.

**Iridium dioxide, IrO<sub>2</sub>**

Very sl sol in acids.

Freshly pptd. Sol in conc H<sub>2</sub>SO<sub>4</sub>, hot 2-N H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, HCl. Insol in 2-N KOH and sl sol in hot 1-N KOH.

Dried in a desiccator. Sol in HCl. Insol in H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub> and KOH.

Dried at 100°. Sol. in hot conc HCl. Insol. in H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub> and KOH. (Wöhler, Z. anorg. 1908, 57. 334.)

See also Iridium dihydroxide.

**Iridium trioxide, IrO<sub>3</sub>.**

Unstable. (Wöhler, Z. anorg. 1908, 57. 340.)

**Iridium sesquioxide, Ir<sub>2</sub>O<sub>3</sub>.**

Insol. in acids.

Sol. in conc. H<sub>2</sub>SO<sub>4</sub> and hot conc HCl. Forms colloidal solution with dil. HCl. Conc. HNO<sub>3</sub> converts it into the dioxide.

Insol in KOH+Aq. (Wöhler, Z. anorg. 1908, 57. 339.)

**Iridium oxybromide, Ir<sub>2</sub>Br<sub>2</sub>O<sub>2</sub> = 2IrBr<sub>4</sub>, IrO<sub>2</sub>.**

Not decomp by H<sub>2</sub>O. (Geisenheimer, A. ch. (6) 23. 286.)

**Iridium phosphide, Ir<sub>3</sub>P.**

(Clarke and Joslin, Am. Ch. J. 5. 231.)

**Iridium sesquiselenide, Ir<sub>2</sub>Se<sub>3</sub>**

Insol. in HNO<sub>3</sub>; slowly sol. in hot aqua regia. (Chabrie and Bouchonnet, C. R. 1903, 127. 1280.)

**Iridium monosulphide, IrS**

Insol in HNO<sub>3</sub>+Aq. and very sl sol if at all in aqua regia (Berzelius.)

Sol in K<sub>2</sub>S<sub>2</sub> and KSH+Aq.  
+ 1 H<sub>2</sub>O. Sl sol. in H<sub>2</sub>O; sol. in cold HNO<sub>3</sub>+Aq. Insol in NH<sub>4</sub>Cl+Aq or dil. acids. More sol. in K<sub>2</sub>S+Aq than PtS<sub>2</sub>. (Berzelius.)

**Iridium disulphide, IrS<sub>2</sub>.**

Not attacked by H<sub>2</sub>O, but decomp when exposed moist in air. Not attacked by sat. HCl+Aq or by conc HNO<sub>3</sub>+Aq, but is oxidised by fuming HNO<sub>3</sub>+Aq, and aqua regia. Insol in NH<sub>4</sub> sulphides, or polysulphides+Aq. Slowly sol. in alkali polysulphides+Aq (Antony, Gazz. ch. it. 23, 1. 190.)

**Iridium sesquisulphide, Ir<sub>2</sub>S<sub>3</sub>.**

Sl. sol in H<sub>2</sub>O. Sol. in HNO<sub>3</sub>, or K<sub>2</sub>S+Aq.

**Iridotriamine chloride, Ir(NH<sub>3</sub>)<sub>3</sub>Cl<sub>3</sub>.**

Sl. sol. in H<sub>2</sub>O. Not attacked by boiling H<sub>2</sub>SO<sub>4</sub>. (Palmaer, B. 22. 15.)

**Iridotetraamine chloride, Ir(NH<sub>3</sub>)<sub>4</sub>Cl<sub>2</sub>.**

Very sol. in H<sub>2</sub>O. (Palmaer, B. 22. 15.)

— chlorosulphate, [Ir(NH<sub>3</sub>)<sub>3</sub>Cl<sub>2</sub>]SO<sub>4</sub>+4H<sub>2</sub>O.

(Palmaer.)

**Iridopentamine bromide, Ir(NH<sub>3</sub>)<sub>5</sub>Br.**

Sol. in 352 pts. H<sub>2</sub>O at 12.5°. (Palmaer, B. 23. 3817.)

— bromochloride, Ir(NH<sub>3</sub>)<sub>5</sub>ClBr<sub>2</sub>.

Sol in H<sub>2</sub>O. (Palmaer, B. 24. 2090.)

— bromonitrite, Ir(NH<sub>3</sub>)<sub>5</sub>Br(NO<sub>2</sub>)<sub>2</sub>.

Sol in 179 pts. H<sub>2</sub>O at 18°. (Palmaer.)

— bromosulphate, Ir(NH<sub>3</sub>)<sub>5</sub>BrSO<sub>4</sub>+H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Palmaer.)

— carbonate, [Ir(NH<sub>3</sub>)<sub>5</sub>]<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>+3H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Claus, J. pr. 63. 99.)

— trichloride, Ir(NH<sub>3</sub>)<sub>3</sub>Cl<sub>3</sub>.

Sol. in 153.1 pts. H<sub>2</sub>O at 15.1°. (Palmaer, B. 23. 3810.)

Sol in hot H<sub>2</sub>O containing HCl. (Claus, J. pr. 69. 30.)

— chlorobromide, Ir(NH<sub>3</sub>)<sub>5</sub>ClBr<sub>2</sub>.

Sol. in 213.6 pts. H<sub>2</sub>O at 15°. (Palmaer.)

— chloriodide, Ir(NH<sub>3</sub>)<sub>5</sub>ClI<sub>2</sub>.

Sol. in 104.5 pts. H<sub>2</sub>O at 15°. (Palmaer.)

— chlorooxalate, Ir(NH<sub>3</sub>)<sub>5</sub>ClC<sub>2</sub>O<sub>4</sub>.

Sl. sol. in H<sub>2</sub>O. (Palmaer.)

**Iridopentamine chloronitrate**,  
 $\text{Ir}(\text{NH}_3)_5\text{Cl}_2(\text{NO}_3)_2$ .  
 Sol. in 51.54 pts.  $\text{H}_2\text{O}$  at  $15.4^\circ$ . (Palmaer.)

— **chloronitrite**,  
 $\text{Ir}(\text{NH}_3)_5\text{Cl}(\text{NO}_2)_2$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Palmaer.)

— **chloroplatinate**,  $\text{Ir}(\text{NH}_3)_5\text{Cl}_3$ ,  $\text{PtCl}_4$ .  
 Very sl. sol. in  $\text{H}_2\text{O}$ . (Palmaer.)

— **chlorosulphate**,  $\text{Ir}(\text{NH}_3)_5\text{ClSO}_4 + 2\text{H}_2\text{O}$ .  
 Sol. in 134.5 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Palmaer.)

— **hydroxide**,  $\text{Ir}(\text{NH}_3)_5(\text{OH})_2$ .  
 Known only in solution, which decomp. on evaporation. (Claus.)

— **nitrate**,  $\text{Ir}(\text{NH}_3)_5(\text{NO}_3)_2$ .  
 Moderately sol. in  $\text{H}_2\text{O}$ . (Claus.)  
 Sol. in 349 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . (Palmaer.)

— **sulphate**,  $[\text{Ir}(\text{NH}_3)_5]_2(\text{SO}_4)_3$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Claus.)

**Irido-aquopentamine bromide**,  
 $\text{Ir}(\text{NH}_3)_5(\text{OH})_2\text{Br}_2$ .  
 Sol. in 4 pts.  $\text{H}_2\text{O}$ . Pptd. from aqueous solution by  $\text{HBr} + \text{Aq}$ . (Palmaer, B. 24. 2090.)

— **chloride**,  $\text{Ir}(\text{NH}_3)_5(\text{OH})_2\text{Cl}_3$ .  
 Sol. in 1.2 to 1.5 pts.  $\text{H}_2\text{O}$  at ord. temp.  
 Pptd. by  $\text{HCl} + \text{Aq}$  from aqueous solution. (Palmaer, B. 24. 2090.)

— **nitrate**,  $\text{Ir}(\text{NH}_3)_5(\text{OH})_2(\text{NO}_3)_3$ .  
 Sol. in about 10 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ . Pptd. from aqueous solution by  $\text{HNO}_3 + \text{Aq}$ . (Palmaer.)

**Iridonitrous acid**,  $\text{H}_2\text{Ir}_2(\text{NO}_2)_2$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Gibbs, B. 4. 281.)

**Ammonium iridonitrite**,  $(\text{NH}_4)_2\text{Ir}_2(\text{NO}_2)_2$ .  
 Almost insol. in cold  $\text{H}_2\text{O}$ ; decomp. by hot  $\text{H}_2\text{O}$  with evolution of  $\text{N}_2$ . Decomp. by hot conc.  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$ . Insol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Leidié, C. R. 1902, 134. 1583.)

**Barium iridonitrite iridochloride**,  
 $\text{Ba}_3\text{Ir}_2(\text{NO}_2)_2$ ,  $\text{Ba}_3\text{Ir}_2\text{Cl}_{12}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Lang.)

**Mercuric iridonitrite**,  $\text{Hg}_2\text{Ir}_2(\text{NO}_2)_2$ .  
 Insol. in  $\text{H}_2\text{O}$ . (Gibbs, B. 4. 280.)

**Potassium iridonitrite**,  $\text{K}_3\text{Ir}_2(\text{NO}_2)_2$ .  
 Sl. sol. in cold, more sol. in boiling  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . Insol. in  $\text{KCl} + \text{Aq}$ . (Leidié, Bull. Soc. 1902, (3) 27. 937.)  
 $+ 2\text{H}_2\text{O}$ . Moderately sol. in  $\text{H}_2\text{O}$ .

**Potassium iridonitrite iridochloride**,  
 $\text{K}_3\text{Ir}_2(\text{NO}_2)_2$ ,  $\text{K}_3\text{Ir}_2\text{Cl}_{12}$ .  
 Sol. in  $\text{H}_2\text{O}$ .

**Silver iridonitrite**,  $\text{Ag}_2\text{Ir}_2(\text{NO}_2)_2$ .  
 Difficultly sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

**Sodium iridonitrite**,  $\text{Na}_3\text{Ir}_2(\text{NO}_2)_2 + 2\text{H}_2\text{O}$ .  
 Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot conc.  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$ . (Leidié, C. R. 1902, 134. 1583.)

**Sodium iridonitrite iridochloride**,  
 $\text{Na}_4\text{Ir}_2\text{Cl}_2(\text{NO}_2)_2 + 2\text{H}_2\text{O}$ .  
 Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)  
 $\text{Na}_2\text{Ir}_2(\text{NO}_2)_2$ ,  $\text{Na}_2\text{Ir}_2\text{Cl}_2$ . Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . (Lang.)

**Iridosamine chloride**,  $\text{Ir}(\text{NH}_3)_5\text{Cl}_2$ .  
 Nearly insol. in  $\text{H}_2\text{O}$ . (Skoblikoff, A. 84. 275.)

— **sulphate**,  $\text{Ir}(\text{NH}_3)_5\text{SO}_4$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Skoblikoff.)

**Iridosodiamine chloride**,  $\text{Ir}(\text{N}_2\text{H}_5)_2\text{Cl}_2$ .  
 Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Skoblikoff.)

— **nitrate**,  $\text{Ir}(\text{N}_2\text{H}_5)_2(\text{NO}_3)_2$ .  
 Easily sol. in  $\text{H}_2\text{O}$ .

— **sulphate**,  $\text{Ir}(\text{N}_2\text{H}_5)_2\text{SO}_4$ .  
 Sl. sol. in cold, easily in boiling  $\text{H}_2\text{O}$ . Sl. sol. in alcohol.

**Iridosulphuric acid**.

**Potassium iridosulphate**,  $\text{K}_4\text{Ir}_2(\text{SO}_4)_4$ .  
 Sol. in  $\text{H}_2\text{O}$  (de Boisbaudran, C. R. 96. 1406.)

**Iridosulphurous acid**.

**Ammonium iridosulphite**,  $(\text{NH}_4)_2\text{Ir}_2(\text{SO}_3)_2 + 6\text{H}_2\text{O}$ .  
 Slightly sol. in  $\text{H}_2\text{O}$ . (Birbaum, A. 136. 179.)

**Potassium iridosulphite**,  $\text{K}_4\text{Ir}_2(\text{SO}_3)_2 + 6\text{H}_2\text{O}$ .  
 Slightly sol. in  $\text{H}_2\text{O}$

**Sodium iridosulphite**,  $\text{Na}_4\text{Ir}_2(\text{SO}_3)_2 + 8\text{H}_2\text{O}$ .  
 Scarcely sol. in  $\text{H}_2\text{O}$ .

**Iron, Fe.**

Permanent in dry air; oxidises only slowly in moist air, but rapidly when in contact with air and  $\text{H}_2\text{O}$  simultaneously.  
 Fe does not rust in contact with air and

H<sub>2</sub>O containing alkalis even in very small amounts. (Payen, A. ch. 50. 305.)

Not attacked at ord. temp. by H<sub>2</sub>O free from air. More easily oxidised by NH<sub>4</sub> salts + Aq than by H<sub>2</sub>O when exposed to an simultaneously. (Peterson, A. ch. (3) 24. 506.)

Iron is slowly attacked by distilled H<sub>2</sub>O in presence of air. 100 ccm. distilled water removed 29 mg. from 118 sq. cm. iron in one week, while air free from CO<sub>2</sub> was passed through the solution. In presence of CO<sub>2</sub> 51 mg. were removed (Wagner, Dingl. 221. 200.)

CO<sub>2</sub> acts as a catalyst for the solution of Fe by H<sub>2</sub>O. (Whitney, J. Am. Chem. Soc. 1903, 25. 394.)

Iron is most easily oxidised when it is exposed to air, and H<sub>2</sub>O is deposited on it at the same time in liquid form.

100 l. sea water dissolve 27.37 g. from 1 sq. metre Fe, 29.16 g. from 1 sq. metre steel, 1.12 g. from 1 sq. metre galvanised Fe (Calvert and Johnson, C. N. 11). 171.)

Readily sol. in HCl, dil. H<sub>2</sub>SO<sub>4</sub> + Aq, and most other acids.

Action of H<sub>2</sub>SO<sub>4</sub> + Aq (1.12) is very much accelerated by a few drops of PtCl<sub>4</sub> + Aq; the addition of As<sub>2</sub>O<sub>3</sub> arrests the action completely. Tartar emetic and HgCl<sub>2</sub> diminish the action, but do not arrest it. CuSO<sub>4</sub> + Aq strongly accelerates the action, and Ag<sub>2</sub>SO<sub>4</sub> + Aq also to a less extent.

In the case of HCl + Aq, the addition of small amts. of metallic salts also influences the action. Weak HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq has but little action, and the addition of PtCl<sub>4</sub> increases it; As<sub>2</sub>O<sub>3</sub> stops it; other solutions have no effect. With racemic and tartaric acids the phenomena are the same.

With oxalic acid, PtCl<sub>4</sub> prevents the action. Saline solutions and even distilled H<sub>2</sub>O, when mixed with PtCl<sub>4</sub>, have slight solvent action. (Millon, C. R. 21. 45.)

Above phenomena are due to galvanic action from metal deposited on the iron. (Barreswill, C. R. 21. 292.)

H<sub>2</sub>SO<sub>4</sub> has only sl. action on cast-iron at ord. temp. with exclusion of air.

Weak acids have a strong action at higher temperatures.

Charcoal pig-iron, and case-hardened cast-iron are much less attacked by weak acids at b.-pt. than other sorts of Fe. Scotch pig-iron is most strongly attacked.

99.8% H<sub>2</sub>SO<sub>4</sub> has very sl. action on iron at ord. temp. when air is excluded. (Lunge, Dingl. 261. 131.)

Resistance against dil. H<sub>2</sub>SO<sub>4</sub> + Aq is greatly increased by increase in amt. of C if chemically combined, less so by P or Si. (Ledebur, Dingl. 223. 326.)

*Passive Iron.*—When Fe is treated with pure conc. HNO<sub>3</sub> + Aq of 1.512–1.419 sp. gr., it soon becomes coated with a bluish or black coating, apparently FeO, and when thus

covered Fe is not attacked by HNO<sub>3</sub> + Aq of any strength at ord. temp. or at the temp. of a freezing mixture; but action occurs on heating. No is Fe attacked at ord. temp. by acid of 1.401 sp. gr. or even somewhat weaker acid, though action begins at once on heating. Very dil. HNO<sub>3</sub> + Aq attacks Fe at ord. temp. with formation of NH<sub>4</sub>NO<sub>3</sub> and Fe(NO<sub>3</sub>)<sub>2</sub>. The action of HNO<sub>3</sub> + Aq is influenced by PtCl<sub>4</sub>. If acid containing 4.5 equivalents of H<sub>2</sub>O is diluted with 2–3 vols. H<sub>2</sub>O, and then poured on Fe turnings, they dissolve at once with evolution of nitrous fumes and formation of ferric salt, but if to the acid one drop of PtCl<sub>4</sub> be added, only H<sub>2</sub> is evolved, and NH<sub>4</sub>NO<sub>3</sub> and Fe(NO<sub>3</sub>)<sub>2</sub> are formed. (Millon, C. R. 21. 47.)

The more H<sub>2</sub>O the acid contains the lower will be the temp. at which the Fe remains passive. Shaking the wire hastens the passivity. Contact with Pt, Au, or C does not prevent it. Fe wire becomes passive by remaining 10 min. in HNO<sub>3</sub> vapour. (Renard, C. R. 79. 159.)

Iron may be made passive by HClO<sub>4</sub>, HBrO<sub>3</sub>, HIO<sub>3</sub>, H<sub>2</sub>CiO<sub>4</sub>, in the same way as by HNO<sub>3</sub>.

Iron may also be made passive by moderate ignition.

Passivity occurs with HNO<sub>3</sub> + Aq of 1.38 sp. gr. after a short time at 31°, but if temp. is 32°, passivity does not occur.

Colourless HNO<sub>3</sub> + Aq of 1.42 sp. gr. produces passivity at 55° but not at 56°. Red fuming HNO<sub>3</sub> + Aq of 1.42 sp. gr. produces passivity at 82° but not at 83°. (Ordway, Sill. Am. J. (2) 40. 316.)

The passivity of Fe is destroyed when it is placed in a magnetic field at a much lower temperature than when in normal condition. (Nichols and Franklin, Sill. Am. J. (3) 34. 419.)

Passivity depends on a coating of NO which hinders the action of the acid. All operations which remove this layer terminate the passivity, as shaking, rubbing, placing in a vacuum, etc. (Varenne, C. R. 89. 783.)

When Fe is plunged in HNO<sub>3</sub> + Aq of 1.42 sp. gr. there is a sudden evolution of gas which ceases after 3 to 20 seconds, and the surface becomes bright. The same phenomena take place with a more dilute acid, if of not less than 1.32 sp. gr. In the latter case, there is an immediate evolution of gas, which suddenly ceases and the metal becomes bright, but soon the acid begins to act again at a single point, and the action gradually spreads over the whole surface, this, however, soon ceases again, and we have an "intermittent passivity."

If a part of a piece of iron is immersed in strong acid, the whole of it is made passive. This is explained by the NO spreading over the whole surface by capillarity.

The passivity ceases when the Fe is placed in dil. acid, after a longer or shorter time,

according to the dilution of the acid,—when the acid has sp. gr. = 1.30, after 11 days  
 " " " 1.28 " 5 "  
 " " " 1.26 " 32 hours  
 " " " 1.16 " 12 "

Iron may also be made passive by long standing in NO gas under pressure. (Vareane, C. R. 90. 998.)

Fe is made passive by a coating of  $\text{Fe}_2\text{O}_3$ , not by NO (Schonbein, Pogg. 39. 342.) (Beetz, Pogg. 87. 286.) (Ramann, B. 14. 1430.)

Passivity may also be caused by  $\text{NH}_4\text{NO}_3$  + Aq. ammoniacal  $\text{AgNO}_3$  + Aq.  $\text{Fe}(\text{NO}_3)_3$ ,  $\text{Fe}(\text{NO}_3)_2$ ,  $\text{Al}(\text{NO}_3)_3$ ,  $\text{Co}(\text{NO}_3)_2$ ,  $\text{Ni}(\text{NO}_3)_2$ , etc + Aq instead of  $\text{HNO}_3$  + Aq. (Ramann, B. 14. 1933.)

Hardly attacked by either dil. or conc. acids when they are under high pressure. (Cailliet, C. R. 68. 395.)

Iron is dissolved by  $\text{HNO}_3$  + Aq. even when very conc., but no gas is evolved and the process is very slow

$\text{HNO}_3$  + Aq. of the following sp. gr. dissolves the given amts. from strips of pure Fe

Sp. gr. of acid	Diminution of weight in 24 hours
1.28	0.82%
1.34	0.75
1.38	0.29
1.48	0.34
1.53	5.80

(Gautier and Charpy, C. R. 113. 1451.)

Insol. in liquid chlorine below  $90^\circ$ . (Lange, Zeit. angew. Ch. 1900. 13. 688.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. ch. J. 1898. 20. 828.)

Not attacked by alkalis

Sol. in  $\text{NaOH}$  + Aq (84%) when air is blown through the liquid (Zirmité, Ch. Ztg. 12. 355.)

$\text{NaOH}$  + Aq attacks iron and steel. (Venator, Dingl. 261. 133.)

$\text{NaOH}$  + Aq has slight action on Fe between  $15^\circ$  and  $100^\circ$ . (Lunge, Dingl. 261. 131.)

Presence of alkalis prevent rusting entirely, and fats and oils greatly hinder it. (Wagner.)

Sol. in alkali hydrogen carbonates + Aq. (Berzelius.)

Sat.  $\text{NaCl}$  + Aq has al. but perceptible action on Fe.  $\text{NH}_4\text{Cl}$  + Aq has stronger action than  $\text{NaCl}$  + Aq. (Lunge.)

100 cem.  $\text{H}_2\text{O}$  containing 0.5 g.  $\text{NaCl}$  or  $\text{KCl}$  removed 42 mg. from 11.8 sq. cm. iron in one week, while air free from  $\text{CO}_2$  was passed through the solution, and 72 mg. in presence of  $\text{CO}_2$ .

100 cem.  $\text{H}_2\text{O}$  containing 1 g.  $\text{NH}_4\text{Cl}$  removed 45 mg., and 78 mg. respectively under the above conditions.

100 cem.  $\text{H}_2\text{O}$  containing 0.8 g.  $\text{MgCl}_2$  re-

moved 49 mg., and 65 mg. respectively under the above conditions.

Not attacked by 100 cem  $\text{H}_2\text{O}$  containing 1 g.  $\text{Na}_2\text{CO}_3$ , or by  $\text{CaO}_2\text{H}_2$  + Aq (Wagner, Dingl. 221. 260.)

Action of  $\text{KClO}_3$  + Aq.  $\text{KClO}_3$  + Aq (6.3%  $\text{KClO}_3$ ) oxidised 11.21 g. cast iron and 20.1 g. pure iron from a surface of 1 sq. metre in 7 hours;  $\text{KClO}_3$  + Aq (25%  $\text{KClO}_3$ ) oxidised 24.59 g. cast, and 44.90 g. pure Fe under above conditions;  $\text{Ca}(\text{ClO}_3)_2$ ,  $\text{CaCl}_2$  + Aq (20° Baume) obtained by passing Cl through  $\text{CaO}_2\text{H}_2$  + Aq oxidised 85 g. cast, and 95 g. pure Fe under the above conditions. (Lange and Deggele, J. Soc. Chem Ind. 4. 32.)

Easily sol. in organic acids

#### Comparative action of oils on Fe.

	Amount Fe dissolved
Nentsfoot oil	0.0875 grains
Colza "	0.0800 "
Spam "	0.0460 "
Lard "	0.0250 "
Olive "	0.0032 "
Linseed "	0.0050 "
Seal "	0.0050 "
Castor "	0.0048 "
Paraffine "	0.0045 "
Almond "	0.0040 "
"Lubricating" oil	0.0018 "

(Watson, C. N. 42. 190.)

$\frac{1}{2}$  cem. oleic acid dissolves 0.0007 g. Fe in 6 days (Gates, J. phys. Chem. 1911. 15. 143.)

Fe dissolves in albumen solution to the extent of 1 to 2 per cent. (Buchner, Arch. Pharm. (3) 20. 417.)

Attacked by sugar + Aq at  $115$ – $120^\circ$ , also by inverted sugar or malt extract, not by glycerine or mannite + Aq. (Klein and Berg, C. R. 102. 1170.)

#### Iron arsenide, $\text{FeAs}_2$ .

Min. *Löllingite*. Sol. in  $\text{HNO}_3$  + Aq with separation of  $\text{As}_2\text{O}_3$ .

$\text{Fe}_2\text{As}_4$ . Min. *Leucopyrite*

#### Iron arsenide sulphide, $\text{FeAs}_2\text{S}_2$ .

Min. *Arsenopyrite*. Sol. in  $\text{HNO}_3$  + Aq with separation of S and  $\text{As}_2\text{O}_3$ ; wholly sol. in aqua regia; not attacked by  $\text{HCl}$  + Aq

#### Iron boride, $\text{Fe}_2\text{B}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in hot dil  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  and in hot conc  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . Sol. in hot dil. or cold conc.  $\text{HNO}_3$ . (Jassonneix, C. R. 1907. 145. 122.)

$\text{FeB}$ . Sol. in molten alkali carbonates; not sol. in dil. or conc.  $\text{H}_2\text{SO}_4$  in the cold; sol. in boiling  $\text{H}_2\text{SO}_4$  and in  $\text{HNO}_3$ . (Moissan, Bull. Soc. 1895. (3) 13. 958.)

Stable in dry air. Decomp. by aqua regia,

but not readily sol in conc.  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$  (Moissan, C. R. 1895, 120, 176.)

$\text{FeBr}_2$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  and in hot conc.  $\text{HCl}$  (Jassomere, C. R. 1907, 145, 122.)

#### Iron (ferrous) bromide, $\text{FeBr}_2$ .

Sol in  $\text{H}_2\text{O}$ . Decomp. by heating on air. Sat.  $\text{FeBr}_2 + \text{Aq}$  contains at

-21°	-7°	+10°	21°
17 0	48 3	52 3	53 7 <sup>c</sup> $\text{FeBr}_2$ .
37°	50°	65°	95°
50 0	58 0	59 4	63 3 <sup>c</sup> $\text{FeBr}_2$ .

(Étard, A. ch. 1894, (7) 2, 541.)

+4 $\text{H}_2\text{O}$ . Very sol in  $\text{H}_2\text{O}$ , pptd. from cooled aq. solution. (Volkman, C. C. 1894, II 611.)

+6 $\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$  (Lowig.)

+9 $\text{H}_2\text{O}$  (Volkman.)

#### Ferric bromide, $\text{FeBr}_3$ .

Deliquescent. Sol in  $\text{H}_2\text{O}$ , alcohol, and ether (Lowig.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

+6 $\text{H}_2\text{O}$ . Sol. in alcohol and ether. (Bolschakoff, C. C. 1898, II 660.)

#### Ferrous mercuric bromide.

Deliquescent (v. Bonsdorff.)

#### Ferric rubidium bromide, $\text{Rb}_2\text{FeBr}_4 \cdot \text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Walden, Z. anorg. 1894, 7, 332.)

#### Ferrous stannic bromide.

See Bromostannate, ferrous.

#### Ferrous bromide nitric oxide, $3\text{FeBr}_2 \cdot 2\text{NO}$

Sol. in  $\text{H}_2\text{O}$ . Not isolated (Thomas, C. R. 1896, 123, 944.)

#### Ferric bromochloride, $\text{FeCl}_2\text{Br}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. Notably sol. in chloroform, benzene, and toluene. Insol. in  $\text{CS}_2$ . (Lenormand, C. R. 116, 820.)

#### Iron carbide, $\text{Fe}_3\text{C}$

(Gurlt, J. B. 1856, 781.)

Mixture of  $\text{Fe}$  and  $\text{Fe}_3\text{C}_4$ . (Tunner, Polyt. Centralbl. 1861, 1227.)

$\text{Fe}_3\text{C}$  (Karsten, J. pr. 40, 229.)

$\text{Fe}_3\text{C}$ . Sol. in hot conc.  $\text{HCl}$ ; oxidized slowly by moist air. (Campbell, Am. Ch. J. 1896, 18, 840-841.)

$\text{Fe}_2\text{C}_2$ . (Rammelsberg, C. C. 1847, 60.)

#### Iron molybdenum carbide, $\text{Fe}_3\text{C} \cdot \text{Mo}_3\text{C}$ .

Sol. in hydrazoids; insol. in  $\text{HNO}_3$ . (Williams, C. R. 1898, 127, 484.)

#### Iron tungsten carbide, $2\text{Fe}_3\text{C} \cdot 3\text{W}_2\text{C}$ .

Insol. in  $\text{H}_2\text{O}$  and hydrazoids; sol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Williams, C. R. 1898, 127, 411.)

#### Iron carbonyl, $\text{Fe}(\text{CO})_5$ .

Slowly decomp. on air. Not attacked by dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ . Conc.  $\text{HNO}_3$ ,  $\text{Cl}_2 + \text{Aq}$ , or  $\text{Br}_2 + \text{Aq}$  decomp. easily. Sol. in alcoholic solution of  $\text{KOH}$  or  $\text{NaOH}$  with subsequent decomp. Sol. in alcohol, ether, benzene, mineral oils, etc. (Mond and Langer, Chem. Soc. 59, 1000.)

$\text{Fe}_2(\text{CO})_9$ . Decomp. on air. Not attacked by  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$ . Sol. in alcoholic potash. Very much less sol. in organic solvents than  $\text{Fe}(\text{CO})_5$  (Mond and Langer.)

#### Ferrous chloride, $\text{FeCl}_2$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  with evolution of heat, or in alcohol. Insol. in ether. (Jahn.)

Sol. in 2 pts.  $\text{H}_2\text{O}$  at 18.75°. (Abl.)

Sol. in 1 pt. strong alcohol. (Wenzel.)

Sp. gr. of  $\text{FeCl}_2 + \text{Aq}$  at 15.5°.

Sp. gr.	% $\text{FeCl}_2$	% $\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$
1.05	5.40	8.45
1.06	6.43	10.09
1.07	7.47	11.69
1.08	8.48	13.29
1.09	9.49	14.86
1.10	10.47	16.41
1.11	11.45	17.86
1.12	12.42	19.46
1.13	13.37	20.96
1.14	14.31	22.41
1.15	15.24	23.87
1.16	16.15	25.31
1.17	17.05	26.73
1.18	17.94	28.13
1.19	18.83	29.51
1.20	19.68	30.85
1.21	20.50	32.14
1.22	21.39	33.53
1.23	22.24	34.84
1.24	23.05	36.11
1.25	23.86	37.38
1.26	24.68	38.67
1.27	25.44	39.87
1.28	26.19	41.04
1.29	26.98	42.29
1.30	27.75	43.49
1.31	28.49	44.65
1.32	29.23	45.81
1.33	29.96	46.94
1.34	30.68	48.08
1.35	31.39	49.18
1.36	32.10	50.30
1.37	32.79	51.39
1.38	33.47	52.46
1.39	34.14	53.50
1.40	34.80	54.55
1.41	35.46	55.57
1.42	36.09	56.56
1.43	36.73	57.55
1.44	37.33	58.51

(Dunn, J. Soc. Chem. Ind. 1902, 21, 390.)

Insol in liquid HF. (Franklin, Z. anorg. 1905, 46, 2)

Sol in acetone; insol in methylal (Eidmann, C. C. 1899, II, 1014)

Sol in acetone (Naumann, B. 1904, 37, 4328.)

Sl. sol in methyl acetate. (Naumann, B. 1909, 42, 3790)

Sol in ethyl acetate. (Naumann, B. 1910, 43, 314)

Insol in ethyl acetate (Naumann, B. 1904, 37, 3601.)

Yellow modification is sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, 15, 21)

+2H<sub>2</sub>O. (Jonas)

+4H<sub>2</sub>O. Deliquescent. Easily sol. in alcohol Sol. in 0.68 pt. cold H<sub>2</sub>O. (Reimann, Mag. Pharm. 17, 215)

Sat. aq. solution contains at:

16° 18° 25° 28° 43°  
40 5 40 9 41.0 42 5 44 4% FeCl<sub>3</sub>,

50° 53° 72° 89° 96° 118°  
45 0 45.9 49 2 51 3 51 0 51 7% FeCl<sub>3</sub>.

(Étard, A. ch. 1894, (7) 2, 637.)

100 g. FeCl<sub>3</sub>, 4H<sub>2</sub>O + Aq contain 17.54 g. Fe at 22.8°; 18.59 g. at 43.2° (Boecke, N. Jahrb. Min 1911, I, 61)

More sol. in water containing NO than in pure H<sub>2</sub>O. (Gay, Bull. Soc. (2) 44, 175.)

Sol in hot HCl + Aq. (Sabatier, Bull. Soc. 1895, (3) 13, 599)

[Sabatier could not obtain FeCl<sub>2</sub> + 6H<sub>2</sub>O of Lescaur]

**Ferroferric chloride, Fe<sub>3</sub>Cl<sub>8</sub> + 18H<sub>2</sub>O.**

Deliquescent. (Lefort, J. Pharm. (4) 10, 85.)

**Ferric chloride, Fe<sub>2</sub>Cl<sub>6</sub> or FeCl<sub>3</sub>**

Very deliquescent, and sol. in H<sub>2</sub>O with evolution of great heat

100 mols. H<sub>2</sub>O dissolve mols. anhydrous Fe<sub>2</sub>Cl<sub>6</sub> at t°.

t°	Mols. Fe <sub>2</sub> Cl <sub>6</sub>	t°	Mols. Fe <sub>2</sub> Cl <sub>6</sub>
66	29.20	80	29.20
70	29.42	100	29.75
75	28.92	.	...

(Roozeboom, Z. phys. Ch. 10, 477.)

See also hydrated salts below

Solution in H<sub>2</sub>O is decomp. into colloidal Fe<sub>2</sub>O<sub>3</sub>, xH<sub>2</sub>O and HCl, upon heating if conc., and on simple standing if dil.

Kreeke (J. pr. (2) 3, 286) gives the following table.

% FeCl <sub>3</sub> in solution	Temp. at which Graham's colloidal hydrate is formed	Temp. at which Saint Gilles' colloidal hydrate is formed	Temp. at which oxychlorides are formed	Temp. at which Fe <sub>2</sub> O <sub>3</sub> is formed
32	100-130°	...	100°+	140°
16	100-120		"	120
8	100-110		"	110
4	90-100		90	..
2	87		87	..
1	83	100-130°	.	..
0.5	75	"	.	..
0.25	64	"	.	..
0.125	54	"	..	...
0.0625	36	"	"	.

Sp. gr. of Fe<sub>2</sub>Cl<sub>6</sub> + Aq.

% Fe <sub>2</sub> Cl <sub>6</sub>	Sp. gr. at 4.5°	Sp. gr. at 9.7°	Sp. gr. at 14.6°	Sp. gr. at 19.7°
49.61	1.5009	1.5575	1.5540	1.5497
41.00	1.4413	1.4387	1.4361	1.4335
36.95	...	1.3847	1.3824	1.3800
33.25	1.3381	1.3359	1.3339	1.3317
24.60	1.2351	1.2334	1.2318	1.2298
22.54	1.2140	1.2129	1.2107	1.2090
16.79	1.1534	1.1521	1.1507	1.1491
10.45	1.0939	1.0930	1.0918	1.0901
4.65	.	.	1.0382	.
2.70	.	.	1.0221	.

(Schult, from Gerlach, Z. anal. 27, 278.)

Sp. gr. of Fe<sub>2</sub>Cl<sub>6</sub> + Aq increases or diminishes between 8° and 24° for a decrease or increase of temp. of 1° by the following amts.

% Fe <sub>2</sub> Cl <sub>6</sub>	Corr.	% Fe <sub>2</sub> Cl <sub>6</sub>	Corr.
50-60	0.0008	30-39	0.0005
45-49	0.0007	20-29	0.0004
40-44	0.0006	10-19	0.0003

(Hager, I. c.)

Sp. gr. of $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ at $17.5^\circ$ .						Solubility of $\text{Fe}_2\text{Cl}_6$ in $\text{HCl} + \text{Aq}$ .			
$\frac{c}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{c}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{c}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	t°	Sat. solution content per 100 mols. $\text{H}_2\text{O}$		Solid phase *
							mols. $\text{HCl}$	mols. $\text{FeCl}_3$	
1	1.0073	21	1.1611	11	1.3746	30	0	12.70	$\text{Fe}_2\text{Cl}_6 + 12\text{H}_2\text{O}$
2	1.0146	22	1.1746	12	1.3870	"	5.92	16.07	
3	1.0219	23	1.1818	13	1.3994	"	0	20.90	
4	1.0292	24	1.1950	14	1.4118	"	0	10.90	
5	1.0365	25	1.2052	15	1.4212	25	0	23.72	
6	1.0439	26	1.2155	16	1.4367	"	2.33	24.50	
7	1.0513	27	1.2258	17	1.4492	"	0	10.20	
8	1.0587	28	1.2365	18	1.4617	20	0	23.60	
9	1.0661	29	1.2464	19	1.4742	"	5.60	25.70	
10	1.0734	30	1.2568	20	1.4867	"	0	9.10	
11	1.0814	31	1.2673	21	1.5010	10	8.75	8.00	
12	1.0894	32	1.2778	22	1.5153	"	16.70	16.65	
13	1.0974	33	1.2883	23	1.5296	"	13.80	23.35	
14	1.1054	34	1.2988	24	1.5439	"	0	8.25	
15	1.1134	35	1.3093	25	1.5582	"	7.52	6.51	
16	1.1215	36	1.3199	26	1.5729	0	13.37	6.33	
17	1.1297	37	1.3305	27	1.5876	"	16.80	8.70	
18	1.1378	38	1.3411	28	1.6023	"	18.45	10.23	
19	1.1458	39	1.3517	29	1.6170	"	20.40	15.40	
20	1.1542	40	1.3622	30	1.6317	"	20.10	16.00	
(Franz, J. pr. (2) 5. 283.)						"	19.95	17.70	
Sp. gr. of $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ at $17.5^\circ$ .						"	19.00	22.75	
$\frac{c}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{c}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{c}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	"	18.05	23.40	
1	1.008	21	1.191	41	1.428	-10	0	7.40	
2	1.016	22	1.202	42	1.441	"	19.46	10.37	
3	1.025	23	1.212	43	1.454	"	20.48	20.54	
4	1.033	24	1.223	44	1.469	"	20.25	21.56	
5	1.042	25	1.234	45	1.481	-12.5	22.14	16.09	
6	1.051	26	1.245	46	1.494	-15	0	6.98	
7	1.060	27	1.256	47	1.507	"	21.30	9.65	
8	1.069	28	1.268	48	1.520	-20	0	6.56	
9	1.078	29	1.280	49	1.533	"	7.50	4.90	
10	1.087	30	1.292	50	1.547	"	15.30	5.09	
11	1.095	31	1.304	51	1.560	"	20.50	7.08	
12	1.104	32	1.316	52	1.573	30	0	25.20	$\text{Fe}_2\text{Cl}_6 + 7\text{H}_2\text{O}$
13	1.113	33	1.328	53	1.587	"	4.25	27.80	
14	1.123	34	1.340	54	1.600	"	0	30.24	
15	1.131	35	1.352	55	1.612	25	0	23.50	
16	1.140	36	1.364	56	1.624	"	2.33	23.72	
17	1.150	37	1.376	57	1.636	"	7.50	29.75	
18	1.160	38	1.390	58	1.648	"	0	31.50	
19	1.170	39	1.403	59	1.659	20	0	22.50	
20	1.180	40	1.415	60	1.670	"	5.00	23.00	
(Hager, Comm. 1883.)						"	11.05	29.20	
Sp. gr. of conc. $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ at $20-21^\circ$ .						"	11.05	29.20	
$\frac{c}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{c}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{c}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	"	0	32.00	
60	1.669	65	1.715	70	1.758	15	10.75	23.50	
61	1.679	66	1.724	71	1.766	"	14.90	28.35	
62	1.688	67	1.733	72	1.774	10	13.80	23.35	
63	1.697	68	1.742	73	1.782	"	17.80	27.75	
64	1.706	69	1.750	74	1.790	"	17.80	27.75	
(Hager, l. c.)						0	18.05	23.40	
						"	19.50	25.93	

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{HCl} + \text{Aq.}$ —Continued.

$t^\circ$	Sat. solution contains per 100 mols. $\text{H}_2\text{O}$		Solid phase	$t^\circ$	Sat. solution contains per 100 mols. $\text{H}_2\text{O}$		Solid phase
	mols. $\text{HCl}$	mols. $\text{FeCl}_3$			mols. $\text{HCl}$	mols. $\text{FeCl}_3$	
50	0	35.00	$\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$	33	30.45	48.70	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
"	3.25	39.95		30	17.15	56.75	
44	0	33.50		"	31.20	43.49	
"	3.04	33.80		"	33.80	47.80	
"	10.62	34.64		"	32.60	49.93	
"	11.50	35.60		25	19.50	35.25	
"	10.70	38.00		"	20.60	35.34	
40	0	32.40		"	31.34	41.58	
"	13.40	37.45		"	33.00	43.00	
33	0	31.00		"	31.65	44.80	
"	15.70	37.06		20	21.25	34.25	
30	0	30.24		"	28.81	37.57	
"	17.20	34.00		"	34.23	42.02	
"	17.15	36.75		"	35.40	43.16	
25	0	29.00		15	29.40	36.50	
"	7.50	29.75		"	33.60	40.03	
"	19.50	35.25		10	24.50	32.75	
20	0	27.90		"	35.04	39.95	
"	11.05	29.20		0	20.00	32.16	
"	15.80	30.08		"	34.60	38.11	
"	21.25	34.25		-10	27.30	32.05	$\text{Fe}_2\text{Cl}_6$ anhydrous
15	14.90	28.35		"	33.56	36.25	
"	16.40	29.32		-20	30.08	32.76	
10	17.80	27.75		"	32.65	35.44	
"	18.80	28.70		45	0	58.00	
"	24.50	32.75		"	31.28	50.08	
0	24.12	30.04		"	40.65	48.00	
"	26.00	32.16		40	0	58.00	
-10	24.95	29.60		"	27.00	50.80	
"	26.05	30.50		"	42.01	48.64	
"	27.30	32.05		35	0	58.00	
70	0	44.0	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$	"	29.01	50.33	
"	6.75	50.00		"	37.04	49.20	
"	0	55.80		30	0	58.00	
65	0	42.50		"	32.60	49.93	
"	10.25	50.00		"	34.40	49.72	
"	3.75	57.25		40	42.50	47.52	$\text{Fe}_2\text{Cl}_6, 2\text{HCl},$ $4\text{H}_2\text{O}$
"	0	59.00		"	42.01	48.04	
60	0	41.40		35	30.47	46.57	
"	14.25	50.00		"	37.04	49.20	
"	10.70	55.25		30	40.21	42.54	
"	0	61.00		"	38.20	44.70	
55	0	40.64		"	35.55	47.30	
"	19.00	50.72		"	34.40	49.72	
"	16.71	53.60		25	40.41	40.25	
"	0	62.00		"	39.03	41.38	
50	0	39.92		"	35.74	45.24	
"	3.25	39.95		20	39.50	39.25	
"	21.24	49.33		"	35.40	43.16	
"	20.04	52.50		10	38.62	37.48	
44	0	39.00		"	37.46	38.33	
"	10.70	38.00		"	36.30	38.70	
"	14.80	38.70		"	35.04	39.93	
"	24.14	50.10		0	37.27	36.60	
40	13.40	37.45		"	34.60	38.11	
"	27.00	50.80		-10	37.92	35.32	
33	15.70	37.06		"	34.54	36.00	
"	29.20	42.70		-20	33.56	36.25	
"	31.08	40.85		"	37.80	34.50	
"	30.81	47.65		"	34.10	34.84	
				"	32.56	35.44	

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{HCl} + \text{Aq}$  — *Continued.*

$t^\circ$	Sat. solution contains per 100 mols. $\text{H}_2\text{O}$		Solid phases
	mols. $\text{HCl}$	mols. $\text{FeCl}_3$	
-4.5	20.50	21.50	$\text{Fe}_2\text{Cl}_6, 2\text{HCl},$ $\text{SH}_2\text{O}$
"	20.66	25.74	
"	23.42	27.40	
-6	29.10	21.73	
"	26.18	21.75	
"	24.41	21.50	
"	23.25	21.35	
"	21.73	21.84	
"	19.73	25.50	
"	24.42	28.45	
"	28.20	27.04	
-10	20.48	20.54	
"	21.90	18.94	
"	28.75	20.31	
"	31.42	28.53	
"	28.25	30.25	
"	26.05	30.50	
-15	21.50	15.83	
-15	28.40	31.80	
-20	19.44	12.10	
"	22.83	11.63	
"	25.20	11.60	
"	27.20	11.31	
"	31.08	11.51	
"	34.13	12.90	
"	33.93	31.77	
"	30.08	32.76	
"	28.70	32.88	
-10	12.01	11.99	$\text{Fe}_2\text{Cl}_6, 2\text{HCl},$ $12\text{H}_2\text{O}$
"	19.78	14.02	
"	20.95	16.20	
"	20.25	20.20	
"	17.73	20.70	
"	15.44	19.65	
-12.5	22.14	16.69	
-15	21.30	9.65	
"	24.50	15.83	
-20	9.96	9.94	
"	13.32	8.57	
"	16.90	7.35	
"	18.97	7.16	
"	20.53	7.08	
"	23.40	7.20	
"	24.85	9.88	
"	25.20	11.60	
"	25.40	12.37	
"	25.59	13.39	

(Roozeboom and Schreinemakers, Z. phys. Ch 1894, 15. 633.)

Solubility of  $\text{Fe}_2\text{Cl}_6 + \text{NH}_4\text{Cl}$ .  
See  $\text{NH}_4\text{Cl} + \text{Fe}_2\text{Cl}_6$  under  $\text{NH}_4\text{Cl}$ Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{CsCl}$ .  
See  $\text{CsCl} + \text{Fe}_2\text{Cl}_6$  under  $\text{CsCl}$ .Solubility of  $\text{FeCl}_3 + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $21^\circ$ .

Substance added		Pts by weight sol in 100 pts of solution	
$\text{FeCl}_3$ grams	$\text{KCl}$ grams	$\text{FeCl}_3$	$\text{KCl}$ *
0	25	0	34.97
13	28	13.44	24.45
18	21	23.18	16.51
3	18.5	28.05	11.69
28	16	35.72	11.68
31	10.5	36.02	11.19
36.2	9	37.35	13.67
41.5	8	42.03	7.88
46.5	6	51.69	7.54
52	0.5		
155	0	83.89	0

(Hinrichsen and Sachscl, Z. phys. Ch. 1904, 50. 95.)

 $\text{FeCl}_3 + \text{NaCl}$ Solubility of  $\text{FeCl}_3 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at  $21^\circ$ .

Substance added		Pts by weight sol in 100 pts of solution	
$\text{FeCl}_3$ grams	$\text{NaCl}$ grams	$\text{FeCl}_3$	$\text{NaCl}$
0	3.6	0	36.10
1.8	3.0	24.27	9.10
3.6	2.5	25.40	8.45
5.5	2.0	26.40	5.25
7.2	1.5	38.15	3.90
9.0	1.0	43.38	2.45
10.8	0.5	46.75	2.11
10.8	0	83.39	0

(Hinrichsen and Sachscl, Z. phys. Ch 1904, 50. 94.)

Solubility of  $\text{FeCl}_3$  in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	Substance added		% of Fe in the solution
	$\text{FeCl}_3$	$\text{NaCl}$	
10	40	20	15.2
10	60	20	15.2
10	100	20	15.16
20	60	20	16.2
20	80	20	16.18
20	100	20	16.2
30	70	30	17.7
30	90	30	17.0
30	110	30	17.67
50	30	20	23.5
50	45	20	23.9
40	35	30	25.4
40	50	30	25.5
30	30	20	23.8
30	45	20	24.0
17.6	30	20	24.47
17.6	50	20	24.5

(Hinrichsen and Sachscl, Z. phys. Ch. 1904, 50. 95.)

Difficultly sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1903, 29, 374.)

Attacked by liquid  $\text{NO}_2$  in the presence of traces of moisture. (Frankland, Chem. Soc. 1901, 79, 1361.)

Sol in liquid  $\text{SO}_2$ . (Walden, B. 1899, 32, 2861.)

Sol in alcohol ether, acetic ether (Cann, C. R. 102, 303), and acetone (Krug and M'Elroy, J. anal. Ch. 6, 184.)

Sl. sol. in ethylamine (Shinn, J. phys. Chem. 1907, 11, 538.)

Sol in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

1 g.  $\text{FeCl}_3$  is sol. in 1.59 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 1.160$ . (Naumann, B. 1904, 37, 4333.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II, 1014.)

Sol in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51, 286.)

Sl. sol. in  $\text{CS}_2$ . (Arcowski, Z. anorg. 1894, 6, 257.)

Mol weight determined in pyridine (Werner, Z. anorg. 1897, 16, 22.)

Sublimed.

Sol. in  $\text{AsCl}_3$ ,  $\text{POCl}_3$ ,  $\text{SO}_2\text{Cl}_2$  and  $\text{PBr}_3$ ; sl. sol. in  $\text{PCl}_5$ . (Walden, Z. anorg. 1900, 25, 214.)

The salts with different amts. of crystal  $\text{H}_2\text{O}$  have different solubilities. (Roozeboom.

+4 $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at  $73.5^\circ$ .

100 mols.  $\text{H}_2\text{O}$  dissolve mols.  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
50	19 96	69	21 53	72 5	26 15
55	20 32	72 5	23 35	70	27 90
60	20 70	73 5	25 00	66	29.20

(Roozeboom, Z. phys. Ch. 10, 477.)

+5 $\text{H}_2\text{O}$ . Correct formula for +6 $\text{H}_2\text{O}$  salt.

100 mols.  $\text{H}_2\text{O}$  dissolve mols.  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
12	12 87	30	15.12	55	19.15
20	13.95	35	15.64	56	20.00
27	14 85	50	17 50	55	20.32

(Roozeboom.)

Melts in crystal  $\text{H}_2\text{O}$  at  $31^\circ$  (Engel, C. R. 104, 1708); at  $56^\circ$  (Roozeboom).

+6 $\text{H}_2\text{O}$ . Very deliquescent. Sol. in alcohol. Ether dissolves out  $\text{Fe}_2\text{Cl}_6$ .

M.-pt. is  $31^\circ$ . (Ordway.) Contains only 5 $\text{H}_2\text{O}$ . (Roozeboom.)

+7 $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at  $32.5^\circ$ .

100 mols.  $\text{H}_2\text{O}$  dissolve mols.  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 7\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
20	11.85	32	13 55	30	15.12
27 4	12 15	32 5	14 99	25	15 54

(Roozeboom.)

+12 $\text{H}_2\text{O}$ . Less deliquescent than  $\text{Fe}_2\text{Cl}_6$  or  $\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$ .

100 mols.  $\text{H}_2\text{O}$  dissolve mols.  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 12\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
-55	2 75	30	5.93	27.4	11 20
-41	2 81	35	6.78	20	12 15
-27	2 98	36.5	7.93	10	12 83
0	4.13	37	8 33	8	13 70
10	4 54	36	9 29	.	.
20	5.10	30	10 45	.	.

(Roozeboom.)

Sol. in alcohol. Ether dissolves out  $\text{Fe}_2\text{Cl}_6$ . Melts in crystal  $\text{H}_2\text{O}$  at  $37^\circ$  (Roozeboom); at  $35.5^\circ$  (Ordway).

Ferric hydrogen chloride,  $\text{FeCl}_3$ ,  $\text{HCl} + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Sabatier, Bull. Soc. (2) 197.)

More sol. in  $\text{H}_2\text{O}$  than  $\text{FeCl}_3$ . (Engel, C. R. 104, 1708.)

For solubility, see  $\text{FeCl}_3 + \text{HCl}$ , under ferric chloride.

+6 $\text{H}_2\text{O}$ . (Roozeboom and Schreinemakers.)

For solubility, see  $\text{FeCl}_3 + \text{HCl}$ , under ferric chloride.

Ferrous lithium chloride,  $\text{FeCl}_2$ ,  $\text{LiCl} + 3\text{H}_2\text{O}$ . (Chassevant, A. ch. (6) 30, 17.)

Ferric magnesium chloride,  $\text{FeCl}_3$ ,  $\text{MgCl}_2 + \text{H}_2\text{O}$ .

Deliquescent. (Neumann, B. 18, 2890.)

Ferrous mercuric chloride,  $\text{FeCl}_2$ ,  $\text{HgCl}_2 + 4\text{H}_2\text{O}$ .

Deliquescent. (v. Bonsdorff.)

Ferric nitrosyl chloride,  $\text{FeCl}_3$ ,  $\text{NOCl}$ .

Very deliquescent. (Weber, Pogg. 118, 477.)

Ferric phosphoric chloride,  $\text{FeCl}_3$ ,  $\text{PCl}_5$ .

Decomp. by  $\text{H}_2\text{O}$ . (Baudrimont, A. ch. (4) 2, 15.)

**Iron (ferrous) potassium chloride,  $\text{FeCl}_2 \cdot 2\text{KCl} + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  (Berzelius)

**Ferrie potassium chloride,  $\text{FeCl}_2 \cdot 2\text{KCl} + \text{H}_2\text{O}$**

A little  $\text{H}_2\text{O}$  dissolves out  $\text{FeCl}_2$ . (Fritzsche J. pr. 18. 483.)

Sol. in  $\text{H}_2\text{O}$  (Walden, Z. anorg. 1891, 71. 332.)

**Ferric rubidium chloride,  $\text{FeCl}_2 \cdot 3\text{RbCl}$**

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HCl} + \text{Aq}$ . (Godeffroy, Arch. Pharm. (3) 9. 343.)

$\text{FeCl}_2 \cdot 2\text{RbCl} + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Neumann, A. 244. 329.)

Sol. in  $\text{H}_2\text{O}$  (Walden, Z. anorg. 1894, 7. 332.)

**Ferric sulphur chloride,  $\text{FeCl}_2 \cdot \text{SCl}_2$**

Very sensitive toward heat and moisture (Ruff, B. 1901, 37. 4518.)

**Ferric thallium chloride,  $\text{FeCl}_2 \cdot 3\text{TlCl}$**

Decomp. by  $\text{H}_2\text{O}$ . Can be crystallised from  $\text{HCl} + \text{Aq}$ . (Wohler, A. 144. 250.)

**Ferrous chloride ammonia,  $3\text{FeCl}_2 \cdot 2\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rogstadus, J. pr. 86. 310.)

$\text{FeCl}_2 \cdot 6\text{NH}_3$ . Loses  $4\text{NH}_3$  at  $100^\circ$  (Miller, Am. Ch. J. 1895, 17. 377.)

$\text{FeCl}_2 \cdot 2\text{NH}_3$ . Decomp. in the air (Miller)

**Ferric chloride ammonia,  $\text{FeCl}_3 \cdot \text{NH}_3$ .**

Slowly deliquescent. Sol. in  $\text{H}_2\text{O}$  with evolution of heat. (Rose, Pogg. 24. 302.)

$\text{FeCl}_3 \cdot 6\text{NH}_3$ . Not deliquescent, not sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$  with decomp. (Miller, Am. Ch. J. 1895, 17. 577.)

Loses  $\text{NH}_3$  to give  $\text{FeCl}_3 \cdot 5\text{NH}_3$ , and  $\text{FeCl}_3 \cdot 4\text{NH}_3$ .

**Ferric chloride cyanhydric acid,  $\text{FeCl}_3 \cdot 2\text{HCN}$ .**

Deliquescent. (Klein, A. 74. 85.)

**Ferrous chloride nitric oxide,  $\text{FeCl}_2 \cdot \text{NO}$ .**

Sol. in  $\text{H}_2\text{O}$  without evolution of gas (Thomas, C. R. 1895, 121. 204.)

$+2\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$  without decomp. (Thomas, C. R. 1895, 120. 448.)

$2\text{FeCl}_2 \cdot \text{NO}$ . Very hygroscopic. (Thomas, C. R. 1895, 121. 129.)

$10\text{FeCl}_2 \cdot \text{NO}$ . Very hygroscopic. (Thomas, C. R. 1895, 121. 128.)

**Ferric chloride nitric oxide,  $\text{Fe}_2\text{Cl}_6 \cdot \text{NO}$ .**

Very hygroscopic. Loses  $\text{NO}$  when exposed to the air.

$2\text{Fe}_2\text{Cl}_6 \cdot \text{NO}$ . Very hygroscopic. In contact with  $\text{H}_2\text{O}$  gives off  $\text{NO}$ . (Thomas, C. R. 1895, 120. 447.)

**Iron (ferrous) fluoride,  $\text{FeF}_2$ .**

Sl. sol. in  $\text{H}_2\text{O}$ , insol. in alcohol and ether. Partly sol. in hot  $\text{HCl} + \text{Aq}$ ; slowly sol. in cold, easily in hot  $\text{HNO}_3$ ; decomp. by  $\text{H}_2\text{SO}_4$ .

(Poulenc, C. R. 115. 941.)  
 $+3\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ ; more easily if it contains  $\text{HF}$ . (Berzelius.)

**Ferroferic fluoride,  $\text{FeF}_3 \cdot \text{FeF}_2 + 7\text{H}_2\text{O}$ .**

Sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 218.)

**Ferric fluoride,  $\text{FeF}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol or ether. Sl. attacked by  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

(Poulenc, C. R. 115. 941.)  
 $+4\frac{1}{2}\text{H}_2\text{O}$ . More sol. in hot than cold  $\text{H}_2\text{O}$ .

Insol. in alcohol. (Seheuer-Kestner, A. ch. (3) 68. 472.)

**Ferric nickel fluoride,  $\text{FeF}_3 \cdot \text{NiF}_2 + 7\text{H}_2\text{O}$ .**

Sl. sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 268.)

**Ferrous potassium fluoride,  $\text{FeF}_2 \cdot \text{KF} + 2\text{H}_2\text{O}$ .**

(Wagner, B. 19. 896.)

$\text{FeF}_2 \cdot 2\text{KF}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Ferric potassium fluoride,  $\text{FeF}_3 \cdot 2\text{KF}$ .**

Somewhat sol. in  $\text{H}_2\text{O}$ , especially if hot. (Berzelius.)

$+ \text{H}_2\text{O}$ . (Christensen, J. pr. (2) 35. 164.)

$\text{FeF}_3 \cdot 3\text{KF}$ . Properties as above. (Berzelius.)

**Ferric sodium fluoride,  $\text{FeF}_3 \cdot 2\text{NaF} + \frac{1}{2}\text{H}_2\text{O}$ .**

Rather easily sol. in  $\text{H}_2\text{O}$ . Solution decomp. on heating. Very sol. in  $\text{FeCl}_3 + \text{Aq}$ .

(Nicksels, J. Pharm. (4) 10. 14.)

$\text{FeF}_3 \cdot 3\text{NaF}$ . (Wagner, B. 19. 896.)

**Ferric thalious fluoride,  $2\text{FeF}_3 \cdot 3\text{TlF}$ .**

Sol. in hot  $\text{H}_2\text{O}$ , less sol. in cold. Sl. sol. in  $\text{HF}$ . (Ephraim, Z. anorg. 1909, 61. 239.)

**Ferrous titanium fluoride.**

See Fluotitanate, ferrous.

**Ferric zinc fluoride,  $\text{FeF}_3 \cdot \text{ZnF}_2 + 7\text{H}_2\text{O}$**

Sl. sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 269.)

**Ferrous hydroxide,  $\text{FeO} \cdot \text{H}_2\text{O}$ .**

Sol. in 150,000 pts.  $\text{H}_2\text{O}$ . (Bineau, C. R. 41. 509.)

Insol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ . Sol. in  $\text{NH}_4$  salts  $+ \text{Aq}$ . Sl. sol. in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Mercer.)

Not pptd. in presence of  $\text{Na}$  citrate. Insol. in boiling cane sugar  $+ \text{Aq}$ , but sl. sol. when  $\text{KOH}$  has been added. Not pptd. in presence of much  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ . (Rose.)

Solubility in glycerine + Aq containing about 60% by vol. of glycerine  
100 ccm. of the solution contain 1.0 g.  $\text{FeO}$ .  
(Muller, Z. anorg. 1905, 43. 322)

Iron (ferric) hydroxides,  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ .

Many indefinite compounds of  $\text{Fe}_2\text{O}_3$  and  $\text{H}_2\text{O}$  are known, and uncertainty exists as to their composition.

According to van Bemmelen (R. t. c. 7. 106) there are probably no true definite compounds of  $\text{Fe}_2\text{O}_3$  and  $\text{H}_2\text{O}$ .

According to Tommasi (B. 12. 1924, 2334), there are two series of Fe hydroxides,  $\alpha$ , red hydroxides, and  $\beta$ , yellow hydroxides.

$\alpha$  *Hydroxides*.  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (unstable),  $\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $50^\circ$ ), and  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $92^\circ$ ).

Sol. in dil. acids and in  $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ , and pptd. from the latter solution by  $\text{Na}_2\text{SO}_4$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

$\beta$  *Hydroxides*.  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (stable below  $70^\circ$ ),  $\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $105^\circ$ ),  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $150^\circ$ ).

Sl. sol. in acids, and insol. in  $\text{Fe}_2\text{Cl}_6 + \text{Aq}$  (Tommasi.)

The following more or less uncertain data are given.

$2\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . Very sl. sol. in  $\text{HNO}_3 + \text{Aq}$  (Davies, Chem. Soc (2) 4. 99.)

Min. *Turgite*.

$\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Insol. in cold acids, difficultly sol. in warm  $\text{HCl}$  and  $\text{H}_2\text{SO}_4 + \text{Aq}$ , and especially in warm  $\text{HNO}_3 + \text{Aq}$  (Schiff, A. 114. 199)

Min. *Gothite*.

$2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ . Sl. sol. in tartaric, citric, or acetic acids, but easily sol. in  $\text{HCl} + \text{Aq}$ . (Wittstein.)

Sparingly attacked by conc.  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ . Sol. in acetic acid or dil.  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ , from which solution it is pptd. by trace of alkali salts (St. Gilles.)

Min. *Lamonte*

$3\text{Fe}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ . (Muck.)

$\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ .

Min. *Xanthoderite*.

$\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ . Sl. sol. in acetic acid of 1.03 sp. gr., but easily sol. if of 1.076 sp. gr. Sol. in mineral acids (Limberger, J. B. 1853. 70.)

Pptd.  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O} = \text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (?). Insol. in  $\text{H}_2\text{O}$ , or in solutions of the alkalis or  $\text{NH}_4$  salts. When recently pptd. is easily sol. in acids. (Fresenius.)

Sl. sol. in  $\text{NH}_4\text{OH}$ , and  $\text{NH}_4$  salts + Aq (Odling.)

Apparently insol. in  $\text{NH}_4\text{Cl}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Brett, 1837.)

Sl. sol. in conc., but insol. in dil.  $\text{KOH} + \text{Aq}$ . (Chodnow, J. pr. 28. 221.)

Sl. sol. in very conc.  $\text{KOH} + \text{Aq}$  free from  $\text{CO}_2$ . (Völeker, A. 59. 34.)

Not at all sol. in pure conc.  $\text{KOH} + \text{Aq}$ , solubility noticed by previous observers being caused by the presence of silicic acid. (Sandrock.)

Sl. sol. in conc. alkali carbonates + Aq.

When freshly pptd., it is not acted upon by conc.  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Grotthaus.)

Readily sol. in conc.  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , but pptd. by addition of  $\text{H}_2\text{O}$ .

Sol. in excess of  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  when pptd. by that reagent. (Wöhler.)

Sol. in solutions of the alkali bicarbonates. (Berzelius.)

Sol. in aqueous solutions of water-glass. (Orlway.)

Immediately dissolved by  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Sol. in  $\text{NH}_4\text{F} + \text{Aq}$ . (Helmholtz, Z. anorg. 3. 121.)

Sol. in conc.  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$ . (Schneider, B. 23. 1352.)

Sl. sol. in a solution of  $\text{MgCO}_3$  (?). (Bischhof.)

Insol. in ethylamine, or amylamine + Aq. (Wurtz, A. ch. (3) 30. 472.)

Sol. in boiling solution of  $\text{Bi}(\text{NO}_3)_3$ , with pptn of  $\text{Bi}_2\text{O}_3$ . (Perron.)

Sol. in  $\text{Cr}_2\text{Cl}_6 + \text{Aq}$ ; after 3 months 15 mols.  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  were dissolved by 1 mol.  $\text{Cr}_2\text{Cl}_6$ . (Béchamp, A. ch. (3) 57. 290.)

Insol. in formic acid, even when freshly pptd.

When recently pptd., it is easily sol. in  $\text{KHCO}_3 + \text{Aq}$ , but after drying it is difficultly sol. therein.

When moist easily sol. in  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$ , but after drying is scarcely sol. therein when cold, and only sl. sol. when hot. (Werther.)

Easily sol. in acetic, citric, and other acids. (Wittstein.)

Solubility in glycerine + Aq containing about 60% by vol. of glycerine.

100 ccm. of the solution contain 0.8 g.  $\text{Fe}_2\text{O}_3$ . (Müller, Z. anorg. 1905, 43. 322.)

Easily sol. in aqueous solution of sucrates of Ca, Ba, Sr, K, Na. (Ilunton, 1837.)

Unacted upon by cane sugar + Aq. (Gladstone.)

Sl. sol. in cane sugar + Aq, from which it is pptd. by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ , but not by  $\text{NH}_4\text{OH}$ , or  $\text{K}_4\text{FeC}_6\text{N}_6 + \text{Aq}$  (Peschier.)

Solubility of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  in sugar solutions. 1 l. of sugar solution of given strength dissolves mg. of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .

% Sugar	Mg. $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$		
	at $17.4^\circ$	at $45^\circ$	at $75^\circ$
10	3.4	3.4	6.1
30	2.3	2.7	3.8
50	2.3	1.9	3.4

(Stolle, Z. Ver. Zuckerind. 1900, 50. 340.)

Not pptd. from solutions by alkalis or alkali carbonates in presence of many organic substances, as tartaric acid, sugar, etc.

Not pptd. by  $\text{NH}_4\text{OH}$  from solutions containing  $\text{Na}_2\text{P}_2\text{O}_7$ . (Rose, Pogg. 76. 19.)

Not pptd. by  $\text{NH}_4\text{OH}$  in presence of Na citrate. (Spiller.)

**Iron (ferrous) potassium chloride,  $\text{FeCl}_2$ ,  $2\text{KCl} + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  (Berzelius.)

**Ferric potassium chloride,  $\text{FeCl}_3$ ,  $2\text{KCl} + \text{H}_2\text{O}$ .**

A little  $\text{H}_2\text{O}$  dissolves out  $\text{FeCl}_3$ . (Fritzsche J. pr 18. 483.)

Sol. in  $\text{H}_2\text{O}$  (Walden, Z. anorg. 1894, 71. 332.)

**Ferric rubidium chloride,  $\text{FeCl}_3$ ,  $3\text{RbCl}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HCl} + \text{Aq}$  (Godeffroy, Arch. Pharm. (3) 9. 343.)

$\text{FeCl}_3$ ,  $2\text{RbCl} + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Neumann, A. 244. 329.)

Sol. in  $\text{H}_2\text{O}$ . (Walden, Z. anorg. 1894, 7. 332.)

**Ferric sulphur chloride,  $\text{FeCl}_3$ ,  $\text{SCl}_2$ .**

Very sensitive toward heat and moisture. (Ruff, B. 1904, 37. 4518.)

**Ferric thallium chloride,  $\text{FeCl}_3$ ,  $3\text{TlCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Can be crystallised from  $\text{HCl} + \text{Aq}$  (Wohler, A. 144. 250.)

**Ferrous chloride ammonia,  $3\text{FeCl}_2$ ,  $2\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rogstadus, J. pr 86. 310.)

$\text{FeCl}_2$ ,  $6\text{NH}_3$ . Loses  $4\text{NH}_3$  at  $100^\circ$ . (Miller, Am. Ch. J. 1895, 17. 577.)

$\text{FeCl}_2$ ,  $2\text{NH}_3$ . Decomp. in the air (Miller).

**Ferric chloride ammonia,  $\text{FeCl}_3$ ,  $\text{NH}_3$ .**

Slowly deliquescent. Sol. in  $\text{H}_2\text{O}$  with evolution of heat. (Rose, Pogg. 24. 302.)

$\text{FeCl}_3$ ,  $6\text{NH}_3$ . Not deliquescent; not sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$  with decomp. (Miller, Am. Ch. J. 1895, 17. 577.)

Loses  $\text{NH}_3$  to give  $\text{FeCl}_3$ ,  $5\text{NH}_3$ , and  $\text{FeCl}_2$ ,  $4\text{NH}_3$ .

**Ferric chloride cyanhydric acid,  $\text{FeCl}_3$ ,  $2\text{HCN}$ .**

Deliquescent. (Klein, A. 74. 85.)

**Ferrous chloride nitric oxide,  $\text{FeCl}_2$ ,  $\text{NO}$ .**

Sol. in  $\text{H}_2\text{O}$  without evolution of gas (Thomas, C. R. 1895, 121. 204.)

$+2\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$  without decomp. (Thomas, C. R. 1895, 120. 448.)

$2\text{FeCl}_2$ ,  $\text{NO}$ . Very hygroscopic. (Thomas, C. R. 1895, 121. 129.)

$10\text{FeCl}_2$ ,  $\text{NO}$ . Very hygroscopic. (Thomas, C. R. 1895, 121. 128.)

**Ferric chloride nitric oxide,  $\text{Fe}_2\text{Cl}_6$ ,  $\text{NO}$ .**

Very hygroscopic. Loses  $\text{NO}$  when exposed to the air.

$2\text{Fe}_2\text{Cl}_6$ ,  $\text{NO}$ . Very hygroscopic. In contact with  $\text{H}_2\text{O}$  gives off  $\text{NO}$ . (Thomas, C. R. 1895, 120. 447.)

**Iron (ferrous) fluoride,  $\text{FeF}_2$ .**

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol and ether. Partly sol. in hot  $\text{HCl} + \text{Aq}$ ; slowly sol. in cold, easily in hot  $\text{HNO}_3$ ; decomp. by  $\text{H}_2\text{SO}_4$ . (Poulenc, C. R. 115. 941.)

$+ \text{SiF}_6$ . Difficultly sol. in  $\text{H}_2\text{O}$ ; more easily if it contains  $\text{HF}$ . (Berzelius.)

**Ferroferric fluoride,  $\text{FeF}_3$ ,  $\text{FeF}_2 + 7\text{H}_2\text{O}$ .**

Sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 268.)

**Ferric fluoride,  $\text{FeF}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol or ether. Sl. attacked by  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Poulenc, C. R. 115. 941.)

$+ 4\frac{1}{2}\text{H}_2\text{O}$ . More sol. in hot than cold  $\text{H}_2\text{O}$ . Insol. in alcohol. (Scheurer-Kestner, A. ch. (3) 68. 472.)

**Ferric nickel fluoride,  $\text{FeF}_3$ ,  $\text{NiF}_2 + 7\text{H}_2\text{O}$ .**

Sl. sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 268.)

**Ferrous potassium fluoride,  $\text{FeF}_2$ ,  $\text{KF} + 2\text{H}_2\text{O}$ .**

(Wagner, B. 19. 896.)

$\text{FeF}_2$ ,  $2\text{KF}$ . Sl. sol. in  $\text{H}_2\text{O}$  (Berzelius.)

**Ferric potassium fluoride,  $\text{FeF}_3$ ,  $2\text{KF}$ .**

Somewhat sol. in  $\text{H}_2\text{O}$ , especially if hot. (Berzelius.)

$+ \text{H}_2\text{O}$ . (Christensen, J. pr (2) 35. 164.)

$\text{FeF}_3$ ,  $3\text{KF}$ . Properties as above. (Berzelius.)

**Ferric sodium fluoride,  $\text{FeF}_3$ ,  $2\text{NaF} + \frac{1}{2}\text{H}_2\text{O}$ .**

Rather easily sol. in  $\text{H}_2\text{O}$ . Solution decomp. on heating. Very sol. in  $\text{FeCl}_3 + \text{Aq}$ . (Nickles, J. Pharm. (4) 10. 14.)

$\text{FeF}_3$ ,  $3\text{NaF}$ . (Wagner, B. 19. 896.)

**Ferric thalious fluoride,  $2\text{FeF}_3$ ,  $3\text{TlF}$ .**

Sol. in hot  $\text{H}_2\text{O}$ , less sol. in cold. Sl. sol. in  $\text{HF}$ . (Ephraim, Z. anorg. 1909, 61. 239.)

**Ferrous titanium fluoride.**

See Fluotitanate, ferrous.

**Ferric zinc fluoride,  $\text{FeF}_3$ ,  $\text{ZnF}_2 + 7\text{H}_2\text{O}$ .**

Sl. sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 269.)

**Ferrous hydroxide,  $\text{FeO}_2\text{H}_2$ .**

Sol. in 150,000 pts.  $\text{H}_2\text{O}$ . (Bineau, C. R. 41. 509.)

Insol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ . Sol. in  $\text{NH}_4$  salts  $+ \text{Aq}$ . Sl. sol. in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Mercer.)

Not pptd. in presence of  $\text{Na}$  citrate. Insol. in boiling cane sugar  $+ \text{Aq}$ , but sl. sol. when  $\text{KOH}$  has been added. Not pptd. in presence of much  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ . (Rose.)

Solubility in glycerine+Aq containing about 60% by vol. of glycerine.

100 cm. of the solution contain 1.0 g. FeO. (Muller, Z. anorg. 1905, 43, 322.)

Iron (ferric) hydroxides,  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$

Many indefinite compounds of  $\text{Fe}_2\text{O}_3$  and  $\text{H}_2\text{O}$  are known, and uncertainty exists as to their composition.

According to van Bemmelen (R. t. c. 7, 106) there are probably no true definite compounds of  $\text{Fe}_2\text{O}_3$  and  $\text{H}_2\text{O}$ .

According to Tommasi (B. 12, 1924, 2334), there are two series of Fe hydroxides,  $\alpha$ , red hydroxides, and  $\beta$ , yellow hydroxides

$\alpha$  *Hydroxides*  $\text{Fe}_2\text{O}_3\text{H}_4$  (unstable),  $\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $50^\circ$ ), and  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $92^\circ$ )

Sol in dil. acids and in  $\text{Fe}_2\text{Cl}_6$ +Aq, and pptd from the latter solution by  $\text{Na}_2\text{SO}_4$  or  $\text{H}_2\text{SO}_4$ +Aq.

$\beta$  *Hydroxides*.  $\text{Fe}_2\text{O}_3\text{H}_2$  (stable below  $70^\circ$ ),  $\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $105^\circ$ ),  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $150^\circ$ ).

Sl. sol. in acids, and insol. in  $\text{Fe}_2\text{Cl}_6$ +Aq. (Tommasi.)

The following more or less uncertain data are given.

$2\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ +Aq. Very sl. sol. in  $\text{HNO}_3$ +Aq (Davies, Chem. Soc. (2) 4, 69.)

Min. *Turgite*.

$\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Insol. in cold acids, difficultly sol. in warm  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ +Aq, and especially in warm  $\text{HNO}_3$ +Aq (Schiff, A. 114, 199.)

Min. *Gothite*.

$2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ . Sl. sol in tartaric, citric, or acetic acids, but easily sol. in  $\text{HCl}$ +Aq. (Wittstein.)

Scarcely attacked by conc.  $\text{HNO}_3$ , or  $\text{HCl}$ +Aq. Sol. in acetic acid or dil.  $\text{HNO}_3$ , or  $\text{HCl}$ +Aq, from which solution it is pptd. by trace of alkali salts (St Gilles.)

Min. *Lamontite*.

$3\text{Fe}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ . (Muck.)

$\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$ +Aq.

Min. *Xanthosiderite*

$\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ . Sl. sol in acetic acid of 1.03 sp. gr., but easily sol. if of 1.076 sp. gr. Sol in mineral acids. (Lamberger, J. B. 1853, 70.)

Pptd.  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O} = \text{Fe}_2\text{O}_3\text{H}_2$ (?). Insol. in  $\text{H}_2\text{O}$ , or in solutions of the alkalis or  $\text{NH}_4$  salts. When recently pptd. is easily sol. in acids (Fresenius.)

Sl. sol. in  $\text{NH}_4\text{OH}$ , and  $\text{NH}_4$  salts+Aq. (Odling.)

Apparently insol. in  $\text{NH}_4\text{Cl}$ , or  $(\text{NH}_4)_2\text{CO}_3$ +Aq. (Brett, 1837.)

Sl. sol. in conc., but insol. in dil.  $\text{KOH}$ +Aq (Chodnew, J. pr. 28, 221.)

Sl. sol. in very conc.  $\text{KOH}$ +Aq free from  $\text{CO}_2$  (Völkner, A. 69, 34.)

Not at all sol. in pure conc.  $\text{KOH}$ +Aq, solubility noticed by previous observers being caused by the presence of silicic acid. (Sandrock.)

Sl. sol. in conc. alkali carbonates+Aq.

When freshly pptd., it is not acted upon by conc.  $\text{K}_2\text{CO}_3$ +Aq. (Grotthaus.)

Readily sol. in conc.  $(\text{NH}_4)_2\text{CO}_3$ +Aq, but pptd by addition of  $\text{H}_2\text{O}$ .

Sol. in excess of  $(\text{NH}_4)_2\text{CO}_3$ +Aq when pptd by that reagent (Wöhler.)

Sol. in solutions of the alkali bicarbonates. (Berzelius.)

Sol. in aqueous solutions of water-glass. (Ordway.)

Immediately dissolved by  $\text{H}_2\text{SO}_4$ +Aq.

Sol. in  $\text{NH}_4\text{F}$ +Aq. (Helmholtz, Z. anorg. 3, 124.)

Sol in conc.  $\text{Al}_2(\text{SO}_4)_3$ +Aq (Schneider, B. 23, 1352.)

Sl. sol in a solution of  $\text{MgCO}_3$ (?). (Bischhof.)

Insol. in ethylamine, or amylamine+Aq. (Wurtz, A. ch. (3) 30, 472.)

Sol in boiling solution of  $\text{Bi}(\text{NO}_3)_3$ , with pptn. of  $\text{Bi}_2\text{O}_3$  (Persoz.)

Sol. in  $\text{Cr}_2\text{Cl}_6$ +Aq; after 3 months 15 mols.  $\text{Fe}_2\text{O}_3\text{H}_4$  were dissolved by 1 mol.  $\text{Cr}_2\text{Cl}_6$ . (Béchamp, A. ch. (3) 67, 206.)

Insol. in fumaric acid, even when freshly pptd.

When recently pptd., it is easily sol. in  $\text{KHC}_2\text{H}_3\text{O}_6$ +Aq, but after drying it is difficultly sol. therein.

When moist easily sol. in  $\text{H}_2\text{C}_2\text{H}_3\text{O}_6$ +Aq, but after drying is scarcely sol. therein when cold, and only sl. sol. when hot. (Werther.)

Easily sol. in acetic, citric, and other acids. (Wittstein.)

Solubility in glycerine+Aq containing about 60% by vol. of glycerine.

100 cm. of the solution contain 0.8 g.  $\text{Fe}_2\text{O}_3$ . (Muller, Z. anorg. 1905, 43, 322.)

Easily sol. in aqueous solution of succates of Ca, Ba, Sr, K, Na. (Huntton, 1837.)

Unacted upon by cane sugar+Aq. (Gladstone.)

Sl. sol. in cane sugar+Aq, from which it is pptd. by  $(\text{NH}_4)_2\text{S}$ +Aq, but not by  $\text{NH}_4\text{OH}$ , or  $\text{K}_4\text{FeC}_6\text{N}_4$ +Aq (Pesohier.)

Solubility of  $\text{Fe}_2\text{O}_3\text{H}_4$  in sugar solutions 1 l of sugar solution of given strength dissolves mg. of  $\text{Fe}_2\text{O}_3\text{H}_4$

° Sugar	Mg FeO.H <sub>2</sub> O		
	at 17°	at 45°	at 75°
10	3.4	3.4	6.1
30	2.3	2.7	3.8
50	2.3	1.9	3.4

(Stollé, Z. Ver. Zuckerind 1900, 50, 340.)

Not pptd. from solutions by alkalis or alkali carbonates in presence of many organic substances, as tartaric acid, sugar, etc.

Not pptd. by  $\text{NH}_4\text{OH}$  from solutions containing  $\text{Na}_2\text{P}_2\text{O}_7$ . (Rose, Pogg. 78, 19.)

Not pptd. by  $\text{NH}_4\text{OH}$  in presence of Na citrate. (Spiller.)

*Soluble* (a) *By dialyses*. Solutions containing 1% can be concentrated somewhat, whereupon they gelatinise. They also gelatinise by cold, or addition of traces of  $H_2SO_4$ , alkalis, alkali carbonates or sulphates, or neutral salts, not, however, by  $HCl$ ,  $HNO_3$ , alcohol, or sugar. (Graham, A. 121. 16.)

When a dil. solution of a solid organic acid, or an alkali, or salt is added to a dialysed solution of  $Fe_2O_3 \cdot 3H_2O$ , a coagulum sol. in  $H_2O$  is formed, but if the solutions are conc. the separating coagulum is no longer sol. in  $H_2O$  (Athenstadt, C. C. 1871. 823.)

(b) *Pean St Gilles' hydride, or meta-iron hydroxide*. Sol. in  $H_2O$ . Pptd. from solution by traces of  $H_2SO_4$ ,  $HCl$ ,  $HNO_3$ ,  $Ag$ , and alkalis; the ppt. is insol. in cold acids, but sol. in pure  $H_2O$  (Pean St Gilles, A. ch. (3) 46. 47.)

See also table by Kiecke in the article on ferric chloride.

**Iron (Ferroferric) hydroxide,  $Fe_2O_3 \cdot H_2O$  (?)**

Sol. in acids

$Fe_2O_3 \cdot 4H_2O$  (Lefort.)

**Ferrous iodide,  $FeI_2$**

Very deliquescent. Sol. in  $H_2O$ . Solution decomp. on evaporating.

+ $4H_2O$ . Very deliquescent, sl. sol. in  $H_2O$ ; sol. in ether. (Jackson, Am. Ch. J. 1900, 24. 19.)

+ $5H_2O$ . Deliquescent. Sol. in alcohol. Sol. in sugar+ $Aq$ , and solution is much more stable than aqueous solution. Easily sol. in glycerine

Insol. in methylene iodide. (Retgers, Z. anorg. 3. 343.)

+ $6H_2O$ , and + $9H_2O$ . Very sol.; pptd. from cooled aq. solution. (Volkmann, C. C. 1894, II. 611.)

**Ferric iodide,  $FeI_3$**

Has not been isolated. Solution of I in  $FeI_3$ + $Aq$  in the molecular ratio of I :  $FeI_3$  probably contains  $FeI_3$ .

Very sol. in liquid  $NH_3$  (Franklin, Am. Ch. J. 1898, 20. 828.)

**Ferrous mercuric iodide,  $FeI_2 \cdot 2HgI_2 \cdot 6H_2O$**

As the corresponding Mg salt. (Duboin, C. R. 1907, 145. 714.)

**Ferrous iodide ammonia,  $FeI_2 \cdot 6NH_3$**

Decomp. by  $H_2O$ . (Jackson, Am. Ch. J. 1900, 24. 27.)

**Ferrous mercuric iodide.**

Very deliquescent. Decomp. by  $H_2O$ ; sol. in  $HCl$ ,  $H_2O$ , or alcohol.

**Iron molybdenide,  $FeMo_2$**

Attacked by  $HCl$ + $Aq$  with difficulty. Sol. in hot conc.  $H_2SO_4$ . (Steinacker.)

**Iron nitride.**

Easily decomp. by  $H_2O$  when finely powdered. (Rössel, C. R. 1895, 121. 942.)

$Fe_3N$ . Easily sol. in  $HNO_3$ ,  $HCl$ , or  $H_2SO_4$ + $Aq$ . Very slowly decomp. by  $H_2O$ . (Stahlschmidt, Pogg. 126. 37.)

Sol. in  $HCl$  with decomp.; decomp. by steam and by  $H_2S$  at  $200^\circ$ . (Fowler, C. N. 1894, 68. 152.)

$Fe_2N_2$ . Probably the same as the above compound (Rogstadus, J. pr. 86. 307.)

**Iron nitrososulphantimonate,  $Fe_2S(NO)_4Sb_2S_5$**

(Low, C. C. 1885. 948.)

Does not exist, but was impure sodium ferroheptanitrososulphide. (Pawel, B. 15. 2600.)

**Iron nitrososulphides.**

See Ferroterranitrososulphidic acid and Ferroheptanitrososulphide, ammonium.

$Fe_2S_3(NO)_4$ . (Roussin, C. R. 46. 224.)

$Fe_2S_2(NO)_4 \cdot 2H_2O$ . (Porcansky, A. 125. 302.)

$Fe_2S_2(NO)_4 \cdot 4H_2O$ . (Rosenberg, B. 3. 312.)

The compound to which the above formula were given was impure, according to Pawel (B. 12. 1407 and 1919; 15. 2600), and contained more or less Na or  $NH_4$ . Pawel considers the substance as  $NH_4$  salt of ferroheptanitrososulphidic acid, which see.

$Fe_2S_2N_2O_4 \cdot 1\frac{1}{2}H_2O$ . Sol. in  $H_2O$ , alcohol, ether,  $CHCl_3$ , acetone and ethyl acetate. Insol. in benzene and light petroleum. (Marie, C. R. 1896, 122. 138.)

**Iron sodium nitrososulphide,  $3Na_2S, Fe_2S_2, 2NO$**

(Roussin.)

$Na_2FeS_2(NO)_{12}$ . (Rosenberg.)

Correct formula is  $Na_2S_2(NO)_4Fe_2$ , sodium ferroterranitrososulphide.

**Iron nitrososulphocarbonate,  $Fe_2S(NO)_4CS_2 \cdot 3H_2O$**

(Low, C. C. 1885. 948.)

Correct formula is  $Na_2S_2(NO)_4Fe_2 \cdot 2H_2O$ , sodium ferroheptanitrososulphide (Pawel, B. 15. 2600.)

**Ferrous oxide,  $FeO$**

Insol. in  $H_2O$ . Sol. in acids.

Easily sol. in  $HCl$ , and  $HNO_3$ + $Aq$ ; nearly insol. in  $H_2SO_4$ , even when heated. (Tissandier, C. R. 74. 531.)

**Ferric oxide,  $Fe_2O_3$**

Attacked by acids with difficulty, the more so the higher it has been heated.  $HCl$ + $Aq$  is the best solvent, in which it is more quickly sol. by long digestion at a gentle heat than by boiling. (Fresenius.)

Most easily sol. in 16 pts. of a mixture of 3 pts.  $H_2SO_4$  and 3 pts.  $H_2O$ . (Mitscherlich, J. pr. 81. 110.)

Solubility of  $\text{Fe}_2\text{O}_3$  in  $\text{HF} + \text{Aq}$  at  $25^\circ$ .

	Time	G. $\text{Fe}_2\text{O}_3$ in 10 ccm. of the solution
N-HF	4½ hrs.	0.1581
	21½ "	0.2235
	45½ "	0.2279
0.5N-HF	2½ "	0.0579
	8½ "	0.0884
	23½ "	0.1045
	56½ "	0.1162
0.25N-HF	2½ "	0.0180
	8½ "	0.0345
	24½ "	0.0475
	142½ "	0.0534
equal amts. N-HF + N-HCl	2½ "	0.1011
	8½ "	0.1611
	23½ "	0.1976
	96 "	0.2223
	264 "	0.2297

(Deussen, Z. anorg. 1905, 44. 414)

Solubility of  $\text{Fe}_2\text{O}_3$  in  $\text{HCl} + \text{Aq}$  at  $25^\circ$ .

	Time	G. $\text{Fe}_2\text{O}_3$ in 10 ccm. of the solution
N-HCl	4½ hrs.	0.0409
	21½ "	0.1230
	45½ "	0.2125
0.5N-HCl	2½ "	0.0126
	8½ "	0.0188
	23½ "	0.0382
	56½ "	0.0672
0.25N-HCl	2½ "	0.0040
	8½ "	0.0054
	24½ "	0.0120
	142½ "	0.0306
equal vol. N-HCl + N-NaF	2½ "	0.0444
	8½ "	0.0640
	23½ "	0.0743
	72½ "	0.0757
	215 "	0.0766

(Deussen, l. c.)

Solubility of  $\text{Fe}_2\text{O}_3$  in N-oxalic acid at  $25^\circ$ .

Time	G. $\text{Fe}_2\text{O}_3$ in 10 ccm. of the solution
1½ hrs.	0.0310
6½ "	0.0790
22 "	0.1900
94 "	0.2326

(Deussen.)

Absolutely insol in  $\text{Br}_2 + \text{Aq.}$  (Balard)  
 Insol. in hot  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Rose.)  
 Insol. in  $\text{KOH} + \text{Aq.}$  (Chodnew, J. pr. 28. 222.)

Slowly sol. in an aq. solution of calcium hydrogen carbonate. The velocity of the reaction may be much increased by the addition of small amounts of alkali sulphate or  $\text{CaSO}_4$ . (Rohland, Z. anal. 1900, 48. 629.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in acetone. (Edmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

Solubility in (calcium succinate + sugar) +  $\text{Aq.}$   
 1 l. solution containing 418.6 g. sugar and 34.3 g.  $\text{CaO}$  dissolves 6.26 g.  $\text{Fe}_2\text{O}_3$ , 296.5 g. sugar and 24.3 g.  $\text{CaO}$  dissolves 1.71 g.  $\text{Fe}_2\text{O}_3$ ; 17½ g. sugar and 14.1 g.  $\text{CaO}$  dissolves 3.08 g.  $\text{Fe}_2\text{O}_3$ . (Bodenbender, J. B. 1865. 600.)

Solubility of  $\text{Fe}_2\text{O}_3$  in sugar solutions 1 l. of sugar solution of given strength dissolves mg.  $\text{Fe}_2\text{O}_3$

% Sugar	mg. $\text{Fe}_2\text{O}_3$	
	at $17.5^\circ$	at $45^\circ$
10	1.4	2.0
30	1.4	1.1
50	0.8	1.1

(Stolle, Z. Ver. Zuckerind, 1900, 50. 340)

## Calcined.

Solubility of calcined  $\text{Fe}_2\text{O}_3$  in acids at  $25^\circ$ .

Acid	Time	g. $\text{Fe}_2\text{O}_3$ in 10 ccm. of the solution
N-HF	4½ hrs.	0.0889
	43½ "	0.2035
	129½ "	0.2194
N-HCl	4½ "	0.0224
	43½ "	0.1000
	139½ "	0.1910

(Deussen, Z. anorg. 1905, 44. 413.)

## See also Ferric hydroxide.

Min. Hematite. Rather easily sol. in  $\text{HCl} + \text{Aq.}$  but not readily sol. in other acids.

## Metallic oxide.

See Ferric hydroxides.

Ferroferric oxide,  $6\text{FeO}, \text{Fe}_2\text{O}_3$ .

$\text{FeO}, \text{Fe}_2\text{O}_3 = \text{Fe}_3\text{O}_4$ . With insufficient  $\text{HCl} + \text{Aq.}$  for complete solution,  $\text{FeO}$  is dissolved and  $\text{Fe}_2\text{O}_3$  left. (Berzelius.)

Insol. in  $\text{HNO}_3 + \text{Aq.}$  at the ordinary temperature. (Millon.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)



tion. (Granger, Bull. Soc. 1896, (3) 15. 1086.)

$\text{Fe}_4\text{P}_3$ . Very slowly sol. in boiling  $\text{HCl} + \text{Aq}$ . Easily sol. in  $\text{HNO}_3$  or aqua regia. (Struve, J. B. 1860, 77.)

Mixture. (Freese, Pogg. 132, 225.)

Almost insol. in aqua regia. Sol. in fused alkali. (Granger)

$\text{Fe}_3\text{P}$ . Nearly insol. in dil. acids; rapidly sol. in  $\text{HNO}_3$  or aqua regia; decomp. by conc.  $\text{HCl}$ , or  $\text{KOH} + \text{Aq}$ . (Schneider, J. B. 1886, 2026)

Of the nine iron phosphides described the constitution has been established for only two,  $\text{Fe}_3\text{P}$  and  $\text{Fe}_2\text{P}$ .

$\text{Fe}_3\text{P}$  Sol. in conc.  $\text{HCl}$ .

$\text{Fe}_2\text{P}$ . Sol. in hot aqua regia. Insol. in other acids. (Le Chatelier, C. R. 1909, 149, 709)

### Iron selenide, $\text{Fe}_2\text{Se}$ .

Not attacked by  $\text{HNO}_3$  or acetic acid. Sol. attacked by conc.  $\text{HCl}$ . Readily attacked by aqua regia. Sol. in  $\text{HF}$ . (Vigouroux, C. R. 1905, 141, 829.)

$\text{FeSe} + x\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{H}_2\text{O}_2 + \text{Aq}$ . Insol. in alkalis, or  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Reeb, J. Pharm. (4) 9, 173.)

$\text{Fe}_3\text{Se}_2$ . Sol. in dil.  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  with evolution of  $\text{H}_2\text{Se}$  Sol. in conc.  $\text{HNO}_3 + \text{Aq}$ . (Little, A. 112, 211.)

$\text{Fe}_2\text{Se}_3$ . Decomp. by fuming  $\text{HNO}_3$ . (Fonze-Diacon, C. R. 1900, 130, 1711.)

$\text{Fe}_3\text{Se}_2$ . Decomp. by fuming  $\text{HNO}_3$ . (Fonze-Diacon, C. R. 1900, 130, 1711.)

$\text{FeSe}_2$ . Insol. in conc.  $\text{HCl}$ ; decomp. by fuming  $\text{HNO}_3$ . (Fonze-Diacon, C. R. 1900, 130, 1711.)

### Iron silicide, $\text{Fe}_3\text{Si}$ .

Difficultly sol. in  $\text{HCl} + \text{Aq}$ ; easily sol. even in dil.  $\text{HF} + \text{Aq}$ . (Hahn, A. 129, 57.)

$\text{Fe}_2\text{Si}$ . Not easily sol. in conc.  $\text{HCl}$  and  $\text{HNO}_3$  but readily sol. in  $\text{HF}$ . (Moissan, C. R. 1895, 121, 623.)

$\text{Fe}_3\text{Si}_2$ . Sol. in hot  $\text{HCl} + \text{Aq}$  only when most finely powdered (Hahn.)

$\text{FeSi}_2$ . Not attacked by conc.  $\text{HF}$  or  $\text{H}_2\text{SO}_4$ . (Hahn.)

Sol. in cold  $\text{HF}$ . (de Chalmot, Am. Ch. J. 1897, 19, 123)

Existence questioned by Jouve, (Bull. Soc. 1901, 25, 290-293)

$\text{Fe}_3\text{Si}_4$ . Sol. in  $\text{HF}$  and in fused  $\text{KNO}_3$  and  $\text{KNaCO}_3$ . (de Chalmot, J. Am. Chem. Soc. 1895, 17, 924.)

### Iron semisulphide, $\text{Fe}_2\text{S}$ .

Sol. in dil. acids with decomposition. (Arfvedson, Pogg. 1, 72.)

### Ferrous sulphide, $\text{FeS}$ .

Decomp. by dil. acids, with evolution of  $\text{H}_2\text{S}$  and without separation of S, except with  $\text{HNO}_3 + \text{Aq}$ .

$+ x\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ , especially if hot. (Berzelius)

1 l  $\text{H}_2\text{O}$  dissolves  $70.1 \times 10^{-6}$  moles  $\text{FeS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58, 204.)

Very violently decomp. even by dil. acids. Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in  $\text{H}_2\text{S}$ , or  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Sol. in  $\text{Na}_2\text{S}$ , or  $\text{K}_2\text{S} + \text{Aq}$ . Sol. in  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S} + \text{Aq}$ . (de Koninck, Z. angew. Ch. 1891, 204)

Insol. in  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4\text{Cl} + \text{Aq}$  (Brett.)

Not completely pptd. in presence of Na citrate (Spiller.)

Contrary to assertion of  $\text{FeSO}_4$ , it can be nearly completely pptd. in presence of  $\text{Na}_2\text{P}_2\text{O}_7$  by  $(\text{NH}_4)_2\text{S} + \text{Aq}$  (Rose, Pogg. 76, 18.)

Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, and -stannates (Storeh, B. 16, 2015.)

Sol. in  $\text{KCN} + \text{Aq}$

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1808, 20, 828)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Solubility of  $\text{FeS}$  in sugar solutions 1 l sugar of given strength dissolves mg.  $\text{FeS}$

% Sugar	mg FeS		
	at $1^\circ 5^\circ$	at $45^\circ$	at $75^\circ$
10	3 8	3 8	5 3
30	7 1	9 1	7 2
50	9 9	19 8	9 1

(Stolle, Z. Ver. Zuckermil. 1900, 50, 300.)

*Colloidal.*—A very dilute solution has been obtained which coagulated very readily. (Winssinger, Bull. Soc. (2) 49, 452.)

### Ferric sulphide, $\text{Fe}_2\text{S}_3$ .

Decomp. by dil.  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  with evolution of  $\text{H}_2\text{S}$ , leaving a residue of  $\text{FeS}_2$ .

$+ 1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in alcoholic ammonia. Sol. in  $(\text{NH}_4)_2\text{S} + \text{very dil. Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Phurson, C. N. 30, 139.)

### Iron disulphide, $\text{FeS}_2$ .

Insol. in dil.  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Decomp. by  $\text{HNO}_3$  or aqua regia with separation of S. Insol. in a 10% solution of alkali sulphide.

Min. *Pyrite*, *Marcasite*. Sol. in a mixture of  $\text{Na}_2\text{S}$  and  $\text{NaOH} + \text{Aq}$ ,  $\text{Na}_2\text{S} + \text{Aq}$ , or mixture of  $\text{Na}_2\text{S}$  and  $\text{NaSH} + \text{Aq}$ ; insol. in cold  $\text{NaSH} + \text{Aq}$ . *Marcasite* is more easily sol. in above than *pyrite*. (Becker, Sill. Am. J. (3) 33, 199.)

### Ferroferric sulphide, $\text{Fe}_3\text{S}_4$ or $\text{Fe}_2\text{S}_3$ .

Min. *Pyrrhotite*. Sol. in dil. acids with a residue of S. Extremely slowly sol. in a 10% solution of alkali sulphides. (Terrel, C. R. 69, 1360.)

Iron (terrous) nickel sulphide,  $2\text{FeS}$ ,  $\text{NiS}$ .

Min. *Pentlandite*.

Ferrous phosphorus sulphide,  $\text{FeS}$ ,  $\text{P}_2\text{S}_3$ .

(Berzelius.)

$2\text{FeS}$ ,  $\text{P}_2\text{S}_3$ . Slowly decomp. by  $\text{H}_2\text{O}$ . Insol. in boiling  $\text{HCl} + \text{Aq}$ ; decomp. by aqua regia. (Berzelius, A. 46. 256.)

Iron potassium sulphide (potassium sulphoferrite),  $\text{K}_2\text{Fe}_2\text{S}_4 = \text{K}_2\text{S}$ ,  $\text{Fe}_2\text{S}_3$ .

Insol. in cold or hot  $\text{H}_2\text{O}$ . Violently attacked by dil. acids. Not decomp. by boiling with alkalis, alkali carbonates, or sulphides +  $\text{Aq}$ . Decomp. by  $\text{KCN}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Proust, J. pr. 107. 16.)  
 $\text{K}_2\text{S}$ ,  $2\text{FeS}$ . (Schneider, Pogg. 136. 460.)

Iron silver sulphide (silver sulphoferrite),  $\text{Ag}_2\text{S}$ ,  $\text{Fe}_2\text{S}_3$ .

Not attacked by dil.  $\text{HCl} + \text{Aq}$ , decomp. by conc.  $\text{HCl} + \text{Aq}$ . (Schneider.)  
 $2\text{Ag}_2\text{S}$ ,  $\text{FeS}_2$ . (Schneider, Pogg. 138. 305.)  
 $\text{Ag}_2\text{S}$ ,  $3\text{FeS}$ ,  $\text{FeS}_2$ . Min. *Steinbergite*. Decomp. by aqua regia.

Iron sodium sulphide (sodium sulphoferrite),  $\text{Na}_2\text{Fe}_2\text{S}_4 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by very dil. acids (Schneider, Pogg. 138. 302.)

Iron sulphophosphide,  $\text{Fe}_2\text{P}_2\text{S}_3$ .

Attacked by acids at  $100^\circ$ . Decomp. by boiling  $\text{NaOH} + \text{Aq}$ . (Ferrand, A. ch. 1896, (7) 17. 410.)

Ferrous telluride,  $\text{FeTe}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids (Fabre, C. R. 105. 277.)

Kermes.

See Antimony trisulphide.

"Knallplatin" compounds.

See Fulminoplatinum compounds.

Krypton, Kr

Absorption by  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Coefficient of absorption (mole) by two series of experiments	
0	0.1240	0.1166
10	0.0965	0.0877
20	0.0788	0.0670
30	0.0762	0.0597
40	0.0740	0.0561
50	0.0823	0.0610

(Antropoff, Roy. Soc. Proc. 1910, 83. A. 480.)

Lanthanic acid.

Barium *metalanthanate*,  $\text{Ba}(\text{H}_2\text{La}_2\text{O}_7)_2$ .

(Baskerville, J. Am. Chem. Soc. 1904, 26. 79.)

Lithium *metalanthanate*,  $\text{LiH}_2\text{La}_2\text{O}_7 + 2\text{H}_2\text{O}$ . (Baskerville.)

Potassium *metalanthanate*,  $\text{KH}_2\text{La}_2\text{O}_7 + 15\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Baskerville.)

Sodium *metalanthanate*,  $\text{NaH}_2\text{La}_2\text{O}_7 + 4\text{H}_2\text{O}$ .

Almost insol. in  $\text{H}_2\text{O}$ , but decomp. by it (Baskerville.)

Disodium *tetralanthanate*,  $\text{Na}_2\text{La}_4\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ . (Baskerville.)

Lanthanicoctungstic acid.

Ammonium lanthanicoctungstate,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{La}_2\text{O}_3$ ,  $16\text{WO}_3 + 16\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . (E. F. Smith, J. Am. Chem. Soc. 1904, 26. 1481.)

Barium lanthanicoctungstate,  $5\text{BaO}$ ,  $\text{La}_2\text{O}_3$ ,  $16\text{WO}_3 + 16\text{H}_2\text{O}$ .

Ppt. (E. F. Smith.)

Silver lanthanicoctungstate,  $5\text{Ag}_2\text{O}$ ,  $\text{La}_2\text{O}_3$ ,  $16\text{WO}_3 + 4\text{H}_2\text{O}$ .

Very insol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

Lanthanum, La

Slowly decomp. cold, rapidly hot  $\text{H}_2\text{O}$ . Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ , but energetically by cold conc.  $\text{HNO}_3 + \text{Aq}$ . Sol. in dil. acids. (Hillebrand and Norton, Pogg. 156. 633.)

Lanthanum bromide,  $\text{LaBr}_3 + 7\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Not very sol. in absolute alcohol. Insol. in ether. (Cleve, Sv. V. A. H. Bih. 2. No. 7.)

Lanthanum nickel bromide,  $2\text{LaBr}_3$ ,  $3\text{NiBr}_2 + 18\text{H}_2\text{O}$ .

Deliquescent. (Frerichs and Smith, A. 191. 355.)

Lanthanum zinc bromide,  $2\text{LaBr}_3$ ,  $3\text{ZnBr}_2 + 36\text{H}_2\text{O}$ .

Very deliquescent. (F. and S.)

Lanthanum carbide,  $\text{LaC}_2$ .

Decomp. by  $\text{H}_2\text{O}$  and dil. acids. (Pettersson, B. 1895, 28. 2422.)

Sol. in conc.  $\text{H}_2\text{SO}_4$  and dil. acids; insol. in conc.  $\text{HNO}_3$ .

Sol in fused oxidizing agents; decomp. by  $H_2O$  at ordinary tempa. (Moissan, C. R. 1896, 123. 149.)

**Lanthanum chloride,  $LaCl_3$ .**

*Deliquescent.* (Hermann.)  
Insol. in acetone. (Naumann, B. 1904, 37. 329.)

+ $7\frac{1}{2}H_2O$ . Not deliquescent. (Zschiesche.)  
Easily sol. in alcohol. (Hermann.)

**Lanthanum mercuric chloride,  $2LaCl_3, HgCl_2$**   
+ $\frac{1}{3}H_2O$ .

Not deliquescent. Very sol. in  $H_2O$ . (Marignac, Ann. Min. (5) 15. 272.)

**Lanthanum stannic chloride.**

See Chlorostannate, lanthanum.

**Lanthanum fluoride,  $LaF_3$  +  $H_2O$ .**

Precipitate. Sl. sol. in  $HCl$  + Aq. (Cleve.)

**Lanthanum hydrogen fluoride,  $2LaF_3, 3HF$ .**

Precipitate. (Frerichs and Smith, A. 191. 355.)

Does not exist. (Cleve, B. 11. 910.)

**Lanthanum hydride,  $La_2H_3$ .**

Decomp. by dil. acids. (Winkler, B. 24. 1906.)

$LaH_3$ . Decomp. by  $H_2O$ . Sol. in acids with evolution of  $H_2$ . Decomp. by alkalis (Muthmann, A. 1902, 325. 266.)

**Lanthanum hydroxide,  $La_2O_3.H_2O$ .**

Insol. in  $H_2O$ ; easily sol. in acids, insol. in  $KOH$ , or  $NaOH$  + Aq.

Sol. in citric acid. (Baskerville, J. Am. Chem. Soc. 1904, 26. 49.)

**Lanthanum zinc iodide,  $2LaI_3, 3ZnI_2 + 27H_2O$ .**

Very sol. in  $H_2O$ . (Frerichs and Smith, A. 191. 353.)

**Lanthanum nitride,  $LaN$ .**

Decomp. by  $H_2O$  with evolution of  $NH_3$ . Sol. in mineral acids. Decomp. by alkali. (Muthmann, A. 1902, 325. 275.)

**Lanthanum oxide,  $La_2O_3$ .**

Easily sol., even when ignited, in mineral, and acetic acids (Hermann.)

Sol. in boiling conc.  $NH_4Cl$  + Aq. (Mosander.)

Sol. in cold conc.  $NH_4NO_3$  + Aq. (Dumour and Deville.)

Insol. in  $(NH_4)_2CO_3$  + Aq. (Mosander.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Lanthanum peroxide,  $La_2O_5$ .**

Sol in  $HCl, H_2SO_4, HNO_3$ , and  $HC_2H_3O_2$  + Aq with decomp. (Cleve, Bull. Soc. (2) 43. 359.)

$La_2O_5 + xH_2O$ . Unstable. Sol. in dil.  $H_2SO_4$  + Aq with decomp. (Melikoff, Z. anorg. 1899, 21. 71.)

**Lanthanum oxybromide,  $LaOBr$ .**

Ppt. (Frerichs and Smith.)

**Lanthanum oxychloride,  $3La_2O_3, 2LaCl_3$ .**

Insol. in  $H_2O$ . Difficultly and slowly sol. in  $HCl$ , or  $HNO_3$  + Aq. (Hermann.)

$LaOCl$ . Boiling  $H_2O$  dissolves only traces. (Frerichs and Smith.)

**Lanthanum sulphide,  $La_2S_3$ .**

Decomp. by  $H_2O$  and acids. (Didier.)

**Lanthanum disulphide,  $LaS_2$ .**

Decomp. by heat. (Biltz, Z. anorg. 1911, 71. 435.)

**Lead, Pb.**

Lead, in contact with  $H_2O$  and air free from  $CO_2$ , gives a solution of PbO which turns litmus blue and turns red, and is turned brown with  $H_2S$ .

$H_2O$  which has been boiled does not dissolve Pb if there is no access of air. When shaken up with air it dissolves 0.91 to 0.008% Pb in 2 hours. Pure spring water, containing  $1\frac{1}{2}$  grains aise in 2 pounds  $H_2O$  and no  $CO_2$ , when conducted through a lead pipe 150 feet long, dissolves so much lead that it turns brown with  $H_2S$  (Yorker, Phil Mag. J. 5. 82.)

$CO_2$  or small amts of salts prevent the solution of Pb. 1 vol.  $H_2O$  with  $\frac{1}{2}$  vol.  $CO_2$  dissolves only a trace of Pb. Spring  $H_2O$ , containing in 10 pounds 1.21 grains  $NaCl$  and  $CaCl_2$ , and 6.4 grains  $CaCO_3$  dissolved in  $CO_2$ , does not dissolve Pb. (Yorker.)

If the amt of salts in solution equals the amt of  $H_2O$ , and especially if they are carbonates, very slight amts. of Pb are dissolved. (Christison, Phil Mag. J. 21. 156.)

$CaCO_3$  dissolved in  $CO_2$  water decreases the solubility of Pb more than any other salt.

Distilled  $H_2O$ , quietly standing in a closed flask with lead and air free from  $CO_2$ , deposits white flakes of  $Pb_2O_3.H_2O$ , and dissolves  $\frac{1}{2}$  pt. PbO. The solution has an alkaline reaction. (A. Bondorff, Pogg. 41. 305.)

Water of 3° hardness does not take up enough Pb to become injurious. (Clarke, J. R. 1886. 008.)

Soluble carbonates increase the solubility of Pb in  $H_2O$  (Nevins, C. C. 1881. 008), especially  $(NH_4)_2CO_3$ . (Böttger.)

Presence of  $H_2SO_4$  decreases the solubility of Pb (Horsford, Chem. Gaz. 1849. 217.)

$H_2O$  containing  $K_2SO_4$  takes up only a trace of Pb. (Wetzel, Schwe. J. 54. 324.)

Presence of sulphates diminishes (Christison), does not diminish (Graham, Miller, and Hoffmann), the action of  $H_2O$  on Pb.

$CaSO_4$  protects Pb, but it is attacked by much  $MgSO_4$ . (Nevins.)

$NaCl$  + Aq dissolves only a trace of Pb.

200 pt. of a chloride in  $H_2O$  is not sufficient to prevent the solubility of Pb in  $H_2O$ . (Christison.)

Presence of chlorides increases the solubility. (Graham, Miller, and Hoffmann, Nevins.)

$H_2O$  containing  $KN_3$  does not corrode Pb.

Nitrates hinder the action of  $H_2O$ . (A. Bondorff.)

Nitrates increase the action of  $H_2O$ . (Graham, Miller, and Hoffmann.) Nitrates have no influence. (Kersting.)

10 lbs. of  $H_2O$  dissolved the following amts. from Pb pipes in 24 hours: if distilled  $H_2O$  + 1%  $Na_2CO_3$ , 0.38 grain Pb; if Duna water, 0.19 grain Pb; if canal water, 0.15 grain Pb; if distilled  $H_2O$  + 1%  $NH_4NO_3$ , 0.15 grain Pb; if hard well water, 0.04 grain Pb; if distilled  $H_2O$  + 1%  $KNO_3$ , 0.01 grain Pb. (Kersting, Dingl. 169. 183.)

200 l. Manchester drinking water dissolved 2.094 g. from 1 sq. metre Pb in 8 weeks; 9 l. well water dissolved 1.477 g. from 1 sq. metre Pb in 8 weeks; 11 l. distilled  $H_2O$  containing

are dissolved 110.003 g. from 1 sq. metre Pb in 8 weeks; distilled H<sub>2</sub>O free from air dissolved 1829 g. from 1 sq. metre Pb in 8 weeks, sea water dissolved 0.038 g. from 1 sq. metre Pb in 8 weeks. (Calvert and Johnson, C. N. 16. 171.)

A lead pipe taken up in Paris, which had been exposed to action of ordinary H<sub>2</sub>O for 200 years, was found perfectly smooth and uncorroded. (Belgrand, C. R. 77. 1655.)

Pb is attacked by all waters, hard or soft, even highly calcareous water dissolves some lead. (Mayençon and Bergeret, C. R. 78. 484.)

Pure distilled H<sub>2</sub>O does not act on Pb, but extremely small quantities of NH<sub>3</sub>, HNO<sub>3</sub>, etc. cause an action; but for this action on Pb the presence of air and CO<sub>2</sub> is also required. (Stallman, Dingl. 180. 366.)

100 ccm. distilled H<sub>2</sub>O dissolved 3 mg. from 11.8 sq. cm. lead in one week when air without CO<sub>2</sub> was passed through the solution. 8 mg. were dissolved when the air contained CO<sub>2</sub>. (Wagner, Dingl. 221. 260.)

Action of dil. salt solutions on lead. In 500 ccm. of the solutions containing salt, bright sheets of lead of 5000 sq. metres' surface were so suspended that the liquid reached all parts of the metal without hindrance, and the amts. dissolved determined after 24, 48, and 72 hours of action.

Salt	Grammes salt per litre	Dissolved Pb in mg. per litre		
		after 24	48	72 hrs
NH <sub>4</sub> NO <sub>3</sub>	0.020	13.0		25
"	0.040	15.0		32
"	0.080	15.0		.
{ KNO <sub>3</sub> + NaNO <sub>3</sub>	{ 0.020	2.0	2.0	.
{ KNO <sub>3</sub> + Na <sub>2</sub> SO <sub>4</sub>	{ 0.050			
{ KNO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub>	{ 0.040	0.8	1.0	.
{ KNO <sub>3</sub> + K <sub>2</sub> SO <sub>4</sub>	{ 0.212			
{ KNO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub>	{ 0.045	.	.	0.3
{ KNO <sub>3</sub> + K <sub>2</sub> SO <sub>4</sub>	{ 0.308			
{ KNO <sub>3</sub> + CaSO <sub>4</sub>	{ 0.070	0.4	1.0	0.8
{ KNO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub>	{ 0.504			
{ KNO <sub>3</sub> + CaSO <sub>4</sub>	{ 0.252	0.4	1.0	0.8
{ KNO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub>	{ 0.408			
{ KNO <sub>3</sub> + CaCl <sub>2</sub>	{ 0.310	.	.	0.2
{ KNO <sub>3</sub> + Na <sub>2</sub> SO <sub>4</sub>	{ 0.516			
{ KNO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub>	{ 0.250	0.5	0.5	0.5
{ KNO <sub>3</sub> + CaCl <sub>2</sub>	{ 0.510			
{ KNO <sub>3</sub> + Na <sub>2</sub> SO <sub>4</sub>	{ 0.200	.	.	0.8
{ KNO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub>	{ 0.400			
{ NH <sub>4</sub> NO <sub>3</sub> + CaCl <sub>2</sub>	{ 0.020	...	...	1.8
{ NH <sub>4</sub> NO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub>	{ 0.060			
{ NH <sub>4</sub> NO <sub>3</sub> + Na <sub>2</sub> SO <sub>4</sub>	{ 0.020	...	.	0.4
{ NH <sub>4</sub> NO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub>	{ 0.100			
{ NH <sub>4</sub> NO <sub>3</sub> + Na <sub>2</sub> SO <sub>4</sub>	{ 0.200	.	.	0.1
{ NH <sub>4</sub> NO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub>	{ 0.200			
{ NH <sub>4</sub> NO <sub>3</sub> + CaCl <sub>2</sub>	{ 0.040	.	.	0.1
{ NH <sub>4</sub> NO <sub>3</sub> + K <sub>2</sub> CO <sub>3</sub>	{ 0.100			
Water from L. Katrine		1.0	1.0	1.5
Distilled water		2.0	2.0	3.0

(Muir, C. N. 25. 294.)

Action of salt solutions on 11.8 sq. cm. Pb in one week while air either with or without CO<sub>2</sub> was passed through the solution.

Solubility of Pb in salt solutions

100 ccm. solutions containing the given amts. salts dissolve Pb in mg. ---

Salt	g. salt in 100 ccm.	mg. Pb dissolved	
		without CO <sub>2</sub>	with CO <sub>2</sub>
KCl	0.5	21	12
NaCl	0.5	21	12
NH <sub>4</sub> Cl	1.0	12	5
MgCl <sub>2</sub>	0.83	20	35
K <sub>2</sub> SO <sub>4</sub>	1.0	0	0
KNO <sub>3</sub>	1.0	14	20
Na <sub>2</sub> CO <sub>3</sub>	1.0	0	0
NaOH	0.923	430	.
CaO.H <sub>2</sub>	Saturated	137	.

(Wagner, Dingl. 221. 260.)

Solubility of Pb in salt solutions.

25 sq. cm. were acted upon by a solution containing 0.2 g. salt in a litre for 21 days.

Three series of experiments were carried on I. In corked flasks. II. In beakers covered with porous paper; diameter of mouth of beaker = 11.5 cm. III. In basins covered with porous paper; diameter of mouth of basin = 14.5 cm. IV. In corked flasks with constant current of air. V. In beakers half filled and covered with porous paper, the lead being suspended so that equal amts. of surface were above and beneath the liquid.

The amts. in mgs. of Pb dissolved were as follows:—

Salt used	I	II	III	IV	V.
NH <sub>4</sub> NO <sub>3</sub>	1.8	4.0	16.0	.	.
KNO <sub>3</sub>	1.6	0.5	6.0	1.5	.
CaCl <sub>2</sub>	3.0	2.8	5.5	3.5	3.5
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	0.7	1.3	16.0	5.0	2.5
K <sub>2</sub> CO <sub>3</sub>	0.3	0.3	0.7	0.6	0.3
Dist. H <sub>2</sub> O	1.5	0.8	4.2	2.0	.

(Muir, Chem. Soc. 36. 660.)

H<sub>2</sub>O sat. with CO<sub>2</sub> dissolves 0.012 g. Pb to a litre in 3 days (Marais, C. R. 77. 1529.)

Action of H<sub>2</sub>O charged with CO<sub>2</sub> under 760 mm. pressure on Pb. 3 mg. of Pb were dissolved per litre in 24 hours, and the amt. was not increased by further action. The addition of 100 mg. K<sub>2</sub>CO<sub>3</sub> + 20 mg. NH<sub>4</sub>NO<sub>3</sub> to a litre prevented all action.

Action of H<sub>2</sub>O charged with CO<sub>2</sub> under 6 atmos. pressure on Pb.

14.8 mg. were dissolved per l. in 24 hours, and 24 mg. per l. in 48 hours.

Action of various salt solutions added to above solution of CO<sub>2</sub> were as follows:—

	mg salt per l	mg Pb dissolved	
		after 24 hrs	after 48 hrs
K <sub>2</sub> CO <sub>3</sub> . . .	80	13.2	32.0
K <sub>2</sub> CO <sub>3</sub> . . .	160	..	6 0
CaCl <sub>2</sub> . . .	160	32.0	44.0
NH <sub>4</sub> NO <sub>3</sub> . .	16	5.0	..
NH <sub>4</sub> NO <sub>3</sub> . .	40	10.0	35.0
Distilled H <sub>2</sub> O .	...	14.8	24 0

(Muir, C. N. 33. 125.)

The corrosion of Pb by ordinary distilled H<sub>2</sub>O depends upon the presence of CO<sub>2</sub> and O. If the dissolved CO<sub>2</sub> is double the amt. of the dissolved O, the action is most energetic. When CO<sub>2</sub> is wholly absent and O present, the action is very slight, and when the H<sub>2</sub>O contains 1½ or more vol % CO<sub>2</sub> with normal amt. of oxygen, there is no visible corrosion. Pure distilled H<sub>2</sub>O containing neither O nor CO<sub>2</sub> has no action on Pb. In the above cases the greater part of the Pb remains in the form of a white ppt. or crust on the Pb, but in the case where O and CO<sub>2</sub> are both present in the ratio of 1 : 2, very small amts. of Pb go into solution in a few days, the amt., however, diminishes on standing. As the amt. of CO<sub>2</sub> increases, the amt. of Pb dissolved in the H<sub>2</sub>O also increases.

NH<sub>4</sub>OH alone does not protect Pb from corrosion, but when in combination with CO<sub>2</sub> the action is much diminished.

CaO<sub>2</sub>H<sub>2</sub> and NaOH+Ag attack Pb much more actively in absence of CO<sub>2</sub> and presence of air. In absence of dissolved O neither CaO<sub>2</sub>H<sub>2</sub> nor NaOH attacks Pb.

Na<sub>2</sub>CO<sub>3</sub>+Ag in absence of CO<sub>2</sub> attacks Pb slightly, but NaHCO<sub>3</sub>+Ag has not the slightest action.

CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>+Ag also has not the slightest action on Pb, and the presence of CaCO<sub>3</sub> and CO<sub>2</sub> wholly prevents H<sub>2</sub>O attacking Pb.

CaSO<sub>4</sub>+Ag in presence of air forms a crust on Pb, but no Pb is found in solution, but if air is excluded there is no visible action. Presence of CO<sub>2</sub> causes a strong corrosive action.

H<sub>2</sub>O containing CaSO<sub>4</sub> and CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub> does not attack Pb.

The above reactions are not in the least altered by the presence of moderate amts. of nitrates, chlorides, or ammonium, or organic compounds; but ammonium salts in excess have a strong solvent action on Pb. (Muller, J. pr. (2) 38. 317.)

See also an extended report of the action of H<sub>2</sub>O on Pb made to the Water Committee of Huddersfield, England, in 1888, by Messrs. Crookes, Odling, and Tidy.

Very extended researches are published by Cornelly and Frew (Jour. Soc. Chem. Ind. 7. 15), of which only the general conclusions can be given here.

The action of slaked lime, limestone, sand and calcium silicate, mortar, etc., was tested. The results were as follows —

1. In nearly all cases the corrosion is greater with free exposure to the air than when air is excluded. The difference is especially great in those cases where the greatest action on the lead takes place. Aluminum hydroxide and blue clay form exceptions, and exert a greater corrosive action when air is excluded. In the case of CaCO<sub>3</sub>, old mortar, CaSiO<sub>3</sub>, or a mixture of CaCO<sub>3</sub> and CaO<sub>2</sub>H<sub>2</sub>, the exclusion or presence of air makes no appreciable difference.

KNO<sub>3</sub>+Ag shows a peculiar behaviour. In the presence of air it acts nearly as much on the Pb as pure H<sub>2</sub>O, but when air is excluded it exerts nearly as much retarding action as CaSiO<sub>3</sub>.

2. In the presence of air the action of H<sub>2</sub>O on Pb is considerably increased by the presence of NH<sub>4</sub>NO<sub>3</sub> or CaO<sub>2</sub>H<sub>2</sub>, with exclusion of air, by CaSO<sub>4</sub>, also by a mixture of CaO<sub>2</sub>H<sub>2</sub> and sand. All the other investigated substances, even KNO<sub>3</sub>, under the action of H<sub>2</sub>O on Pb either with or without exclusion of air.

3. CaO<sub>2</sub>H<sub>2</sub>+Ag exerts in all cases a much greater corrosive action than pure H<sub>2</sub>O, and although this action is diminished by sand yet fresh mortar very quickly destroys lead pipes when in contact therewith. Old mortar, on the other hand, and also CaSiO<sub>3</sub> and CaCO<sub>3</sub>, have a protective action.

4. The fact is very important that sand, CaCO<sub>3</sub>, old mortar, CaSiO<sub>3</sub>, and a mixture of sand and CaCO<sub>3</sub> afford considerable protection to lead against H<sub>2</sub>O. A mixture of limestone and sandstone has more effect than the two substances separately.

5. CaSiO<sub>3</sub> totally prevents the corrosive action of KNO<sub>3</sub> and NH<sub>4</sub>NO<sub>3</sub>, so that the lead is not attacked by solutions of those salts any more than by H<sub>2</sub>O containing CaSiO<sub>3</sub> alone. Sand, and a mixture of sand and CaCO<sub>3</sub> have a similar effect, but not to such a degree.

6. The protective influence of CaCO<sub>3</sub> does not appear to depend on the presence of CO<sub>2</sub> and the formation of CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>.

7. MgCO<sub>3</sub> prevents the corrosion of Pb as much as CaSiO<sub>3</sub>. (Carmelley and Frew, Jour. Soc. Chem. Ind. 7. 15.)

Pb in contact with Zn or Fe is protected thereby from the solvent action of H<sub>2</sub>O, and in fact the action is nearly null. Sn, on the other hand, increases the action. This is of importance in regard to use of tin-coated lead pipes.

The presence of Ca salts does not influence the action of the H<sub>2</sub>O on Pb, hard or soft H<sub>2</sub>O provided it contains CO<sub>2</sub> having a strong corrosive action. Removal of air from H<sub>2</sub>O diminishes the solvent action. Simple filtration will remove all Pb from H<sub>2</sub>O if suitable filters are used. (Flogel, J. B. 1888. 2645.)



tions; and  $\text{Ca}(\text{ClO}_3)_2$ ,  $\text{CaCl}_2 + \text{Aq}$  (20° Baume), obtained by passing  $\text{Cl}_2$  through  $\text{CaO} \cdot \text{H}_2\text{O} + \text{Aq}$ , oxidised 437.70 g. (Lunge and Daggeker, Jour. Soc. Chem. Ind. 4. 31.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

Sol. in a solution of K in liquid  $\text{NH}_3$ . (Kraus, J. Am. Chem. Soc. 1907, 29. 1562.)

1.2 ccm. oleic acid dissolves 0.0592 g. Pb in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

Solubility of Pb in petroleum.

If b.-pt. is under 230°, only slightest trace is dissolved in 4 months; if 230–300°, 0.0026% in 4 months; if over 300°, 0.0244% in 4 months in 4 months; if over 300°, 0.0244% in 4 months.

Solubility of Pb in commercial oil of turpentine and resin oil.

	Temp	% Pb dissolved	
		in 5 days	in 14 days
Fresh oil of turpentine	15–20°	sl trace	0.0722
Old oil of turpentine	15–20	0.0522	0.1435
Fresh oil of turpentine	100	0.265	0.715
Old oil of turpentine	100	0.982	1.851
Fresh oil of turpentine	130–150	0.938	2.045
Old oil of turpentine	130–150	1.738	4.083
Fresh resin oil	15–20	trace	0.024
Old "	15–20	0.073	0.185
Fresh "	100	0.380	0.880
Old "	100	1.190	2.711
Fresh "	130–150	1.050	2.065
Old "	130–150	2.208	4.740

(Engler and Kneis, Dingl. 263. 193.)

Pb is strongly attacked by oil of turpentine (Am. Chem. 4. 280.)

The fatty oils dissolve Pb in considerable amt. (Macadam, J. B. 1878. 1169.)

Not attacked by sugar + Aq. (Klein and Berg, C. R. 102. 1176.)

Lead potassium amide.

See Potassium ammonoplumbite.

Lead azoumide, basic,  $\text{PbO}$ ,  $\text{PbN}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Wöhler, B. 1913, 46. 2054.)

Lead azoumide,  $\text{PbN}_3$ .

Insol. in cold  $\text{H}_2\text{O}$ ; much less sol. in boiling  $\text{H}_2\text{O}$  than  $\text{PbCl}_2$ . 1 l.  $\text{H}_2\text{O}$  dissolves about 1/2 g.  $\text{PbN}_3$ . Easily sol. in warm  $\text{HCl} \cdot \text{H}_2\text{O} + \text{Aq}$ . Insol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Curtius, B. 24. 2214.)

Lead bromide,  $\text{PbBr}_2$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ , or in  $\text{H}_2\text{O}$  containing  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{HCl} \cdot \text{H}_2\text{O}$ , (Lowig.)

1 l.  $\text{H}_2\text{O}$  dissolves 6 g.  $\text{PbBr}_2$  at 10°, addition of  $\text{HBr}$  causes a ppt. which redissolves on further addition of  $\text{HBr}$ . 1000 pts. of a liquid containing 720 pts.  $\text{HBr}$  dissolve 550 g.  $\text{PbBr}_2$ . This solubility increases by heating. (Ditte, C. R. 92. 718.)

1 l.  $\text{H}_2\text{O}$  dissolves 26.28 millimols.  $\text{PbBr}_2$  at 25.2°. (von Ende, Z. anorg. 1901, 26. 159.)

Solubility in 100 g.  $\text{H}_2\text{O}$  at t°.

t°	G $\text{PbBr}_2$
0	0.4554
15	0.7305
25	0.9744
35	1.3220
45	1.7457
55	2.1376
65	2.5736
80	3.3420
95	4.3613
* 100	4.7510

\* By extrapolation. (Lichiy, J. Am. Chem. Soc. 1903, 25. 474.)

Sl. sol. in  $\text{H}_2\text{O}$ .

8.34 × 10<sup>-1</sup> gram. are dissolved in 1 liter of sat. solution at 20°. (Böttger, Z. phys. ch. 1903, 46. 643.)

Solubility of  $\text{PbBr}_2$  in  $\text{HNO}_3 + \text{Aq}$  at 25.2°. S = solubility in millimols per litre.

$\text{HNO}_3$ normal	S
0.001	39.11
0.01	39.87
0.051	42.56
0.04 $\text{KNO}_3 +$	
0.01 $\text{HNO}_3$	42.77

(von Ende, Z. anorg. 1901, 26. 162.)

Slowly sol. in cold, easily in warm  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Wittstein.)

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in  $\text{H}_2\text{O}$  containing  $\text{Pb}(\text{NO}_3)_2$ . (von Ende, Z. anorg. 1901, 26. 159.)

Insol. in benzene. (Franchimont, B. 16. 387.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate (Naumann, B. 1900, 42. 3790); ethyl acetate (Naumann, B. 1910, 43. 314.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

1.2  $\text{H}_2\text{O}$  (Ditte, C. R. 92. 718.)

Lead hydrogen bromide,  $5\text{PbBr}_2 \cdot 2\text{HBr} + 10\text{H}_2\text{O}$ .

Sol. in  $\text{HBr} + \text{Aq.}$  (Ditte, C. R. 92, 718.)

Lead magnesium bromide,  $\text{PbBr}_2 \cdot 2\text{MgBr}_2 + 16\text{H}_2\text{O}$ .

Very deliquescent. Decomp. immediately by  $\text{H}_2\text{O}$  or alcohol. (Otto and Drewes, Arch. Pharm. 229, 585.)

Lead potassium bromide (potassium bromoplumbite,  $\text{PbBr}_2 \cdot \text{KBr} + \text{H}_2\text{O}$ .

(Remsen and Hefty, Am. Ch. J. 14, 124.)

$+ \text{H}_2\text{O}$ . (Wells, Sill. Am. J. 145, 129.)

$\text{PbBr}_2 \cdot 2\text{KBr}$  Sol. in a little  $\text{H}_2\text{O}$  without decomp., but decomp. by an excess with separation of  $\text{PbBr}_2$  (Lowig.)

$+ \text{H}_2\text{O}$ . (Wells, Sill. Am. J. 145, 129.)

$2\text{PbBr}_2 \cdot \text{KBr}$ . (Wells.)

Lead potassium perbromide,  $\text{K}_2\text{Pb}_2\text{Br}_7 + 4\text{H}_2\text{O}$

Decomp. by  $\text{H}_2\text{O}$  and alcohol (Wells, Z. anorg. 4, 340.)

Lead rubidium bromide,  $\text{PbBr}_2 \cdot 2\text{RbBr} + \frac{1}{2}\text{H}_2\text{O}$ .

(Wells, Sill. Am. J. 146, 34.)

$2\text{PbBr}_2 \cdot \text{RbBr}$  (Wells)

Lead sodium bromide.

Decomp. by  $\text{H}_2\text{O}$ . (Lowig.)

Lead bromochloride,  $\text{PbBrCl} = \text{PbBr}_2 \cdot \text{PbCl}_2$ .

Can be recrystallised from  $\text{H}_2\text{O}$  without decomp. (Hes. C. N. 43, 216.)

$3\text{PbCl}_2 \cdot \text{PbBr}_2$  Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in  $\text{HCl}$  and in  $\text{HBr}$ . Insol. in cold alcohol, sl. sol. in boiling alcohol. (Thomas, C. R. 1899, 128, 1235.)

Lead bromiodide,  $\text{PbBrI} = \text{PbBr}_2 \cdot \text{PbI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Cryst. from a solution of  $\text{PbI}_2$  in  $\text{HBr}$ . (Grissom and Thorp, Am. Ch. J. 10, 220.)

$3\text{PbBr}_2 \cdot \text{PbI}_2$  Decomp. by  $\text{H}_2\text{O}$ . (Thomas, C. R. 1899, 128, 1236.)

$6\text{PbBr}_2 \cdot \text{PbI}_2$ . (G. and T.)

Lead bromosulphide,  $\text{PbBr}_2 \cdot \text{PbS}$ .

Properties as chlorosulphide. (Parmentier.)

Lead chloride,  $\text{PbCl}_2$ .

Slowly sol. in 146 pts  $\text{H}_2\text{O}$  at  $12.5^\circ$ , and in a much smaller quantity of hot  $\text{H}_2\text{O}$  (Buehler.)

Sol. in 30 pts cold and 22 pts hot  $\text{H}_2\text{O}$  (Wittstein.)

Sol. in 20 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  (ABL.)

100 pts  $\text{H}_2\text{O}$  dissolve 1.50 pts.  $\text{PbCl}_2$  at  $15.5^\circ$  (Ure's Dict.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.9712 pt.  $\text{PbCl}_2$  at  $20^\circ$ . (Formánek, C. C. 1887, 270.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.946 pt.  $\text{PbCl}_2$  at  $17.7^\circ$ . (Bell, Chem. Soc. (2) 6, 355.)

Sol. in 105.2 pts.  $\text{H}_2\text{O}$  at  $18.5^\circ$ . (Bell, C. N. 16, 69.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.8 pt.  $\text{PbCl}_2$  at  $0^\circ$ , 1.18 pts. at  $20^\circ$ ; 1.7 pts. at  $40^\circ$ ; 2.1 pts. at  $55^\circ$ ; 3.1 pts. at  $80^\circ$ . (Ditte, C. R. 92, 718.)

1 l.  $\text{H}_2\text{O}$  dissolves 38.80 millimols.  $\text{PbCl}_2$  at  $25.2^\circ$  (von Ende, Z. anorg. 1901, 26, 148.)

$9.61 \times 10^{-4}$  gram are dissolved in 1 liter of sat. solution at  $20^\circ$  (Rottger, Z. phys. ch. 1903, 46, 603.)

Solubility in  $\text{H}_2\text{O}$ .

100 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{PbCl}_2$  at  $t^\circ$

$t^\circ$	G $\text{PbCl}_2$
0	0.6728
15	0.9090
25	1.0842
35	1.3244
45	1.5673
55	1.8263
65	2.1265
80	2.6224
95	3.1654
* 100	3.3420

\* By extrapolation.

(Lachty, J. Am. Chem. Soc. 1903, 25, 474.)

33.6 millimols.  $\text{Pb}$  are dissolved in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$  (Plessner, C. C. 1907, II 1056.)

1 l.  $\text{H}_2\text{O}$  dissolves 77.76 milliequivalents  $\text{PbCl}_2$  at  $25^\circ$ . Sp. gr. of the solution  $25^\circ/4^\circ = 1.0069$ . (Harkins and Winnighoff, J. Am. Chem. Soc. 1911, 33, 1816.)

0.0388 mol. mg.  $\text{PbCl}_2$  are sol. in 1 l.  $\text{H}_2\text{O}$ . (Kernot and Pomilio, Soc. R. Napoli, 1912, (3), XVII, 353.)

A colloidal modification is sol. in hot water to give cryst. modification. (Van de Velde, Ch. Z. 1893, 17, 1908.)

Solubility in  $\text{H}_2\text{O}$  is not much increased by the addition of acids. (Fresenius.)

Sol. in conc.  $\text{HCl} + \text{Aq.}$  from which it is pptd. by  $\text{H}_2\text{O}$ , but less sol. in dil.  $\text{HCl} + \text{Aq.}$  than in  $\text{H}_2\text{O}$ . (Berzelius.)

Sol. in 1636 pts.  $\text{H}_2\text{O}$  containing  $\text{HCl}$ . (Bischof.)

Sat. solution of  $\text{PbCl}_2$  in  $\text{HCl} + \text{Aq.}$  of 1.116 sp. gr. contains 2.566%  $\text{PbCl}_2$  at  $16.5^\circ$ .

Solubility in  $\text{HCl} + \text{Aq.}$  100 pts. liquid containing pts.  $\text{HCl}$  of 1.162 sp. gr. in 100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{PbCl}_2$  at  $17.7^\circ$ .

Pts $\text{HCl}$	Pts. $\text{PbCl}_2$	Pts $\text{HCl}$	Pts. $\text{PbCl}_2$	Pts $\text{HCl}$	Pts. $\text{PbCl}_2$
1	0.347	8	0.099	50	0.356
2	0.201	9	0.096	60	0.559
3	0.165	10	0.093	70	0.933
4	0.145	15	0.090	80	1.498
5	0.131	20	0.111	90	2.117
6	0.107	30	0.151	100	2.900
7	0.100	40	0.216	..	..

(Bell, Chem. Soc. 21, 350.)

Solubility of  $PbCl_2$  in  $HCl$ .

Amt. $HCl$ in 100 pts ( $H_2O$ )	Amount $PbCl_2$ dissolved in 1000 pts of liquid				
	At 0°	At 20°	At 40°	At 55°	At 80°
0 0	8 0	11 8	17 0	21 0	31 0
5 6	2 8	3 0	4 6	6 5	12 4
10 0	1 2	1 4	3 2	5 5	12 0
18 0	2 4	4 8	7 2	9 8	19 8
21 9	4 7	6 2	10 4	12 9	23 8
31 5	11 9	14 1	19 0	24 0	38 0
46 0	29 8	30 0			

(Ditte, C. R. 92, 718.)

Solubility in  $HCl + Aq$  at 0°.  $\frac{PbCl_2}{2} = 1/2$  mols $PbCl_2$  in mgs. in 10 ccm. solution;  $HCl =$  mols  $HCl$  in ditto.

$\frac{PbCl_2}{2}$	$HCl$	$\frac{PbCl_2}{2}$	$HCl$
0 42	0	0 072	5 8
0 22	0 35	0 088	11 7
0 135	0 675	0 100	29 5
0 11	1 125	0 209	46 7
0 105	1 6	0 95	73 5
0 099	2 3	1 5	89 0
0 090	3 4	1 9	96 0
0 08	4 5	3 01	111 5

It is seen that very little  $HCl + Aq$  is sufficient to diminish solubility very considerably, and, that on further addition of  $HCl + Aq$ , the solubility is nearly constant, and increases finally very much when large amts. of  $HCl + Aq$  are present (Engel, A. ch. (6) 17, 359.)

Solubility of  $PbCl_2$  in  $HCl + Aq$  at 25°

G. $HCl$ per l.	G. $PbCl_2$ per l.	G. $HCl$ per l.	G. $PbCl_2$ per l.
0	10 79	3	5 0
0 5	9 0	6	3 1
1	7 6	10	1 8
2	6 0		

(Noyes, Z. phys. Ch. 1892, 9, 623.)

Solubility of  $PbCl_2$  in  $HCl + Aq$  at 25.20°.  $S =$  solubility in millimols per litre.

$HCl$ normal	S	$HCl$ normal	S
0 0000	38.80	0 3714	6.35
0 0009	38 66	0 5142	5 37
0 0022	38 20	0 7386	4.73
0 0030	37.94	1.026	4 41
0 0045	37 35	1.538	4.61
0 0091	35 80	2.051	5.18
0 0114	34 99	2.564	6.25
0 0151	33 75	3 085	7.78
0 0226	31.46	3.718	8.10
0 0302	29 32	5 0	19 38
0 0452	25 46	7.5	65.86
0 0910	17 12	10 0	141 35
0 1850	10 12	12 05	164 3

(von Ende, Z. anorg. 1901, 26, 148.)

Solubility of  $PbCl_2$  in  $HCl$  at 18°

$HCl$ Normality	G. $PbCl_2$ per l.
0	9 34
0 0001	9 305
0 0002	9 300
0 0005	9 243
0 00102	9 200
0 0102	8 504

(Plessner, Arb. Kaiser. Gesundheitsamt. 1907, 26, 384.)

Sol. in hot, insol. in cold conc.  $H_2SO_4$ . (Hayes.)Sol. in dil  $HNO_3 + Aq$ , from which it is pptd. by  $HCl + Aq$ . (Gladstone.)Easily and completely decomp. by hot  $HNO_3 + Aq$ . (Wurtz.)Solubility of  $PbCl_2$  in  $HNO_3 + Aq$  at 25.2°,  $S =$  solubility in millimols per litre.

$HNO_3$ normal	S
0 001	38 87
0.01	39.71
0.051	42 92
0 04 $KNO_3 +$	
0 01 $HNO_3$	43.30

(von Ende, Z. anorg. 1901, 26, 162.)

Solubility of  $PbCl_2$  in  $NH_4Cl + Aq$  at 25.20°.  $S =$  solubility in millimols per litre.

$NH_4Cl$ normal	S
0.25	0 47
0.50	7.11
1 0	4 35

(von Ende, Z. anorg. 1901, 26, 152.)

Solubility of  $PbCl_2 + NH_4Cl$  at 22°.

G. equiv per l. $H_2O$ $NH_4Cl$	G. equiv. per 100 cc. $H_2O$ $PbCl_2$	G. equiv. per l. $H_2O$ $NH_4Cl$	G. equiv. per 100 cc. $H_2O$ $PbCl_2$
0 0	7 49 x $10^{-3}$	1 0	0 758 x $10^{-3}$
0 1	3 10	1 2	0 707
0 2	1 916	1 5	0 671
0 3	1 508	2 0	0 695
0 4	1.348	2 5	0 812
0 5	1.263	3 0	0 908
0 55	1 189	4 0	1 502
0 6	1 092	5 0	2 338
0 05	1 012	6 0	3 580
0 7	0 950	7 0	5 628
0 8	0 837	7.20*	6 46
0 9	0 793		

\* Saturated.

(Brønsted, Cong. Appl. Chem. 1909, Sec. X, 110.)

Solubility in $\text{NH}_4\text{Cl} + \text{Aq}$ at $t^\circ$				Much more sol. in $\text{HgCl}_2 + \text{Aq}$ than in $\text{H}_2\text{O}$ .			
$t^\circ$	g. $\text{PbCl}_2$ in 100 g. of the solution	g. $\text{NH}_4\text{Cl}$ in 100 g. of the solution	Solid phase	Grammes $\text{HgCl}_2$ in 100 c.c.m.	Grammes $\text{PbCl}_2$ dissolved	After subtracting amt. dissolved by $\text{H}_2\text{O}$ alone	Calculated no. of grammes for 100 g. $\text{HgCl}_2$
17°	0.89	0.0	$\text{PbCl}_2$	0	0.9712		
	0.21	0.96		1	1.8972	0.9350	23.37
	0.16	1.43		2	1.4874	0.5208	26.01
	0.11	2.40		1	1.3272	0.2000	26.00
	0.076	3.48		0.5	1.0808	0.1134	22.68
	0.078	4.23	eutectic-pt.	0.25	1.0192	0.0500	20.00
	0.078	4.93		0.125	0.9926	0.0226	18.08
	0.098	12.36		(Formánek, C. C. 1887, 270.)			
	0.31	22.33		Solubility of $\text{PbCl}_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 20°			
	0.61	26.19		G equiv. per l.			
	0.52	26.68	$\text{NH}_4\text{Cl}$	$\text{Pb}(\text{NO}_3)_2$		$\text{PbCl}_2$	
	0.33	26.91		0.0		0.0777	
	0.30	27.03		0.2		0.0832	
	0.0	27.14		(Noyes, Z. phys. Ch. 1892, 9, 623.)			
				Solubility in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 25°.			
50°	1.69	0.0	$\text{PbCl}_2$	C = concentration of $\text{Pb}(\text{NO}_3)_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ expressed in milliequivalents per l.			
	1.08	0.51		$d_1$ = Sp. gr. of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 25°.			
	0.67	1.15		S = Solubility of $\text{PbCl}_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ expressed in milliequivalents per l.			
	0.58	2.45		$d_2$ = Sp. gr. 25°/4° of $\text{PbCl}_2 + \text{Pb}(\text{NO}_3)_2 + \text{Aq}$ .			
	0.48	4.86		C	$d_1$	S	$d_2$
	0.49	12.45	eutectic pt.	20.020	1.0008	76.75	1.0095
	0.71	19.42		50.063	1.0045	76.64	1.0139
	1.70	27.16		99.660	1.0119	77.98	1.0210
	3.31	31.90		(Harkins and Winninghof, J. Am. Chem. Soc. 1911, 33, 1816.)			
	3.00	33.56		Solubility of $\text{PbCl}_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 25°.			
	2.65	33.62	eutectic pt.	G $\text{Pb}(\text{NO}_3)_2$ per l.		% $\text{PbCl}_2$	
	1.02	33.88		0		1.09	
	0.32	34.14		3.31		1.10	
	0.0	34.25		6.62		1.05	
				33.12		1.11	
100°	3.10	0.0	$\text{PbCl}_2$	S2.80		1.29	
	2.02	1.32		(Armstrong and Eyre, Proc. Roy. Soc. 1913, (A) 88, 234.)			
	1.85	5.33		Solubility of $\text{PbCl}_2$ in $\text{KCl} + \text{Aq}$ at 25.20°.			
	1.80	6.01		S = Solubility in millimols per litre.			
	1.70	8.59	eutectic pt.	KCl normal	S	KCl normal	S
	1.98	13.19		0.0000	38.80	0.0999	16.90
	4.54	26.08		0.001	38.32	0.5006	7.40
	8.32	32.64		0.0025	37.85	0.7018	7.38
	11.40	36.29		0.0049	37.02	0.9991	4.90
	12.67	37.62	eutectic pt.	0.0049	37.02	0.9991	4.90
	12.50	38.14		0.0099	35.28	1.5018	4.83
	11.60	38.32		0.0200	32.16	2.0024	5.56
	10.70	38.66		0.0599	22.62	3.0036	9.74
	9.88	40.22		(von Ende, Z. anorg. 1901, 26, 151.)			
	9.26	41.90	eutectic pt.				
	4.21	42.91					
	3.06	43.20					
	1.61	43.42					
	0.0	43.51					

These results show that the double salt  $\text{PbCl}_2, 2\text{NH}_4\text{Cl}$  can only exist in aqueous solution at temperature above 70°.

(Demassieux, C. R. 1913, 156, 894.)

Solubility of  $\text{PbCl}_2 + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $20^\circ$ .  
Values = g. equivalents.

In 1000 g solution		In 1000 g $\text{H}_2\text{O}$		Solid phase
$\text{PbCl}_2$	KCl	$\text{PbCl}_2$	KCl	
		28.0	4.57	$\text{PbCl}_2, \text{KCl}$ $\frac{1}{2}\text{H}_2\text{O} + \text{KCl}$
17.80	3.18	23.42	4.18	$\text{PbCl}_2, \text{KCl}$ $\frac{1}{2}\text{H}_2\text{O}$
16.50	3.05	21.50	3.96	
15.50	2.91	19.85	3.73	
14.70	2.77	18.06	3.50	
13.90	2.60	17.48	3.33	
13.10	2.47	16.17	3.03	
13.08	2.45	16.06	3.01	
12.94	2.40	15.80	2.93	
12.90	2.36	14.92	2.87	
12.86	2.35	15.63	2.86	
12.44	2.30	15.03	2.78	$2\text{PbCl}_2, \text{KCl}$
11.84	2.20	14.30	2.77	
11.38	2.24	13.70	2.70	
10.60	2.20	12.72	2.64	
11.98	2.29	14.35	2.62	
10.46	2.14	12.47	2.55	
10.22	2.10	12.18	2.49	
9.82	2.04	11.60	2.41	
9.34	1.96	10.96	2.31	
8.94	1.88	10.42	2.20	
7.86	1.57	8.92	1.79	$\text{PbCl}_2$
7.72	1.52	8.72	1.74	
7.00	1.40	8.50	1.570	
7.46	1.32	8.29	1.472	
7.36	1.24	8.11	1.348	
7.38	1.23	8.13	1.347	
7.30	1.27	7.98	1.231	
7.34	1.22	8.01	1.225	
7.36	1.059	8.00	1.152	
7.48	1.022	8.10	1.107	
7.52	0.988	8.13	1.068	$\text{PbCl}_2$
7.70	0.930	8.28	1.000	
7.82	0.880	8.38	0.943	
8.24	0.821	8.79	0.875	
8.42	0.783	8.96	0.833	
8.84	0.719	9.36	0.761	
9.54	0.639	10.03	0.672	
10.08	0.575	11.18	0.602	
12.32	0.523	12.85	0.545	
12.38	0.503	12.88	0.523	$\text{PbCl}_2$
12.36	0.483	12.85	0.502	
12.50	0.475	13.04	0.497	
12.48	0.458	12.95	0.475	
12.24	0.375	13.65	0.387	
14.52	0.299	14.88	0.306	
19.00	0.195	19.33	0.199	

(Brünsted, Z. phys. Ch. 1912, 80. 208.)

$\text{PbCl}_2$  is sol in 120 pts. pure  $\text{H}_2\text{O}$ , but on adding 5% NaCl 437 pts. are required to effect solution. When  $\text{PbCl}_2$  is digested with conc. NaCl + Aq, 1 pt. dissolves in 129 pts. of the liquid.

A study of the equilibrium between lead chloride and sodium chloride in aqueous solution at  $13^\circ$ ,  $50^\circ$  and  $100^\circ$  shows that at none of these temp. do these chlorides form a double salt. (Demassieux, C. R. 1914, 158. 702.)

Solubility in salts + Aq at  $25^\circ$ .

Salt used	Concentration of the salt Equivalents per liter	Solubility of $\text{PbCl}_2$ Equivalents per liter
None	0	0.07770
HCl	0.05	0.04786
"	0.1	0.03243
"	0.2	0.01927
KCl	0.05	0.0482
"	0.1	0.0341
"	0.2	0.0219
$\text{MgCl}_2$	0.05	0.0503
"	0.1	0.0350
$\text{CaCl}_2$	0.05	0.0503
"	0.1	0.0355
"	0.2	0.0219
$\text{MnCl}_2$	0.05	0.0501
"	0.1	0.0349
"	0.2	0.0217
$\text{ZnCl}_2$	0.2	0.0220
$\text{CdCl}_2$	0.05	0.0601
"	0.1	0.0481
"	0.2	0.0355

(Noyes, Z. phys. Ch. 1892, 9. 623.)

Sol. in KOH + Aq. (Rosa.)  
Less sol. in dil. salt solutions than in  $\text{H}_2\text{O}$ , especially  $\text{CaCl}_2$  + Aq, sol. in 534 pts.  $\text{H}_2\text{O}$  containing  $\text{CaCl}_2$ . (Bischof.)

More sol. in  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq than in  $\text{H}_2\text{O}$ , but not as sol. as  $\text{AgCl}$ . (Herschell, 1819.)

More sol. in  $\text{NaC}_2\text{H}_3\text{O}_2$  + Aq than in  $\text{H}_2\text{O}$ . (Anthon.)

Easily sol. in  $\text{NH}_4\text{NO}_3$  + Aq.

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Ann. Ch. J. 1898, 20. 828.)

Insol. in conc. alcohol. (Wittstein.) Insol. in 94% alcohol; very sl. sol. in cold or hot 76% alcohol.

Solubility in alcohol at  $25^\circ$ .

Alcohol = g. mol. alcohol in 1 l. of solvent.

$\text{PbCl}_2$  = g. mol.  $\text{PbCl}_2$  in 1 l. of solution.

Alcohol	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$
$\text{PbCl}_2$	0.0172	0.0257	0.0298	0.0330	0.0338

Alcohol  $\frac{1}{2}$ , 0

$\text{PbCl}_2$  0.0367 0.0388

(Kernot and Pomilio, Soc. R. Napoli, (3) 17. 353.)

Insol. in benzene. (Franchimont, B. 16. 387.)

Insol. in  $\text{CS}_2$ . (Arcetowski, Z. anorg. 1894, 6. 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate (Naumann, B.

1909, 42, 3700), ethyl acetate. (Naumann, B. 1910, 43, 314.)

Insol in methylal. (Eidmann, C. C. 1899, 11, 1014.)

Insol in acetone. (Naumann, B. 1904, 37, 4329.)

Glycerine dissolves 1.995%,  $PbCl_2$   
1 pt. glycerine + 1 pt.  $H_2O$  dissolves 1.32%,  
 $PbCl_2$

1 pt. glycerine + 3 pts.  $H_2O$  dissolves 1.0365%  
in  $PbCl_2$

Glycerine containing 87.5%  $H_2O$  dissolves  
0.01%  $PbCl_2$ . (Piesse, R. 7, 599.)

Solubility of  $PbCl_2$  in mannite + Aq at 25°  
Mannite = g. mol. mannite in 1 l. of solvent

$PbCl_2$  = g. mol.  $PbCl_2$  in 1 l. of solution  
Mannite  $\frac{1}{2}$   $\frac{1}{4}$   $\frac{1}{8}$   $\frac{1}{16}$   $\frac{1}{32}$   
 $PbCl_2$  0.0408 0.0403 0.0391 0.0384 0.0385

Mannite  $\frac{1}{4}$  0

$PbCl_2$  0.0377 0.0388

(Kernot and Pomilio, Soc. R. Napoli, (3) 17, 353.)

Min. *Chloranite*

Lead tetrachloride,  $PbCl_4$ .

Sol. in  $H_2O$  with subsequent decomp.  
(Rivot, Boudant, and Daguin, Ann. Min. (5) 4, 239.)

Obtained in a pure state by Friedrich. Sol.  
in a little cold  $H_2O$ , but it decomp. by warm-  
ing or diluting. Miscible with conc.  $HCl$  +  
Aq; not attacked by conc.  $H_2SO_4$  even on  
warming. (Friedrich, W. A. B. 102, 2b, 534.)

Lead tetrachloride with  $MCl$ .

See Chloroplumbate, M.

Lead magnesium chloride,  $PbCl_2 \cdot 2MgCl_2 + 13H_2O$ .

Deliquescent. Decomp. by  $H_2O$ . (Otto  
and Drewes, Arch. Pharm. 228, 495.)

Lead potassium chloride (potassium chloro-  
plumbite),  $PbCl_2 \cdot KCl$ .

(Ramsen and Herty, Am. Ch. J. 14, 125.)  
Contains  $\frac{1}{3} H_2O$ . (Wells, Sill. Am. J. 145, 130.)

See also Demassieux,  $PbCl_2 + KCl$  under  
 $PbCl_2$ .

$2PbCl_2 \cdot KCl$ . (Wells.)

See also Demassieux as above.

Lead rhodium chloride.

See Chlororhodite, lead.

Lead rubidium chloride,  $PbCl_2 \cdot 2RbCl + \frac{1}{2}H_2O$ .

(Wells, Sill. Am. J. 146, 34.)

$2PbCl_2 \cdot RbCl$ . (Wells.)

Lead sodium chloride.

Decomp. by  $H_2O$ .

Lead sodium tetrachloride,  $2PbCl_4 \cdot 9NaCl$ .

Very sol. in  $H_2O$ . (Sobrero and Selmi, A. ch. (3) 29, 165.)

See also Chloroplumbate, lead.

Lead thalious chloride,  $PbCl_2 \cdot 3TlCl$ .

Sl. sol. in cold, more in hot  $H_2O$ . (Noyes,  
Z. phys. Ch. 9, 622.)

$PbCl_2 \cdot TlCl$  Ppt. (Ephraim, Z. anorg.  
1909, 61, 245.)

Lead chloride ammonia,  $2PbCl_2 \cdot 3NH_3$ .

(Rose, Pogg. 20, 157.)

Lead tetrachloride ammonia,  $PbCl_4 \cdot 4NH_3$ .

Pptd. from chloroform solution (Mat-  
thews, J. Am. Chem. Soc. 1898, 20, 825.)

$PbCl_4 \cdot 2NH_3$  Fumes in the air. Decomp.  
by  $H_2O$ . (Matthews.)

Lead chloride arsenate,  $3Pb_2(AsO_4)_3 \cdot PbCl_2$ .

See Arsenate chloride, lead.

Lead chloride borate,  $Pb_2(BO_3)_2 \cdot PbCl_2 + H_2O$ .

See Borate chloride, lead.

Lead chloride carbonate.

See Carbonate chloride, lead.

Lead chloride chlorite.

See Chlorite chloride, lead.

Lead chloride with fluoride and iodide.

See Lead chlorofluoride and Lead chloro-  
iodide.

Lead chloride phosphate.

See Phosphate chloride, lead.

Lead chloride phosphite,  $PbCl_2 \cdot Pb_2P_2O_5(?)$ .

Ppt. (Berzelius.)

Does not exist. (Rose.)

Lead chloride sulphate.

See Sulphate chloride, lead.

Lead chloride sulphide,  $PbCl_2 \cdot 3PbS$ .

See Lead chlorosulphide.

Lead chlorofluoride,  $PbClF$ .

Sl. sol. in  $H_2O$  without decomp. Easily  
sol. in  $HNO_3$  + Aq. (Berzelius.)

Solubility in  $H_2O$ .

100 g.  $H_2O$  dissolve 0.0211 g.  $PbClF$  at  
0°; 0.0370 g. at 25°; 0.1081 g. at 100°. (Starck,  
Z. anorg. Ch. 1911, 70, 174.)

Solubility in  $HCl$  + Aq at 25°.

Solution of  $PbClF$  in  $HCl$  + Aq containing  
0.0535 g. equiv. per l. contains 0.0758 g.  
 $PbClF$  in 100 cc. of solvent

Solution of  $PbClF$  in  $HCl$  + Aq containing

0.1069 g. equiv. per l. contains 0.1006 g. PbClF in 100 cc. of solvent. (Starek.)

Solubility in acetic acid at 25°.

Solution of PbClF in  $\text{HCl}_2\text{H}_2\text{O}_2$  containing 0.0518 g. equiv. per l. contains 0.05129 g. PbClF in 100 cc. of solvent.

Solution of PbClF in  $\text{HCl}_2\text{H}_2\text{O}_2$  containing 0.1035 g. equiv. per l. contains 0.0561 g. PbClF in 100 cc. of solvent. (Starek.)

#### Solubility in $\text{PbCl}_2 + \text{Aq.}$

t°	G equiv. per l PbCl <sub>2</sub>	G PbClF in 100 cc of solvent
18°	0 0100	0 0020
"	0 0195	0 0016
"	0 0435	0 0002
25°	0 00996	0 0030
"	0 0196	0.0008
"	0 0392	0 0005

(Starek.)

#### Lead chloriodide, $2\text{PbCl}_2, \text{PbI}_2$

Sol in hot  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Poggiale, J. pr 35. 320.)

$\text{PbCl}_2, \text{PbI}_2$  Sol. in hot  $\text{HCl} + \text{Aq.}$  (Engelhardt.)

Sol. in  $\text{H}_2\text{O.}$  (Thomas, C. R. 1898, 126. 1351.)

#### Lead chloroselenide.

Decomp. by boiling  $\text{H}_2\text{O}$  and by conc  $\text{KOH} + \text{Aq.}$  (Fonze-Diacon, C. R. 1900, 130. 1133.)

#### Lead chlorosulphide, $\text{PbCl}_2, 3\text{PbS.}$

Partially decomp. by hot  $\text{H}_2\text{O}$ . Not attacked by dil., but decomp. by conc.  $\text{HCl} + \text{Aq.}$  (Hunefeld, J. pr. 7. 27.)

$\text{PbS, PbCl}_2$ . Decomp. by  $\text{H}_2\text{O}$ , acids, or alkalies. (Parmentier, C. R. 114. 298.)

$\text{ClPbS}_2\text{PbS}_2\text{PbS}_2\text{PbCl.}$  Ppt. (Hofmann, B. 1904, 37. 250.)

#### Lead fluoride, $\text{PbF}_2$

Very sl. sol. in  $\text{H}_2\text{O}$ , and not more in  $\text{HF} + \text{Aq.}$  (Berzelius, Pogg. 1. 31.)

5.5 millimols are sol. in 1000 ccm.  $\text{H}_2\text{O.}$  (Jaeger, Z. anorg. 1901, 27. 38.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.40 mg at 18°. (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

641 mg. in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, 64. 108.)

More sol. in  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq.}$  Sl. sol. in  $\text{KF} + \text{Aq.}$  (Herty, Am. Ch. J. 14. 107.)

Sl. sol. in dil.  $\text{HF} + \text{Aq.}$ , insol. in strong  $\text{HF} + \text{Aq.}$

0.0130? g. atoms Pb are sol. in 1000 cc.  $\text{HF.}$  (Jaeger, Z. anorg. 1901, 27. 37.)

Insol. in liquid  $\text{HF.}$  (Franklin, Z. anorg. 1905, 46. 2.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. J. Ch. 1898, 20. 828.)

Insol. in ethylacetate. (Naumann, B. 1910, 43. 311.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

#### Lead potassium fluoride, $3\text{KF, HF, PbF}_4$

Decomp.  $\text{H}_2\text{O}$ , stable in dry air. (Brauner, Z. anorg. 1894, 7. 7.)

#### Lead silicon fluoride.

See Fluosilicate, lead.

#### Lead tantalum fluoride.

See Fluotantalate, lead.

#### Lead titanium fluoride.

See Fluotitanate, lead.

#### Lead fluoride sulphate.

See Sulphate fluoride, lead.

#### Lead hydroxide, $\text{PbO}_2\text{H}_2$

Not appreciably sol. in  $\text{H}_2\text{O.}$  (Jaeger, Z. anorg. 1901, 27. 38.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.135 g.  $\text{PbO}_2\text{H}_2$  at 20° and 100° (Schmal, C. R. 1909, 148. 1399.)

#### Solubility in $\text{NaOH} + \text{Aq.}$

G. Na in 20 ccm	G. Pb in 20 ccm.
0 2024	0 1012
0 3196	0.1736
0 5866	0 3532
0.9476	0.4071
1 7802	0.5170

(Rübenbauer, Z. anorg. 1902, 30. 336.)

#### Solubility of $\text{PbO}_2\text{H}_2$ in $\text{NaOH} + \text{Aq}$ at 25°.

G mol per l		Solid Phase
Na	Pb	
0.274	0 0181	$\text{PbO}_2\text{H}_2$
0 431	0 287	"
0.476	0.319	"
0.745	0 459	"
1.132	0.711	"
1.519	0.101	"

(Wood, Chem Soc. 1910, 97. 884.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

$2\text{PbO, PbO}_2\text{H}_2 = 3\text{PbO, H}_2\text{O.}$  Sol. in 10,000 to 12,000 pts.  $\text{H}_2\text{O.}$  (Yorke.) Sol. in 7000 pts.  $\text{H}_2\text{O.}$  (v. Bonsdorff, Pogg. 41. 307.)

0.45 millimol. Pb are sol. in 1 liter  $\text{H}_2\text{O}$  at 18°. (Pleissner, C. C. 1907, II 1056.)

Sol. in acids. Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq.}$  Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq.}$  and reprecip. by  $\text{NH}_4\text{OH} + \text{Aq.}$

Solubility in  $\text{KOH} + \text{Aq.}$  according to Ditté (C. R. 94. 130). When  $\text{KOH} + \text{Aq}$  is gradu-

ally added to lead hydroxide suspended in  $H_2O$ , the lead hydroxide is at last dissolved proportional to the amount of KOH, until the strength reaches 200 g. KOH to 1 litre  $H_2O$ . The solubility then diminishes and increases again until 400 g. KOH are dissolved in 1 litre  $H_2O$ . The amorphous lead hydroxide is then converted into crystalline  $2PbO(PhO_2H_2)$ . By further addition of KOH the solubility is suddenly decreased, and then increases again. (Ditte)

Sol. in triethyl toluenyl ammonium hydrate + Aq.

Sol. in sorbine + Aq. (Pelouze.)

Sol. in acetates + Aq. (Mercer.)

Sol. in Ca, Ba, Sr, K, or Na citrate + Aq.

Not pptd. in presence of Na citrate + Aq. (Spiller.)

See also under Lead, and Lead oxide.

Lead perhydroxide,  $PbO_2$ ,  $H_2O$ .

See Lead peroxide.

Lead imide,  $PbNH$

Decomp. by  $H_2O$  and dilute acids. (Franklin, Z. anorg 1905, 46. 27.)

Lead iodide,  $PbI_2$ .

Sol. in 187 pts. boiling  $H_2O$  (Berthelot.)  
Sol. in 1235 pts.  $H_2O$  at ord. temp., and 194 pts. at  $100^\circ$ . (Denot, J. pr. 1. 425.)

Sol. in 2400 pts.  $H_2O$  at  $18.75^\circ$ . (Abl.)

Sat.  $PbI_2$  + Aq at  $20^\circ$  contains 0.0017 pt.; at  $27^\circ$ , 0.002 pt.; at  $100^\circ$ , 0.0039 pt.  $PbI_2$  (Lassaigne, J. chim. med. 7. 364)

1 l.  $H_2O$  dissolves 0.6 g.  $PbI_2$  at  $10^\circ$ . (Ditte, C. R. 92. 718)

1 l.  $H_2O$  dissolves 1.58 millimols  $PbI_2$  at  $25.3^\circ$ . (Von Ende, Z. anorg 1901, 26. 150.)

$0.47 \times 10^{-1}$  gram are dissolved in 1 litre of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch 1903, 46. 603.)

Solubility in 100 g.  $H_2O$  at  $t^\circ$ .

$t^\circ$	G $PbI_2$
0	0.0442
15	0.0613
25	0.0764
35	0.1042
45	0.1453
55	0.1755
65	0.2183
80	0.3023
95	0.3960
* 100	0.4360

\* By extrapolation.

(Lichty, J. Am. Chem. Soc. 1903, 25. 474.)

0.0013 g. mol.  $PbI_2$  are dissolved in 1 l.  $H_2O$  at  $20^\circ$  (Fedotieff, Z. anorg 1911, 73. 178)

Not more sol. in  $HC_2H_3O_2$  + Aq than in  $H_2O$ , contrary to Henry. (Denot, l. c.)

Pptd. from aqueous solution by little HI + Aq, but redissolved by the addition of more. (Ditte, C. R. 92. 718)

Insol. in cold, sol. in hot HCl + Aq with decomp.

Solubility of  $PbI_2$  in  $HNO_3$  + Aq at  $25.2^\circ$ .

S = Solubility in millimols. per litre.

$HNO_3$ normal	S
0.001	38.87
0.01	39.06
0.051	39.45
0.04 $KNO_3$ +	
0.01 $HNO_3$	39.45

(von Ende, Z. anorg. 1901, 26. 162.)

Sol. in KOH + Aq.

Sol. in conc. KI, NaI,  $BaI_2$ ,  $SrI_2$ ,  $CaI_2$ , and  $MgI_2$  + Aq, from which it is pptd. by  $H_2O$ . (Berthelot)

Very sol. in KI + Aq, 2 mols.  $PbI_2$  being dissolved for 1 mol. KI. (Boullay)

Sol. in  $NH_4I$  + Aq. Easily sol. in  $Na_2S_2O_3$  + Aq. (Werner, C. N. 53. 51.)

Not pptd. in presence of Na citrate. (Spiller)

Solubility in sat.  $I_2$  + Aq at  $20^\circ = 0.00216$  g. mol. per l. Solid phase  $PbI_2 + I_2$ . (Fedotieff, Z. anorg. 1911, 73. 178.)

Very easily sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Sl. sol. in alcohol. (Henry.) Decomp. by boiling ether (Vogel)

100 g. formic acid dissolve 0.25 g. at  $19.8^\circ$ . (Aschan, Ch. Ztg. 1913, 37. 1117.)

Insol. in  $CS_2$ . (Aretowski, Z. anorg. 1894, 6. 257.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

0.02 pts. are sol. in 100 pts. acetone at  $59^\circ$ .

0.02 pts. are sol. in 100 pts. amyl alcohol at  $133.5^\circ$

0.50 pts. are sol. in 100 pts. aniline at  $13^\circ$ .

1.10 pts. are sol. in 100 pts. aniline at  $184^\circ$ . (Laszczynski, B. 1894, 27. 2287.)

Solubility of  $PbI_2$  in pyridine at  $t^\circ$ 

$t^\circ$	G $PbI_2$ per 100 g pyridine	Solubility phase
-37	0.106	$PbI_2, C_5H_5N$
-20	0.175	"
-9	0.186	"
0	0.200	"
+3	0.215	"
6	0.225	$PbI_2, C_5H_5N + PbI_2, 2C_5H_5N$
15	0.208	$PbI_2, 2C_5H_5N$
35	0.188	"
57	0.190	"
77	0.228	"
92	0.290	"
98	0.340	"
103	0.370	"
108	0.410	"
112	0.445	"

(Heise, J. phys. Ch. 1912, 16, 273)

**Lead hydrogen iodide,  $PbH_2I_4 = PbI_2, 2HI$** Cold  $H_2O$  dissolves out  $HI$ . Sol in hot  $H_2O$ , from which crystallizes  $PbI_2$  (Guyot, J. chim. med. 12, 247.)+10 $H_2O$  Decomp. by  $H_2O$ . (Berthelot, C. R. 91. 1024)**Lead lithium iodide,  $PbI_2, LiI + 5H_2O$ .**Loses 1 mol.  $H_2O$  at  $95^\circ$  and loses another mol.  $H_2O$  at  $100^\circ$ . (Bogorodski, C. C. 1894, II. 515.) $PbI_2, 2LiI + 6H_2O$ . Sl. sol in  $H_2O$  (Mosnier, C. R. 1895, 120, 446.)**Lead magnesium iodide,  $PbI_2, 2MgI_2$** Decomp. by  $H_2O$  and by alcohol. (Mosnier, A. ch. 1897, (7) 12, 402.)+16 $H_2O$ . Very hygroscopic. Decomp. immediately by  $H_2O$ . (Otto and Drewes, Arch. Pharm. 229, 180)**Lead nickel iodide,  $PbNi_2I_4 + 3H_2O$ .**Decomp. by  $H_2O$ . (Mosnier, A. ch. 1897, (7) 12, 411.)**Lead potassium iodide (Potassium iodoplumbite),  $PbI_3, KI$** Permanent Completely decomp. by  $H_2O$ . Unacted upon by cold, but completely decomp. by hot alcohol. (Boullay, A. ch. (2) 34, 366.)+2 $H_2O$ . The only salt that could be obtained by Remsen and Herty (Am. Ch. J. 14, 110.) $PbI_2, 2KI$ . Sl. sol. in boiling chloroform; easily sol in strong  $KI + Aq$ , insol. in alcohol. (Brooks, C. N. 1898, 77, 191)+2 $H_2O$ . Decomp. by  $H_2O$ . (Berthelot, A. ch. (5) 29, 289)

Does not exist (R. and H.)

+4 $H_2O$ . (Ditte, C. R. 92, 134) Does not exist. (R. and H.) $PbI_2, 4KI$ . Decomp. by  $H_2O$ , insol. in alcohol. (Boullay.) Does not exist (R. and H.) $3PbI_2, 4KI + 6H_2O$ . (Berthelot, l. c.) Does not exist. (R. and H.)**Lead potassium periodide,  $K_3Pb_2I_8 + 4H_2O$ .**Decomp. by  $H_2O$  or alcohol (Wells, Z. anorg. 4, 346.)**Lead rubidium iodide,  $PbI_2, RbI + 2H_2O$ .**

(Wells, Sil. Am. J. 146, 34.)

**Lead silver iodide,  $PbI_2, 2AgI$ .**

(Ruff and Geisel, B. 1903, 38, 2663.)

**Lead silver iodide ammonia,  $PbI_2, 2AgI, 5NH_3$ .**

(Ruff and Geisel, B. 1905, 38, 2663.)

**Lead sodium iodide,  $PbI_2, NaI$ .**Decomp. by  $H_2O$ . (Poggale, C. R. 20, 1180.)+ $cH_2O$ . (Remsen and Herty, Am. Ch. J. 14, 124.) $PbI_2, 2NaI + 6H_2O$  Sl. sol in  $H_2O$ .

(Moussier, C. R. 1893, 120, 445.)

**Lead iodide ammonia,  $PbI_2, 2NH_3$ .**Decomp. by  $H_2O$  (Rammelsberg, Pogg. 48, 166.)**Lead iodide carbonate.**

See Carbonate iodide, lead.

**Lead iodosulphide,  $PbS, 4PbI_2$ .**

Decomp. by light, heat, acids and alkalis. (Lenher, J. Am. Chem. Soc. 1895, 17, 512.)

Sol in conc  $HI$ ; insol in dil  $HI + Aq$ . (Lenher, J. Am. Chem. Soc. 1901, 23, 681.) $IPbS_2PbS_2PbI$ . Ppt. (Hofmann, B. 1904, 37, 261)**Lead suboxide,  $Pb_2O$ .**Decomp. by  $H_2O$  into  $PbO_2H_2$ .Decomp. by dil  $H_2SO_4$ ,  $HCl$ ,  $HNO_3$ ,  $HC_2H_3O_2 + Aq$ , or alkalis, into  $PbO$ , which dissolves, and  $Pb$ , which dissolves or not, according to the reagent Sol in dil  $Pb(NO_3)_2 + Aq$ .**Lead monoxide (Litharge),  $PbO$** Sol. in 7000 pts.  $H_2O$ . (Horsford.)Pure  $PbO$  is insol. in  $H_2O$ . (Brandecke, Repert. 63, 155, Siebold, Repert, 63, 174; Herbergen, Repert. 66, 55) Sl. sol. in  $H_2O$ . (Yorke, Phil. Mag. (3) 5, 82.)0.31 millimoles  $Pb$  are dissolved in 1 liter  $H_2O$  at  $18^\circ$ . (Pleissner, C. C. 1907, II. 1056.)1.71  $\times 10^{-5}$  g. are dissolved in 1 litre of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46, 603.)

Easily sol. in acids.

Sol. in KOH, or NaOH + Aq, also in  $\text{CaO.H}_2\text{O}$  + Aq.

Sol. in boiling  $\text{Cu(NO}_3)_2$  + Aq with pptn. of Aq.

Sol. in  $\text{CaCl}_2$  and  $\text{SiCl}_4$  + Aq (Andre, C. R. 104, 359.)

Sol. in  $\text{MgCl}_2$  + Aq. (Voigt, Ch. Ztg. 13, 695.)

Sol. in boiling  $\text{Cu(NO}_3)_2$  + Aq with pptn. of  $\text{CuO}$ .

Partially sol. in  $\text{Cd(NO}_3)_2$  and  $\text{Mn(NO}_3)_2$  + Aq with pptn. of  $\text{CdO}$  and  $\text{MnO}$  respectively.

Not acted upon by Mg, Ag, Co, Ni, or Ce nitrates + Aq. (Persoz.)

Very sol. in  $\text{Pb(C}_2\text{H}_3\text{O}_2)_2$  + Aq. (Roehleder.)

Insol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1808, 20, 828.)

Insol. in acetone (Eidmann, C. C. 1899, II, 1014.)

When finely pulverised, sol. in cane sugar + Aq, but less than  $\text{Pb}_3\text{O}_4$ . (Peschier.)

Sl. sol. in glycerine. Readily sol. in glucose + Aq. (Persoz.)

Sol. in volatile oils (Schwitzer.)

Yellow modification

Solubility in  $\text{H}_2\text{O}$  at 22°

	Solubility in g. equiv. per litre
1. Yellow $\text{PbO}$ , obtained by boiling lead hydroxide with 10% NaOH	$1.03 \times 10^{-4}$
2. Yellow $\text{PbO}$ , obtained by heating 1 at 630°	$1.05 \times 10^{-4}$
3. Yellow $\text{PbO}$ , obtained by heating at 740° red $\text{PbO}$ , formed by boiling lead hydroxide with conc. NaOH	$1.00 \times 10^{-4}$
4. Yellow $\text{PbO}$ obtained by heating pure, commercial, yellow-brown $\text{PbO}$ at 620°.	$1.09 \times 10^{-4}$

(Ruer, Z. anorg. 1906, 50, 273.)

*Red modification.* Obtained by boiling lead hydroxide with conc. NaOH + Aq.

Solubility in  $\text{H}_2\text{O}$  at 22° =  $0.56 \times 10^{-4}$  g. equiv. per l. (Ruer, Z. anorg. 1906, 50, 273.)

*Yellow-brown modification.* Solubility in  $\text{H}_2\text{O}$  at 22° =  $1.10 \times 10^{-4}$  g. equiv. per litre (Ruer, Z. anorg. 1906, 50, 273.)

See also Lead.

Min. *Massicot*.

**Lead oxide (Red lead),  $\text{Pb}_3\text{O}_4$ .**

Insol. in  $\text{H}_2\text{O}$ .

Converted by acids into  $\text{PbO}_2$  and salts of monoxide.

Sol. in a large amt. of glacial acetic acid. (Berzelius.) Insol. in acetic acid. (Schonbein, J. pr. 74, 325.)

Solution in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq may decompose or not according to concentration of acid. When treated with an excess of  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq of 8° B,  $\text{Pb}_3\text{O}_4$  is quickly dissolved, but the solution soon deposits  $\text{PbO}_2$ , this decomposition is facilitated by dilution. But if  $\text{Pb}_3\text{O}_4$  is treated with a large excess of glacial  $\text{HC}_2\text{H}_3\text{O}_2$ , it dissolves, and the solution is permanent if atmospheric air is excluded, and temp. does not rise above 40°.

(Jacquelin, J. pr. 53, 152.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37, 4329.)

Easily sol. in cane sugar + Aq. (Peschier.)

Min. *Minium*.

**Lead sesquioxide,  $\text{Pb}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$  or in KOH + Aq.

Decomp. by strong acids into  $\text{PbO}_2$  and corresponding salt of monoxide.

**Lead peroxide,  $\text{PbO}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids, also in conc. alkali hydroxides + Aq. The solutions in acids are very unstable, except when concentrated and kept at a low temperature.

Decomp. by cold HCl, HCN, HBr, and HI + Aq. Not attacked by other acids when cold, but decomp. thereby when hot. Insol. in moderately conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq.

There are two forms of  $\text{PbO}_2$ , the amorphous and the crystalline.

1 l. of very conc.  $\text{H}_2\text{SO}_4$  dissolves 10 millimols. crystalline  $\text{PbO}_2$ .

**Solubility of amorphous  $\text{PbO}_2$  in  $\text{H}_2\text{SO}_4$  + Aq at 22°.**

99.5 millimols  $\text{PbO}_2$  are dissolved in 1 l. of acid containing 1720 g.  $\text{H}_2\text{SO}_4$ .

4 millimols  $\text{PbO}_2$  are dissolved in 1 l. of acid containing 1087 g.  $\text{H}_2\text{SO}_4$ .

$v$  = moles  $\text{H}_2\text{SO}_4$  per mole of  $\text{H}_2\text{O}$ .

$c$  = millimols  $\text{PbO}_2$  dissolved in 1 litre

$v$	$c$	$v$	$c$
0.32	0.82	0.20	$8 \cdot 10^{-3}$
0.30	0.4	0.15	$5 \cdot 10^{-4}$
0.25	$7 \cdot 10^{-2}$	0.10	$1 \cdot 10^{-5}$

(Dolezalek and Finckel, Z. anorg. 1906, 51, 323-5.)

Decomp. by  $\text{NH}_4\text{OH}$  + Aq. Sol. in conc. KOH, or NaOH + Aq.

Sol. with decomp. in  $\text{Hg}_2(\text{NO}_3)_2$  + Aq. (Levol.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37, 2943.)

Min. *Plattnerite*.

**Lead manganese peroxide,  $\text{PbO}_2, 4\text{MnO}_2$ .**

Ppt. (Gibbs and Parkmann, Sil. Am. J. (2) 39, 58.)

**Lead oxybromide,  $\text{PbBr}_2$ ,  $\text{PbO}$ .**

Insol. in  $\text{H}_2\text{O}$ .  
 +1,  $1\frac{1}{2}$ , and  $3\text{H}_2\text{O}$  (André, C. R. 96. 1503.)  
 $6\text{PbO}$ ,  $\text{PbBr}_2 + 2\text{H}_2\text{O}$ . Ppt. (Stromholm, Z. anorg. 1904, 38. 436.)

**Lead oxychloride,  $2\text{PbCl}_2$ ,  $\text{PbO} + 2\text{H}_2\text{O}$ .**

(André, C. R. 96. 435.)  
 $\text{PbCl}_2$ ,  $\text{PbO}$ . Absolutely insol. in hot or cold  $\text{H}_2\text{O}$ . (André, A. ch. (6) 3. 108.)  
 Min. *Mallockite*.  
 + $\text{H}_2\text{O}$ . Sol. in hot  $\text{NaOH} + \text{Aq}$ . (André) 0.38 millimols. Pb are dissolved in 1 litre  $\text{H}_2\text{O}$  at  $18^\circ$  (Plessner, C. C. 1907, II. 1055.)  
 $\text{PbCl}_2$ ,  $2\text{PbO}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil  $\text{KOH} + \text{Aq}$  (about 110 g. in 1 l.) (Ditte, C. R. 94. 1180.)

Min. *Mendipite*. Easily sol. in  $\text{HNO}_3 + \text{Aq}$ .  
 + $2\text{H}_2\text{O}$ . (André, A. ch. (6) 3. 111.)

$\text{PbCl}_2$ ,  $3\text{PbO}$ . Insol. in  $\text{H}_2\text{O}$ . (Dober-einer.)

+ $\frac{1}{2}\text{H}_2\text{O}$ . Ppt. (Stromholm, Z. anorg. 1904, 38. 435.)  
 + $2\text{H}_2\text{O}$ . 0.10 millimols Pb are dissolved in 1 litre  $\text{H}_2\text{O}$  at  $18^\circ$  (Plessner, C. C. 1907, II. 1054.)

+ $3\text{H}_2\text{O}$ . Ppt. (André, C. R. 104. 359.)  
 + $4\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{NaOH} + \text{Aq}$ . (Vauquelin.)

$\text{PbCl}_2$ ,  $5\text{PbO}$ . (Dober-einer.)  
 $6\text{PbO}$ ,  $\text{PbCl}_2 + 2\text{H}_2\text{O}$ . Ppt. (Stromholm, Z. anorg. 1904, 38. 434.)  
 $\text{PbCl}_2$ ,  $7\text{PbO}$ . Cassel-yellow.

**Lead strontium oxychloride,  $2\text{PbO}$ ,  $\text{SrCl}_2 + 5\text{H}_2\text{O}$ .**

(André, C. R. 104. 359.)

**Lead oxychloride, iodide,  $\text{PbCl}_2$ ,  $\text{PbI}_2$ ,  $4\text{PbO}$ .**

Min. *Schwarzenbergite*. Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ .

**Lead oxyiodide,  $\text{PbI}_2$ ,  $\text{PbO}$** 

Insol. in boiling  $\text{H}_2\text{O}$  or  $\text{KI} + \text{Aq}$ . (Braudes, A. 10. 269.)

+ $\frac{1}{2}\text{H}_2\text{O}$ . (Ditte, C. R. 92. 145.)

+ $\text{H}_2\text{O}$ .

$\text{PbI}_2$ ,  $2\text{PbO}$ . Insol. in  $\text{H}_2\text{O}$ . (Denot, J. Pharm. 20. 1.)

+ $\text{H}_2\text{O}$ .

$\text{PbI}_2$ ,  $3\text{PbO} + 2\text{H}_2\text{O}$ . Ppt. (Kuhn, C. C. 1847. 503.)

$\text{PbI}_2$ ,  $5\text{PbO}$ . Insol. in  $\text{H}_2\text{O}$ . (Denot.)

+ $7\text{H}_2\text{O}$ . (Ditte, C. R. 92. 145.)

$6\text{PbO}$ ,  $\text{PbI}_2 + 2\text{H}_2\text{O}$ . Ppt. (Stromholm, Z. anorg. 1904, 38. 437.)

$9\text{PbO}$ ,  $\text{PbI}_2 + 2\text{H}_2\text{O}$  (Stromholm, Z. anorg. 1904, 38. 437.)

**Lead oxyperiodide,  $\text{PbO}$ ,  $\text{PbI}_2$ .**

Decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{H}_2\text{O}_2 + \text{Aq}$ . (Grogger, W. A. B. 100, 2b. 415.)

**Lead phosphide,  $\text{PbP}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  and dil. acids. (Bossuet, C. R. 1913, 167. 721.)

**Lead phosphoselenide,  $\text{PbSe}$ ,  $\text{P}_2\text{Se}$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ .

Insol. in cold, slowly decomp. by hot alkalis +  $\text{Aq}$ . (Hahn, J. pr. (2) 93. 436.)

$2\text{PbSe}$ ,  $\text{P}_2\text{Se}_3$ . Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . Slowly sol. in red fuming  $\text{HNO}_3$ . (Hahn.)

$2\text{PbSe}$ ,  $\text{P}_2\text{Se}_3$ . Decomp. by fuming  $\text{HNO}_3$ . (Hahn.)

**Lead selenide,  $\text{PbSe}$ .**

Cold  $\text{HNO}_3 + \text{Aq}$  dissolves Pb with separation of Se, which dissolves on warming.

(Little, A. 112. 212.)

Min. *Clausthalite*. Sol. in  $\text{HNO}_3 + \text{Aq}$  with separation of Se, when warmed.

**Lead mercury selenide,  $(\text{Pb}, \text{Hg})\text{Se}$ .**

Min. *Lehrbachite*.

**Lead sulphide,  $\text{PbS}$ .**

Very sl. sol. in  $\text{H}_2\text{O}$

1 l.  $\text{H}_2\text{O}$  dissolves  $3.6 \times 10^{-3}$  moles.  $\text{PbS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 204.)

1 l.  $\text{H}_2\text{O}$  dissolves  $3 \times 10^{-4}$  g.  $\text{PbS}$  at  $25^\circ$ . (Hevesy, Z. anorg. 1913, 82. 328.)

Insol. in dilute acids, alkalis, and alkali sulphides +  $\text{Aq}$ . Decomp. with solution in moderately dil.  $\text{HNO}_3 + \text{Aq}$ . With conc.  $\text{HNO}_3$  or aqua regia,  $\text{PbSO}_4$  is formed. Sol. in hot conc.  $\text{HCl} + \text{Aq}$ .

1 l.  $\text{H}_2\text{O}$  sat. with  $\text{H}_2\text{S}$  dissolves  $1.5 \times 10^{-4}$  g.  $\text{PbS}$  at  $25^\circ$  (Hevesy, Z. anorg. 1913, 82. 328.)

Insol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett.)

Somewhat sol. in  $\text{H}_2\text{S} + \text{Aq}$  when heated therewith in a sealed tube. (Sarnmont, A. ch. (3) 32. 168.)

Insol. in potassium thiocarbonate +  $\text{Aq}$ . (Rosenblatt, Z. anal. 26. 15.)

Sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Waller, J. Anal. Ch. 5. 646.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 823.)

Min. *Galena*, *Galenite*.

**Lead polysulphide,  $\text{PbS}_x$ .**

Ppt.; insol. in alkali sulphides; decomp. by conc.  $\text{HNO}_3$ . (Bodroux, C. R. 1900, 130. 1398.)

**Lead platinum sulphide.**

See Sulphoplatinate, lead.

**Lead sulphide mercuric chloride,  $3\text{PbS}$ ,  $4\text{HgCl}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Levallois, C. R. 96. 1666.)

Lead sulphobromide, chloride, or iodide.

*See* Lead bromosulphide, etc.

Lead disulphodibromide,  $PbN_2S_2, NH_3$

Ppt

Very stable in the air or in a vacuum  
Sol in no solvent without decomp.

When rapidly heated it explodes very violently at  $140^\circ$  (Ruff, B 1901, 37. 1581)

Lead telluride,  $PbTe$

Insol in  $H_2O$ . Sol in cold  $HNO_3 + Aq$   
(Rose, Pogg 18. 68.)

Min. *Altaite*. Easily sol in  $HNO_3 + Aq$ .

"Leucone."

Wohler (A. 127. 268) gives this substance the formula  $H_{10}Si_4O_{10}$ , but it is identical with silicoformic anhydride,  $Si_2H_2O_6$ , which see

Lime.

*Quacklime*,  $CaO$ . *See* Calcium oxide.

*Slaked lime*,  $Ca(OH)_2$ . *See* Calcium hydroxide.

Lithium,  $Li$

Decomposes  $H_2O$ .

Easily sol in dil acids. Slowly attacked by conc  $H_2SO_4$ , rapidly by conc  $HNO_3 + Aq$   
Insol. in hydrocarbons. Sol in liquid  $NH_3$ , but not so easily as  $K$ .

Sol in liquid  $NH_3$ . (Franklin, Am Ch. J. 1898, 20. 820.)

1 gram atom dissolves

at	$0^\circ$	in	3.93	mol	liquid	$NH_3$
"	$-25^\circ$	"	3.93	"	"	"
"	$-50^\circ$	"	3.93	"	"	"
"	$-80^\circ$	"	3.93	"	"	"

(Ruff, B 1906, 39. 840)

Sol in ethylamine. Insol. in propylamine and in secondary and tertiary amines. (Kraus, J. Am. Chem. Soc. 1907, 29. 1561.)

Lithium amalgam,  $LiHg_8$ .

$LiHg_8$  is obtained at all temp. up to  $100^\circ$ . Can be cryst from  $Hg$  without decomp. at any temp. below  $100^\circ$ . (Kerp, Z anorg. 1900, 25. 68.)

Lithium amide,  $LiNH_2$ .

(Ruff, B. 1911, 44. 505.)

Decomp. slowly in the air.

Slowly decomp. by cold, rapidly by hot  $H_2O$ .

Slowly decomp. by  $HCl$ .

Slowly decomp by cold, rapidly by hot abs. alcohol. (Titherley, Chem. Soc. 1894, 65. 518.)

Tri-lithium amide,  $Li_3NH_2$ .

Hydroscopic; decomp. by  $H_2O$ . (Dafert, M. 1910, 31. 994.)

Lithium ammonia,  $Li, NH_3$ .

Decomp by  $H_2O$  at ordinary temp; sol. in liquid  $NH_3$ . (Moissan, C. R. 1898, 127. 689)

$Li, 3NH_3$ . (Moissan, C. R. 1901, 133. 716.)

*T*-lithium ammonium,  $Li_3NH_4$ .

Very hygroscopic, decomp. by  $H_2O$ . (Dafert, M. 1910, 31. 992.)

Lithium antimonide,  $Li_3Sb$ .

Decomp. by  $H_2O$  with evolution of  $H_2$ . Sol in liquid  $NH_3$ . (Lebeau, C. R. 1902, 134. 285)

Lithium arsenide,  $Li_3As$

Decomp. by  $H_2O$ ; decomp. violently by fuming  $HNO_3$ . (Lebeau, C. R. 1899, 129. 50.)

Lithium azoimide,  $LiN_3$ .

Deliquescent. Stable in aq solution.

36.12 pts. are sol. in 100 pts.  $H_2O$  at  $10^\circ$ .

62.07 " " " " 100 "  $H_2O$  "  $15.5^\circ$ .

66.41 " " " " 100 "  $H_2O$  "  $16^\circ$ .

20.26 " " " " 100 " abs alcohol at  $16^\circ$ .

Insol. in ether. (Curtius, J pr. 1898, (2) 58. 277.)

+ $H_2O$ . Very hygroscopic; decomp. in the air. Very sol in  $H_2O$  and alcohol. (Dennis, Z. anorg. 1898, 17. 18)

Lithium bromide,  $LiBr$ .

Deliquescent.

100 pts.  $H_2O$  dissolve at:

$0^\circ$	$34^\circ$	$59^\circ$	$82^\circ$	$103^\circ$
143	196	222	244	270

pts.  $LiBr$ .  
Sp. gr. of  $LiBr + Aq$  at  $19.5^\circ$  containing:  
0 10 15 20 25 30%  $LiBr$ ,  
1.035 1.072 1.113 1.158 1.204 1.254

35 40 45 50 55%  $LiBr$ .

1.309 1.368 1.432 1.500 1.580

(Kremers, Pogg 103. 65; 104. 133; Gerlach, Z anal. 8. 285)

Temp of maximum g-mol  $LiBr$  dissolved density of  $LiBr + Aq$ . in 1000 g.  $H_2O$ .

1.921° 0.2941

0.881° 0.4383

(de Coppet, C. R. 1900, 131. 178.)

Moderately sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369)

Solubility in glycol at  $14.7^\circ = 37.5\%$ . (de Coninck, Belg. Acad. Bull. 1905, 359.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328; Edmann, C. C. 1899, II. 1014.)

Sol. in methyl acetate (Naumann, B. 1909, 42. 3789); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Difficultly sol. in ethyl acetate. (Nau-  
mann, B. 1910, 43, 314.)  
+11<sub>2</sub>O. 100 g. H<sub>2</sub>O dissolve 209 g. LiBr  
at 15° (Bogorodski, C. C. 1894, II 514.)  
+2H<sub>2</sub>O (Bogorodski.)  
+311<sub>2</sub>O. 100 g. H<sub>2</sub>O dissolve 80 g. LiBr  
at -30°, and 122 g. at -10° (Bogorodski.)

Lithium molybdenyl bromide, LiBr, MoOBr<sub>2</sub>  
+4H<sub>2</sub>O.

Very hygroscopic. (Weinland and Knoll,  
Z. anorg. 1905, 44, 111.)

Lithium bromide ammonia.

LiBr, NH<sub>3</sub>. Sol. in H<sub>2</sub>O with decomp.  
LiBr, 2NH<sub>3</sub>. " " " " "  
LiBr, 3NH<sub>3</sub>. " " " " "  
LiBr, 4NH<sub>3</sub>. " " " " "

(Bonnefoi, C. R. 1900, 130, 1395.)

Lithium carbide, LiC<sub>2</sub>.

Insol. in conc. acids.  
Sol. in fused oxidizing agents; decomp. H<sub>2</sub>O  
in the cold. (Moissan, C. R. 1896, 122, 363.)

Lithium subchloride, Li<sub>2</sub>Cl.

Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1895,  
121, 945.)

Lithium chloride, LiCl.

Very deliquescent. Most deliquescent salt  
known to Berzelius. Very sol. in H<sub>2</sub>O. Sol.  
in 1.315 pts. H<sub>2</sub>O at 15°. (Gerlach.)

100 pts. H<sub>2</sub>O dissolve at:  
0° 20° 65° 80° 89° 140° 160°  
63.7 80.7 104.2 115 129 139 145 pts. LiCl  
(Gerlach, Z. anal. 8, 281.)

Sp. gr. of LiCl + Aq at 15° containing:  
1 5 10 15 20% LiCl,  
1.006 1.030 1.058 1.086 1.117  
25 30 35 40% LiCl  
1.148 1.182 1.219 1.256  
(Gerlach, Z. anal. 8, 281.)

Sp. gr. of LiCl + Aq at 18° containing:  
5 10 20 30 40% LiCl.  
1.0274 1.0563 1.115 1.181 1.255  
(Kohlrausch, W. Ann. 1879, 1.)

Sp. gr. of LiCl + Aq at 25°.

Concentration of LiCl + Aq	Sp. gr.
1-normal	1.0243
1/2 " "	1.0129
1/3 " "	1.0062
1/4 " "	1.0030

(Wagner, Z. phys. Ch. 1890, 5, 38.)

Sp. gr. of LiCl + Aq.

g. LiCl in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
2.3923	1.001405
6.2360	1.003647
10.1093	1.005921

(Dijken, Z. phys. Ch. 1897, 24, 109.)

Sp. gr. of LiCl + Aq at 0°.  
% LiCl 4.26 12.18 23.2 32.5 41.4 43.2  
Sp. gr. 1.026 1.073 1.133 1.203 1.267 1.282  
(Lemoine, C. R. 1897, 125, 603.)

Sp. gr. of LiCl + Aq at 20°.

Normality of LiCl + Aq	% LiCl	Sp. gr.
10 35	35 97	1.2230
7.17	26 40	1.1550
5.57	21 10	1.1215
2.98	11.83	1.0691
1.06	4.37	1.0232

(Forchheimer, Z. phys. Ch. 1900, 34, 25.)

Sp. gr. 20°/4° of a normal solution of LiCl =  
1.022375. (Haugh, J. Am. Chem. Soc. 1912,  
34, 1151.)

Sp. gr. of dil. LiCl + Aq at 20.004°.  
Conc. = g. equiv. LiCl per l. at 20.004°.  
Sp. gr. compared with H<sub>2</sub>O at 20.004° = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,002,5
0.0002	1.000,005,0
0.0005	1.000,012,5
0.0010	1.000,025,3
0.0020	1.000,050,5
0.0050	1.000,125,8
0.0100	1.000,251,0

(Lamb and Lee, J. Am. Chem. Soc. 1913, 35,  
1688.)

B.-pt. of LiCl + Aq.

% LiCl	B.-pt.	% LiCl	B.-pt.
3 38	101°	16.66	107°
6 54	102	19.35	109
13.04	105	21.8	111

(Skinner, Chem. Soc. 61, 341.)

Sat. LiCl + Aq boils at 171° (Kiemers.)

B.-pt. of LiCl + Aq. P = pts. LiCl to 100 pts. H<sub>2</sub>O

B.-pt	P	B.-pt	P	B.-pt	P
101°	3.5	121°	48.5	147°	87.5
102	7	125	50	148	90
103	10	126	51.5	149	92.5
104	12.5	127	53	150	95
105	15	128	54.5	151	97.5
106	17.5	129	56	152	100
107	20	130	57.5	153	102.5
108	22	131	59	154	105
109	24	132	60.5	155	107.5
110	26	133	62	156	110.5
111	28	134	63.5	157	113.5
112	30	135	65	158	116.5
113	32	136	66.5	158.5	117.90
114	33.5	137	68	159	119.5
115	35	138	69.75	160	122.5
116	36.5	139	71.5	161	125.5
117	38	140	73.25	162	128.5
118	39.5	141	75	163	131.5
119	41	142	77	164	135
120	42.5	143	79	165	138.5
121	44	144	81	166	142.5
122	45.5	145	83	167	146.5
123	47	146	85	168	151

(Gerlach, Z. anal. 26. 437.)

Solubility of LiCl in HCl + Aq at 0°

Mg. mol. per 10 cc of solution		G per 10 cc of solution		Sp. gr. of solution
LiCl	HCl	LiCl	HCl	
120	0.0	51.0	0.0	1.255
97.5	22.5	41.4	8.2	1.243
67.0	66.0	28.5	24.1	1.249
58.0	81.0	24.6	29.5	1.251

(Engel, A. ch. (6) 13. 385.)

See also LiCl + H<sub>2</sub>O.Sl. sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. in absolute alcohol, ether, and alcohol-ether.

B.-pt. of alcoholic solution of LiCl.

% LiCl	B.-pt.	% LiCl	B.-pt.
2.4	78.43° + 0.70°	9.93	78.43° + 5.55°
5.39	" + 2.15	15.94	" + 11.75
8.01	" + 4.18	.	.

(Skinner.)

Solubility in alcohol + Aq decreases to 40% alcohol + 60% H<sub>2</sub>O. Curve shows minimum at 30% H<sub>2</sub>O to 70% alcohol. The sat. pure H<sub>2</sub>O and pure alcohol solutions cooled to 0° deposit LiCl, H<sub>2</sub>O and LiCl, 4C<sub>2</sub>H<sub>5</sub>O respectively. (Pina de Rubies, C. A. 1914. 743, 3006.)

Solubility in ethyl alcohol.

Temp 1.06° 5.07° 13.0° 25.0° 40.6° 62.6°  
 % LiCl 14 14 13 14 15 18  
 (Lemoine, C. R. 1897, 125. 605.)

100 g ethyl alcohol dissolve at

0° 5° 10° 15° 17°  
 14.42 15.01 16.77 18.79 20.31 g. LiCl.

The solid phase from 0°-17° is LiCl, 4C<sub>2</sub>H<sub>5</sub>O

20° 30° 40° 50° 60°  
 24.28 25.10 25.38 24.40 23.46 g. LiCl.

The solid phase from 20°-60° is LiCl.  
 (Tanner and Bissott, Chem Soc. 1913, 103 1907)

Solubility in ethyl alcohol + Aq at 25°.

100 g. of the solution contain

G C <sub>2</sub> H <sub>5</sub> OH	G H <sub>2</sub> O	G LiCl
0	55.10	44.90
5.96	51.52	42.52
11.07	48.78	40.20
17.46	43.90	38.64
18.56	43.70	37.74
22.16	41.17	36.67
26.29	39.51	34.70
28.97	37.42	33.61
29.27	36.89	33.84
30.10	36.64	33.26
30.51	35.67	33.82
32.79	34.95	32.26
38.40	31.58	30.02
49.27	24.67	26.06
50.32	24.04	25.64
53.50	20.94	25.56
58.15	18.47	23.38
59.78	17.46	22.76
63.09	14.83	22.08
70.24	8.66	21.10
70.70	8.26	21.04
70.74	7.78	21.48
79.26	0	20.74

The solid phase in the mixtures which are richest in alcohol is LiCl; in the other mixtures the solid phase is LiCl + H<sub>2</sub>O.

(Pina de Rubies, C. C. 1915, I. 521.)

Sp. gr. of LiCl in ethyl alcohol (LiCl 2C<sub>2</sub>H<sub>5</sub>O).

% salt	Sp. gr. at 14°	Sp. gr. at 0°
0	0.797	0.809
5.2	0.839	0.851
10.1	0.871	0.881
14.6	0.903	0.903

(Lemoine, C. R. 1897, 125. 605.)

Solubility in methyl alcohol at t°	
t°	% LiCl in sat. solution
1	26
23	27
50	30

(Lemoine, C. R. 1897, 125. 604.)

Sp. gr. of LiCl in methyl alcohol (LiCl, 3CH <sub>3</sub> O)			
% salt	5.2	14.5	22.1
Sp. gr. at 21.5°	0.836	0.910	0.974
Sp. gr. " 0°	0.854	0.926	0.988

(Lemoine, C. R. 1897, 125. 604.)

15.86 g. are sol. in 100 g. propyl alcohol. (Schlump, Z. phys. Ch. 1894, 14. 276.)

Sol. in 15 pts. fusel oil (Gooch, Am. Ch. J. 9. 33.)

100 g. methyl alcohol dissolve 42.36 g. LiCl at 25°.

100 g. ethyl alcohol dissolve 25.83 g. LiCl at 25°.

100 g. propyl alcohol dissolve 16.22 g. LiCl at 25°.

100 g. isomyl alcohol dissolve 0.03 g. LiCl at 25°.

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

Solubility of fused LiCl in alcohols at 25°

Solvent	% LiCl
Water	45.0
Ethyl alcohol	2.475
Propyl alcohol	3.720
Butyl alcohol	9.56
Amyl alcohol	8.26
Allyl alcohol	4.20
Glycerine	4.14
Phenol (at 53°C)	1.89

(Patten and Mott, J. phys. Chem. 1904, 8. 155.)

100 pts. pyridine dissolve 7.78 pts. LiCl at 15°; 14.26 pts. LiCl at 100°. (Laszczyński, B. 1894, 27. 2288.)

Soluble in anhydrous pyridine, 97% pyridine + Aq, 95% pyridine + Aq, and 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

Difficultly sol. in methyl acetate (Naumann, B. 1909, 42. 3789); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Solubility in glycol at 15° = 11%. (de Coninck, Belg. Acad. Bull. 1905, 359.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Sol. in ethylamine. (Shinn, J. phys. Chem. 1907, 11. 538.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Solubility of LiCl in acetone.	
Pts. sol. in 100 pts. acetone	t°
4.60	0
4.40	12
4.11	25
3.76	46
3.12	53
2.14	58

(Laszczyński, B. 1894, 27. 2287.)

+H<sub>2</sub>O. 13.536 millimols. are contained in 1 l. sat. solution at 25°. (Herz, Z. anorg. 1912, 73. 274.)

Solubility in HCl + Aq at 25°.

Millimols HCl in 10 cm	Millimols LiCl in 10 cm.
	135.36
6.30	134.14
10.53	126.52
17.64	122.58

(Herz, Z. anorg. 1912, 73. 274.)

+2H<sub>2</sub>O. Sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

+3H<sub>2</sub>O. (Bogorodski, C. C. 1894, II. 514.)

**Lithium gold chloride.**

See Chloraurate, lithium.

**Lithium manganous chloride**, LiCl, MnCl<sub>2</sub> + 3H<sub>2</sub>O.

Decomp. by H<sub>2</sub>O; stable only in excess of LiCl. (Chassevant, A. ch. (6) 30. 10.)

**Lithium mercuric chloride**, 2LiCl, HgCl<sub>2</sub>.

Very deliquescent and sol. in H<sub>2</sub>O. (Harth, Z. anorg. 1897, 14. 323.)

**Lithium nickel chloride**, LiCl, NiCl<sub>2</sub> + 3H<sub>2</sub>O.

Deliquescent. Sol. in H<sub>2</sub>O and alcohol. (Chassevant.)

**Lithium thallic chloride**, 3LiCl, TlCl<sub>3</sub> + 8H<sub>2</sub>O.

Very deliquescent. Sol. in H<sub>2</sub>O. (Pratt, Am. J. Sci. 1895, (3) 49. 404.)

**Lithium stannic chloride.**

See Chlorostannate, lithium.

**Lithium uranous chloride**, Li<sub>2</sub>UCl<sub>6</sub>.

As K salt. (Aloy, Bull. Soc. 1899, (3) 21. 264.)

**Lithium uranium chloride**, UCl<sub>6</sub>, 2LiCl.

Very hygroscopic; sol. in H<sub>2</sub>O with decomp. Sol. in acetic acid. Decomp. by alcohol. (Aloy, Bull. Soc. 1899, (3) 21. 264.)

**Lithium zinc chloride,  $\text{LiCl} \cdot \text{ZnCl}_2 \cdot 3\text{H}_2\text{O}$** 

Extremely deliquescent (Ephraim, *Z. anorg.* 1908, 59, 68.)

$3\text{LiCl} \cdot \text{ZnCl}_2 \cdot 10\text{H}_2\text{O}$  (?) Not obtained in solid state (Ephraim, *Z. anorg.* 1908, 59, 69.)

**Lithium chloride ammonia.**

$\text{LiCl} \cdot \text{NH}_3$

$\text{LiCl} \cdot 2\text{NH}_3$

$\text{LiCl} \cdot 3\text{NH}_3$

$\text{LiCl} \cdot 4\text{NH}_3$

Above salts are all decomp. by  $\text{H}_2\text{O}$ . (Bonnet, *C. R.* 1898, 127, 367-369.)

**Lithium chloriodide,  $\text{LiLiI} \cdot 4\text{H}_2\text{O}$** 

Deliquescent (Wells and Wheeler, *Sill. Am. J.* 144, 42.)

**Lithium fluoride,  $\text{LiF}$ .**

Very difficultly sol. in  $\text{H}_2\text{O}$ . (Berzelius, *Pogg.* 1, 17.)

Two crystalline forms. Only very sl. sol. in  $\text{H}_2\text{O}$ . Very sl. decomp. by  $\text{H}_2\text{O}$  at red heat. (Poulenc, *Bull. Soc.* 1894, (3) 11, 17.)

Sp. gr. of solution sat. at  $18^\circ = 1.003$  and contains 0.27%  $\text{LiF}$ . (Mylius, *B.* 1897, 30, 1718.)

Sol. in 800 pts.  $\text{H}_2\text{O}$ , and the presence of  $\text{NH}_4\text{F}$  and  $\text{NH}_3$  decreases solubility to 1/3500 (Carnot, *Bull. Soc.* 1889, (3) 1, 250.)

Two crystalline forms are very sl. sol. in  $\text{HCl}$ , easily sol. in  $\text{HNO}_3$ . (Poulenc, *Bull. Soc.* 1894, (3) 11, 17.)

Two crystalline forms are insol. in 95% alcohol. (Poulenc.)

Insol. in methyl acetate. (Naumann, *B.* 1909, 42, 3790.)

Difficultly sol. in ethyl acetate. (Naumann, *B.* 1910, 43, 314.)

Insol. in acetone (Naumann, *B.* 1904, 37, 4329; Eidmann, *C. C.* 1899, II, 1014.)

**Lithium hydrogen fluoride,  $\text{LiHF}_2$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ , but more easily than  $\text{LiF}$ . (Berzelius.)

**Lithium silicon fluoride.**

See Fluosilicate, lithium.

**Lithium stannic fluoride.**

See Fluostannate, lithium.

**Lithium tantalum fluoride.**

See Fluotantalate, lithium.

**Lithium uranyl fluoride,  $\text{UO}_2\text{F}_2 \cdot 4\text{LiF}$ .**

(Ditte.)

**Lithium zirconium fluoride.**

See Fluozirconate, lithium.

**Lithium hydride,  $\text{LiH}$ .**

Not deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Guntz, *C. R.* 1896, 123, 997.)

**Lithium hydrosulphide,  $\text{LiSH}$  (?).**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Berzelius, *Pogg.* 6, 139.)

**Lithium hydroxide,  $\text{LiOH}$ .**

Not so deliquescent as  $\text{NaOH}$ , and apparently not more sol. in hot than cold  $\text{H}_2\text{O}$ . (Gmelin, *Gib.* 62, 399.)

Not deliquescent. (Arfvedson, *A. ch.* 10, 82.)

The solubility of  $\text{LiOH}$  in  $\text{H}_2\text{O}$  can be expressed by  $y = 6.6750 + 0.00346t + 0.0003t^2$ , where  $y$  = the percentage of  $\text{Li}_2\text{O}$  in a saturated solution (Dittmar, *Jour. Soc. Chem. Ind.* 7, 730.)

**Solubility of  $\text{LiOH}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .**

$t^\circ$	G per 100 g. Solution		G $\text{LiOH}$ per 100 g. $\text{H}_2\text{O}$
	$\text{Li}_2\text{O}$	$\text{LiOH}$	
0	6.67	10.64	12.7
10	6.74	10.80	12.7
20	6.86	10.99	12.8
25	6.95	11.14	12.9
30	7.05	11.27	12.9
40	7.29	11.68	13.0
50	7.56	12.12	13.3
60	7.96	12.76	13.8
80	8.87	14.21	15.3
100	10.02	16.05	17.5

(Seidl's Solubilities, 1st Ed. 174.)

A sat. aq. solution contains 7.09%  $\text{LiOH}$ . (Schreinemakers, *C. C.* 1905, II, 1486.)

Sp. gr. of  $\text{LiOH} + \text{Aq}$  at  $18^\circ$  containing:

1.25 2.5 5 7.5%  $\text{LiOH}$   
1.0132 1.0276 1.0547 1.0804

(Kohlrausch, *W. Ann.* 1879, 1.)

**Solubility in  $\text{Li}_2\text{SbS}_4 + \text{Aq}$  at  $30^\circ$ .**

$\text{LiOH}$	$\text{Li}_2\text{SbS}_4$	Solid Phase
11.4	0	$\text{LiOH} \cdot \text{H}_2\text{O}$
9.1	8.3	"
2.3	29.9	"
2.1	48.3	"
2.1	52.1	$\text{LiOH} \cdot \text{H}_2\text{O} + \text{Li}_2\text{SbS}_4 \cdot 10\text{H}_2\text{O}$
1.4	51.8	$\text{Li}_2\text{SbS}_4 \cdot 10\text{H}_2\text{O}$
0	51.3	"

(Donk, *Chem. Weekbl.* 1908, 5, 529, 629, 767.)

Sl. sol. in alcohol; insol. in alcohol-ether. (Mayer.)

Insol. in methyl acetate (Naumann, *B.* 1909, 42, 3790); ethyl acetate. (Naumann, *B.* 1904, 37, 3601.)

Insol. in acetone (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II 1011.)  
Cryst. also with  $H_2O$ , and  $\frac{1}{2}H_2O$ . (Gottig, B. 20. 2912.)

### Lithium imide, $Li_2NH$

Decomp. at high temp. Insol. in toluene, benzene, ether and ethyl acetate. Decomp.  $CHCl_3$ . (Ruff, B. 1911, 44. 506.)

### Lithium iodide, $LiI$ .

Deliquescent.

Solubility in 100 pts.  $H_2O$  at:

0° 19° 40° 59° 75° 80° 90° 120°  
151 164 179 200 263 435 476 588 pts.  $LiI$ .

Sp. gr. of  $LiI + Aq$  at 19.5° containing:

5 10 15 20 25 30%  $LiI$ ,  
1.038 1.079 1.124 1.172 1.224 1.280

35 40 45 50 55 60%  $LiI$   
1.344 1.414 1.489 1.575 1.670 1.777

(Kremers, Pogg. 104. 133; 111. 60: Gerlach, Z. anal. 8. 295.)

Sp. gr. of  $LiI + Aq$  at 18° containing.

5 10 15 20 25%  $LiI$ .  
1.0361 1.0756 1.1180 1.1643 1.2138

(Kohlrausch, W. Ann. 1879. 1.)

Temp of maximum g.-mol.  $LiI$  dissolved  
density of  $LiI + Aq$ . in 1000 g.  $H_2O$ .

2.516° 0 1795  
0.039° 0 4666

(de Coppet, C. R. 1900, 131. 178.)

Very sol in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

100 g. methyl alcohol dissolve 343.4 g.  $LiI$  at 25°.

100 g. ethyl alcohol dissolve 250.8 g.  $LiI$  at 25°.

100 g. propyl alcohol dissolve 47.52 g.  $LiI$  at 25°.

100 g. isoamyl alcohol dissolve 112.50 g.  $LiI$  at 25°.

In the case of propyl alcohol the solid phase at 25° is  $LiI \cdot 4C_3H_7O$ . (Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

Solubility in organic solvents at t°.

C = pts by wt. of  $LiI$  in 100 cem. of the sat. solution.

L = no. of liters which at the saturation temp. hold in solution 1 mol.  $LiI$ .

Solvent	t°	C	L
Furfural	25°	45.86	0.262
Nitromethane	25°	2.519	5.32
"	0°	1.219	10.98

(Walden, Z. phys. Ch. 1906, 55. 718.)

Solubility in glycol at 15.3° = 28%. (de Coninck, Belg. Acad. Bull. 1905, 359.)

Sol in benzoinital. (Naumann, B. 1911, 47. 1309.)

Sol. in methyl acetate (Naumann, B. 1909, 42. 3789.)

Difficultly sol in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sol in acetone (Kadmann, C. C. 1899, II. 1014; Naumann, B. 1901, 37. 1328.)

+ $H_2O$  Mpt below 200°. (Bogorodsky, C. C. 1897, II. 175.)

+2 $H_2O$ . Mpt. 86-88°. (Bogorodsky.)

+3 $H_2O$  Mpt. 75°. (Bogorodsky.)

Sol in absolute alcohol without decomp. (Thiess, Chem. Soc. 1894, 66. (2) 234.)

The composition of the hydrates formed by  $LiI$  at different dilutions is calculated from determinations of the lowering of the fr-pt. produced by  $LiI$  and of the conductivity and sp. gr. of  $LiI + Aq$  (Jones, Am. Ch. J. 1905, 34. 301.)

### Lithium mercuric iodide, $2LiI, HgI_2 + 6H_2O$ .

Very deliquescent. Decomp. by  $H_2O$ . Very sol. without decomp. in alcohols, glycerine, acetone, fuming formic acid, acetic acid, ethyl acetate, ethyl oxalate, etc. Less sol in nitrobenzene. Insol. in benzene and methyl iodide. (Duboin, C. R. 1905, 141. 1017.)

+8 $H_2O$ . Decomp. by  $H_2O$ . Very sol in alcohols, glycerine, acetone, fuming formic acid, acetic acid, ethyl acetate, etc. without decomp. Sol. in nitrobenzene. Insol. in benzene and methyl iodide (Duboin, l. c.)  
+9 $H_2O$  Hygroscopic. Sol. in alcohol and acetone without decomp. (Dobroserdoff, C. C. 1901, I. 664.)

### Lithium nitride, $Li_3N$ .

Sol. in  $H_2O$  with decomp. (Ouvrard, C. R. 114. 120.)

Very hygroscopic. (Dafert, M. 1910, 31. 987.)

### Lithium oxide, $Li_2O$ .

Slowly sol. in  $H_2O$  to form  $LiOH$ .

See Lithium hydroxide.

### Lithium peroxide, $Li_2O_2$ .

(de Foreaud, C. R. 1900, 130. 1467.)

### Lithium hydrogen peroxide, $Li_2O_2, H_2O_2 + 3H_2O$ .

Sol. in  $H_2O$ . Insol. in alcohol. (de Foreaud, C. R. 1900, 130. 1466.)

### Lithium selenide, $Li_2Se$ .

Sol. in  $H_2O$ . (Fabre, C. R. 103. 269.)

+9 $H_2O$  Sol. in  $H_2O$ . (Fabre.)

### Lithium silicide, $Li_6Si_2$ .

Decomp. by  $H_2O$  and by dil. acids. Decomp. by aqueous solutions of alkalis with evolution of  $H_2$ . (Moissan, C. R. 1902, 134. 1083.)

**Lithium metasulphide,  $\text{Li}_2\text{S}$** More sol. in  $\text{H}_2\text{O}$  or alcohol than  $\text{LiOH}$ **Luteochromium bromide,  $\text{Cr}(\text{NH}_3)_6\text{Br}_3$** Less sol. in  $\text{H}_2\text{O}$  than the chloride (Jorgensen, J. pr. (2) 30. 1)— bromoplatinate,  $[\text{Cr}(\text{NH}_3)_6]_2[\text{PtBr}_6]_2 + 11\text{H}_2\text{O}$ Sl. sol. in  $\text{H}_2\text{O}$  Insol. in alcohol (Jorgensen)— chloride,  $\text{Cr}(\text{NH}_3)_6\text{Cl}_3 + \text{H}_2\text{O}$ Efflorescent, and very sol. in  $\text{H}_2\text{O}$  (Jorgensen.)

— chloroplatinate.

(a)  $[\text{Cr}(\text{NH}_3)_6]_2[\text{PtCl}_6]_2 + 6\text{H}_2\text{O}$  Nearly completely insol. in  $\text{H}_2\text{O}$  (Jorgensen.)(b)  $\text{Cr}(\text{NH}_3)_6\text{Cl}[\text{PtCl}_6] + 2\frac{1}{2}\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$  into above, insol. in alcohol. (Jorgensen.)(c)  $[\text{Cr}(\text{NH}_3)_6]_2\text{Cl}_4[\text{Pt}(\text{Cl})_6] + 2\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$  into (a) (Jorgensen)— mercuric chloride,  $\text{Cr}(\text{NH}_3)_6\text{Cl}_2, \text{HgCl}_2$ Decomp. by  $\text{H}_2\text{O}$ ; sl. sol. in dil.  $\text{HCl} + \text{Aq}$ ; insol. in alcohol. $\text{Cr}(\text{NH}_3)_6\text{Cl}_2, 3\text{HgCl}_2 + 2\text{H}_2\text{O}$  Decomp. by dil.  $\text{HCl} + \text{Aq}$  into above salt (Jorgensen)— chromicyanide,  $\text{Cr}(\text{NH}_3)_6\text{Cr}(\text{CN})_6$ 

Precipitate.

— cobaltcyanide,  $\text{Cr}(\text{NH}_3)_6\text{Co}(\text{CN})_6$ Nearly insol. in  $\text{H}_2\text{O}$  or in conc.  $\text{HCl} + \text{Aq}$  (Jorgensen)— ferrocyanide,  $\text{Cr}(\text{NH}_3)_6\text{Fe}(\text{CN})_6$ Very sl. sol. in cold  $\text{H}_2\text{O}$  or dil. acids. (Jorgensen)— iodide,  $\text{Cr}(\text{NH}_3)_6\text{I}_3$ Sl. sol. in  $\text{H}_2\text{O}$ . (Jorgensen, l. c.)— iodosulphate,  $\text{Cr}(\text{NH}_3)_6\text{SO}_4\text{I}$ Sol. in  $\text{H}_2\text{O}$ ; nearly insol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$  or alcohol. (Jorgensen)— nitrate,  $\text{Cr}(\text{NH}_3)_6(\text{NO}_3)_3$ Sol. in 35–40 pts.  $\text{H}_2\text{O}$  Insol. in cold dil.  $\text{HNO}_3 + \text{Aq}$  or alcohol. Can be crystallised out of  $\text{H}_2\text{O}$  containing a little  $\text{HNO}_3$ . (Jorgensen, J. pr. (2) 30. 1.)

— nitrate chloroplatinate,

 $\text{Cr}(\text{NH}_3)_6(\text{NO}_3)_3\text{PtCl}_6 + \text{H}_2\text{O}$ Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Jorgensen.)— nitratosulphate,  $\text{Cr}(\text{NH}_3)_6(\text{NO}_3)\text{SO}_4$ Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Jorgensen.)**Luteochromium oxalate,  $[\text{Cr}(\text{NH}_3)_6]_2(\text{C}_2\text{O}_4)_2 + 4\text{H}_2\text{O}$** Nearly insol. in cold  $\text{H}_2\text{O}$ . (Jorgensen.)— orthophosphate,  $\text{Cr}(\text{NH}_3)_6\text{PO}_4 + 4\text{H}_2\text{O}$ Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Jorgensen.)

— sodium pyrophosphate,

 $\text{Cr}(\text{NH}_3)_6[\text{Na}_2\text{P}_2\text{O}_7] + 11\frac{1}{2}\text{H}_2\text{O}$ Nearly insol. in cold  $\text{H}_2\text{O}$ ; wholly insol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Jorgensen.)— sulphate,  $[\text{Cr}(\text{NH}_3)_6]_2(\text{SO}_4)_2 + 5\text{H}_2\text{O}$ Quite sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Jorgensen)

— sulphate chloroplatinate,

 $[\text{Cr}(\text{NH}_3)_6(\text{SO}_4)]_2\text{PtCl}_6$ Nearly insol. in  $\text{H}_2\text{O}$ . (Jorgensen)**Luteocobalt diamine chromium sulphocyanide.**

See Diamine chromium luteocobalt sulphocyanide.

**Luteocobaltic bromide,  $\text{Co}(\text{NH}_3)_6\text{Br}_3$** Sol. in  $\text{H}_2\text{O}$  Precipitated from saturated  $\text{H}_2\text{O}$  solution by dil.  $\text{HBr} + \text{Aq}$  (Jorgensen, J. pr. (2) 35. 417.)

— bromopermanganate,

 $\text{Co}(\text{NH}_3)_6\text{Br}_3(\text{MnO}_4)$ Easily sol. in  $\text{H}_2\text{O}$  (Klobb, A. ch. (6) 12. 5.)— bromoplatinate,  $\text{Co}(\text{NH}_3)_6\text{Br}_3, \text{PtBr}_4 + \text{H}_2\text{O}$ Sl. sol. in  $\text{H}_2\text{O}$ ; can be recrystallised from hot  $\text{H}_2\text{O}$  containing  $\text{HBr}$ . (Jorgensen.)— bromosulphate,  $\text{Co}(\text{NH}_3)_6\text{Br}(\text{SO}_4)$ Nearly insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Jorgensen.)— carbonate,  $[\text{Co}(\text{NH}_3)_6]_3(\text{CO}_3)_2 + 7\text{H}_2\text{O}$ Efflorescent; easily sol. in  $\text{H}_2\text{O}$ . $[\text{Co}(\text{NH}_3)_6]_3(\text{CO}_3)_2, \text{H}_2\text{CO}_3 + 5\text{H}_2\text{O}$  Less sol. in  $\text{H}_2\text{O}$  than the neutral salt. (Gibbs and Genth)— chloride,  $\text{Co}(\text{NH}_3)_6\text{Cl}_3$ Sol. in 17.09 pts.  $\text{H}_2\text{O}$  at  $10.5^\circ$ ; 16.81 pts. at  $11.4^\circ$ ; 16.48 pts. at  $12^\circ$ ; and more easily in hot  $\text{H}_2\text{O}$ . (F. Rose.)100 pts.  $\text{H}_2\text{O}$  dissolve 4.26 pts. at  $0^\circ$ , and 12.74 pts. at  $46.6^\circ$ . (Kurnakoff, J. russ. Soc. 24. 629.)Not appreciably sol. in conc.  $\text{HCl} + \text{Aq}$ . (Jorgensen.)

Insol. in alcohol or solutions of the alkali chlorides (Gibbs and Genth)

Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Aqueous solution is pptd. by alcohol, mineral acids, or alkali chlorides.

**Lutecobaltic mercuric chloride**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $\text{HgCl}_2 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol in hot  $\text{H}_2\text{O}$ . (Krok, 1870.)

By recrystallizing from hot  $\text{H}_2\text{O}$  containing  $\text{HCl}$  is converted into—

$\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $3\text{HgCl}_2 + \text{H}_2\text{O}$ . Very sl. sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen.)

$\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $2\text{HgCl}_2 + \frac{1}{2}\text{H}_2\text{O}$ . Sol. in hot  $\text{H}_2\text{O}$ , from which it crystallizes on cooling. Insol. in cold conc.  $\text{HCl} + \text{Aq}$ , and is pptd. from  $\text{H}_2\text{O}$  solution by  $\text{HCl}$  or alcohol. (Carstensen.)

Does not exist (Jørgensen.)

$+3\text{H}_2\text{O}$ . More easily sol. in cold  $\text{H}_2\text{O}$  and other solvents than the preceding comp (Carstensen, Berlin, 1861.)

Does not exist (Jørgensen.)

— **stannous chloride**,  $2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,

$3\text{SnCl}_2 + 10\text{H}_2\text{O}$ .

$+8\text{H}_2\text{O}$ .

— **chloraurate**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $\text{AuCl}_3$ .

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$  containing  $\text{HCl}$ . (Gibbs and Genth, Sill. Am. J. (2) 23. 330.)

— **chloriodate**,  $[\text{Co}(\text{NH}_3)_6\text{Cl}_2]\text{I}_2\text{O}_{11} + \text{H}_2\text{O}$

— **chloriridite**,  $\text{Co}(\text{NH}_3)_6\text{IrCl}_4$ .

Insol. in boiling  $\text{H}_2\text{O}$  or dil.  $\text{HCl} + \text{Aq}$ . (Gibbs.)

— **chloriridate**,  $2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $3\text{IrCl}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— **chlorochromate**,  $\text{Co}(\text{NH}_3)_6\text{CrO}_4\text{Cl} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Klobb, Bull. Soc. 1901, (3) 25. 1027.)

— **chlorofluoride**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2\text{F}$ .

(Bohm, Z. anorg. 1905, 43. 339.)

— **chloropalladite**,  $2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $3\text{PdCl}_2$ .

Easily sol. in dil.  $\text{HCl} + \text{Aq}$ . (Gibbs, Sill. Am. J. (2) 37. 58.)

— **chloroperchlorate**,  $\text{Co}(\text{NH}_3)_6\text{Cl}(\text{ClO}_4)_2$ .

(Millosevich, Gazz. ch. it. 1901, 31. (2) 285.)

— **chloropermanganate**,

$\text{Co}(\text{NH}_3)_6\text{Cl}_2(\text{MnO}_4)$ .

Can be recrystallized from  $\text{H}_2\text{O}$ . (Klobb, C. R. 103. 354.)

— **chloropermanganate ammonium chloride**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2(\text{MnO}_4)$ ,  $\text{NH}_4\text{Cl}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Klobb.)

**Lutecobaltic chloropermanganate potassium chloride**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2(\text{MnO}_4)$ ,  $\text{KCl}$ .

Very easily sol. in  $\text{H}_2\text{O}$ , with decomp. into constituents; sol. in  $\text{KCl} + \text{Aq}$ . (Klobb.)

— **chloropermanganate sodium chloride**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2(\text{MnO}_4)$ ,  $\text{NaCl}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Klobb.)

— **chloroplatinate**,  $2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$ .

Can be recrystallized from much hot  $\text{H}_2\text{O}$ . (Gibbs and Genth.)

$+21\text{H}_2\text{O}$ . (Gibbs and Genth.)

$\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $\text{PtCl}_4 + \frac{1}{2}\text{H}_2\text{O}$ . Very sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$  into—

$2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $\text{PtCl}_4 + 2\text{H}_2\text{O}$ . By recrystallizing from hot  $\text{H}_2\text{O}$  containing  $\text{HCl}$  this salt is converted into the above salt. (Jørgensen.)

— **chlororhodate**.

Nearly insol. in boiling  $\text{H}_2\text{O}$  or dil. acids. Sol. in conc.  $\text{HCl} + \text{Aq}$ . (Gibbs, Sill. Am. J. (2) 37. 57.)

— **chlororuthenate**,  $2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $3\text{RuCl}_4$ .

Sol. in dil. acids. (Gibbs.)

— **chloroselenate**,  $\text{Co}(\text{NH}_3)_6\text{ClSeO}_4 + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Klobb, Bull. Soc. 1901, (3) 25. 1029.)

— **chlorosulphate**,  $\text{Co}(\text{NH}_3)_6\text{Cl}(\text{SO}_4)$ .

Sol. in  $\text{H}_2\text{O}$ .

$+3\text{H}_2\text{O}$ . Only sl. sol. in cold  $\text{H}_2\text{O}$ . (Klobb, Bull. Soc. 1901, (3) 25. 1025.)

— **ammonium chlorosulphate**,

$[\text{Co}(\text{NH}_3)_6\text{Cl}_2(\text{SO}_4)_2]$ ,  $3(\text{NH}_4)_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Klobb, Bull. Soc. 1901, (3) 25. 1027.)

— **chlorosulphate chloroplatinate**,

$2\text{Co}(\text{NH}_3)_6\text{Cl}(\text{SO}_4)$ ,  $\text{PtCl}_4$ .

Very sl. sol. in cold pure  $\text{H}_2\text{O}$ . Can be recrystallized out of  $\text{H}_2\text{O}$  containing  $\text{HCl}$ . (Krok.)

— **chlorosulphate mercuric chloride**,

$\text{Co}(\text{NH}_3)_6\text{Cl}(\text{SO}_4)$ ,  $\text{HgCl}_2$ .

Scarcely sol. in pure  $\text{H}_2\text{O}$ , but can be crystallized from warm acidified  $\text{H}_2\text{O}$ . (Krok.)

— **chlorosulphite**,  $\text{Co}(\text{NH}_3)_6(\text{SO}_2)\text{Cl} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vortmann and Magdeburg, B. 22. 2637.)

— **chromate**,  $[\text{Co}(\text{NH}_3)_6]_2(\text{CrO}_4)_2 + 5\text{H}_2\text{O}$ .

Ppt. Sol. in hot  $\text{H}_2\text{O}$ .

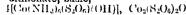
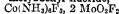
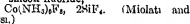
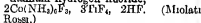
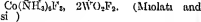
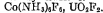
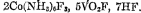
$[\text{Co}(\text{NH}_3)_6]_2(\text{Cr}_2\text{O}_7)_2 + 5\text{H}_2\text{O}$ . Moderately sol. in hot  $\text{H}_2\text{O}$ .

**Luteocobaltic chromicyanide,**

Ppt. (Braun.)

**— cobaltcyanide,  $\text{Co}(\text{NH}_3)_6(\text{Co}(\text{CN})_6)$ .**

Ppt

**— dithionate, basic,**Sol in  $\text{H}_2\text{O}$  and dil. alcohol**— ferricyanide,  $\text{Co}(\text{NH}_3)_6\text{Fe}(\text{CN})_4 + \frac{1}{2}\text{H}_2\text{O}$ .**Insol in  $\text{H}_2\text{O}$ . (Braun)**— fluoride,  $\text{Co}(\text{NH}_3)_6\text{F}_6$ .**Sl. sol. in cold  $\text{H}_2\text{O}$ . Nearly insol. in acids (Bohm, Z. anorg. 1905, 43. 349.)**— hydrogen fluoride,  $\text{Co}(\text{NH}_3)_6\text{H}_7\text{F}_6$ .**Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Miolati and Rossi, Real. Acc. Linc. 1896, (5) 5. II, 185.)**— hydrogen boron fluoride,  $\text{Co}(\text{NH}_3)_6\text{F}_3, 3\text{BF}_3, \text{H}_2\text{F}$ .**Cryst. from  $\text{H}_2\text{O}$  acidified with  $\text{HF}$ . (Miolati and Rossi)**— molybdenyl fluoride,**Cryst. from  $\text{H}_2\text{O}$  containing  $\text{H}_2\text{F}$ . (Miolati and Rossi.)**— silicon fluoride,****— titanium hydrogen fluoride,****— tungstyl fluoride,****— uranyl fluoride,**Can be cryst. from  $\text{H}_2\text{O}$  containing  $\text{HF}$ . (Miolati and Rossi.)**— vanadyl fluoride,**

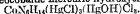
Ppt. (Miolati and Rossi.)

**— fluoride nitrate,**

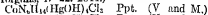
(Bohm, Z. anorg. 1905, 43. 336.)

**— hydroxide,  $\text{Co}(\text{NH}_3)_6(\text{OH})_2$ .**

Known only in aqueous solution.

**Luteocobaltic mercuric hydroxychloride,**

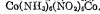
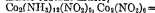
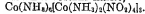
Ppt. Easily decomp. (Vortmann, and Morgulis, B. 22. 2644.)

**— iodide,  $\text{Co}(\text{NH}_3)_6\text{I}_3$ .**Insol. in cold, but moderately sol. in hot  $\text{H}_2\text{O}$ .According to Jørgensen, contains  $\text{HNO}_2$  and has the formula  $\text{Co}_2(\text{NH}_3)_{12}\text{I}_4(\text{NO}_2)_2$ .**— iodosulphate,  $\text{Co}(\text{NH}_3)_6\text{I}(\text{SO}_4)$ .**Can be recrystallized from hot  $\text{H}_2\text{O}$ . Sl. sol. in warm, nearly insol. in cold  $\text{H}_2\text{O}$ . (Krok, B. 4. 711.)**— mercuriodide,  $\text{Co}_2\text{N}_{12}\text{H}_{16}(\text{HgI})_2\text{I}_4$ .**

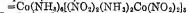
Ppt. (Vortmann and Borsbach.)

**— mercuriodide, basic,**Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Vortmann and Borsbach, B. 23. 2804.)**— nitrate,  $\text{Co}(\text{NH}_3)_6(\text{NO}_3)_4$ .**Sol in  $\text{H}_2\text{O}$ . Can be recrystallized from boiling  $\text{H}_2\text{O}$ . Sol in about 60 pts.  $\text{H}_2\text{O}$ . Insol. in conc.  $\text{HNO}_3 + \text{Aq}$ . (Jørgensen, J. pr. (2), 35. 417.)

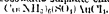
Almost insol. in acids. (Rogojski, A. ch. (3), 41. 451.)

Insol. in  $\text{NH}_4\text{OH}$ ,  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ ; decomp. by  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Gibbs and Genih.) $\text{Co}(\text{NH}_3)_6(\text{NO}_3)_4$ ,  $\text{HNO}_2$ . Decomp. by  $\text{H}_2\text{O}$  or dil. alcohol. (Jørgensen, J. pr. (2), 44. 63.)**— nitrate chloroplatinate,**Not decomp. by  $\text{H}_2\text{O}$ . (Jørgensen.)**— nitrosulphate,  $\text{Co}(\text{NH}_3)_6(\text{NO}_2)(\text{SO}_4)$ .**Sol in  $\text{H}_2\text{O}$ . (Jørgensen.)**— nitrite cobaltic nitrite,**Nearly insol. in  $\text{H}_2\text{O}$ . (Jørgensen.)Much less sol. in  $\text{H}_2\text{O}$  than the corresponding roseo salt. (Gibbs.)**— diamine cobaltic nitrite,**

Ppt. (Gibbs.)

Nearly insol. in cold, sl. sol. in boiling  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. 5. 179.)**— oxalate,  $[\text{Co}(\text{NH}_3)_6]_2(\text{C}_2\text{O}_4)_2 + 4\text{H}_2\text{O}$ .**Insol. in hot or cold  $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ .

- Luteocobaltic oxalate chloraurate**,  
 $2\text{Co}(\text{NH}_3)_6(\text{C}_2\text{O}_4)_2\text{Cl} \cdot \text{AuCl}_3 \cdot 4\text{H}_2\text{O}$   
 Easily sol. in hot  $\text{H}_2\text{O}$ . (Gibbs.)
- **perchlorate**,  $\text{Co}(\text{NH}_3)_6(\text{ClO}_4)_2$ .  
 (Millosevich, Gazz. ch. it. 1901, 31, (2) 285.)
- **permanganate**,  $[\text{Co}(\text{NH}_3)_6]_2(\text{MnO}_4)_2$ .  
 Nearly insol. in  $\text{H}_2\text{O}$ . 100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve only 0.072 pt. salt. Moderately sol. in hot  $\text{H}_2\text{O}$ . (Klobb, A. ch. (6) 12. 5.)
- **persulphate sulphate**,  
 $[\text{Co}(\text{NH}_3)_6]_2\text{S}_2\text{O}_8(\text{SO}_4)_2$ .  
 Much less sol. in  $\text{H}_2\text{O}$  than the sulphate. Sol. in 641 pts.  $\text{H}_2\text{O}$  at  $18.8^\circ$  and in 632 pts. at  $20^\circ$ . Not easily sol. even in boiling  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. 1898, 17. 459.)
- **orthophosphate**,  $\text{Co}(\text{NH}_3)_6(\text{PO}_4)_4 \cdot 4\text{H}_2\text{O}$ .  
 Sl. sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Jørgensen.)  
 $[\text{Co}(\text{NH}_3)_6]_2(\text{PO}_4)_2(\text{PO}_3\text{H})_2 + 5\frac{1}{2}\text{H}_2\text{O}$  (?).  
 Ppt. (Braun.)  
 $[\text{Co}(\text{NH}_3)_6]_2(\text{PO}_4)_2\text{H}_2\text{O}$ . Ppt. Easily sol. in very dil.  $\text{HCl} + \text{Aq}$ . (Jørgensen.)
- **metaphosphate**.  
 Ppt
- **pyrophosphate**,  $[\text{Co}(\text{NH}_3)_6]_2\text{P}_2\text{O}_7 \cdot 6\text{H}_2\text{O}$ .  
 (Gibbs, Am. Acad. Proc. 11. 29); or  $\text{Co}_2(\text{NH}_3)_{12}(\text{P}_2\text{O}_7)(\text{ONa})_2$  (Vortmann, B. 11. 2181); or  $\text{Co}(\text{NH}_3)_6(\text{P}_2\text{O}_7\text{Na}) + 11\frac{1}{2}\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 36. 438.)  
 Very nearly insol. in  $\text{H}_2\text{O}$ . With  $\text{H}_2\text{O}$  at  $80^\circ$  it is decomp. into—  
 $[\text{Co}(\text{NH}_3)_6]_4(\text{P}_2\text{O}_7)_2 + 20\text{H}_2\text{O}$ . Less easily sol. than the preceding salt.
- **pyrophosphate, acid**,  $\text{Co}(\text{NH}_3)_6(\text{P}_2\text{O}_7\text{H})$ .  
 Wholly insol. in  $\text{H}_2\text{O}$ . Somewhat sol. in dil.  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Jørgensen.)
- **sodium pyrophosphate**,  
 $\text{Co}(\text{NH}_3)_6(\text{P}_2\text{O}_7\text{Na}) + 11\frac{1}{2}\text{H}_2\text{O}$ .  
 Ppt. Not wholly insol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Less sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Jørgensen.)  
 $[\text{Co}(\text{NH}_3)_6]_4(\text{P}_2\text{O}_7)_2 \cdot 2\text{Co}(\text{NH}_3)_6(\text{NaP}_2\text{O}_7) + 39\text{H}_2\text{O}$ . As above. (Jørgensen.)
- **selenate**,  $[\text{Co}(\text{NH}_3)_6]_2(\text{SeO}_4)_2 \cdot 5\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . (Klobb, Bull. Soc. 1901, (3) 25. 1028.)
- **hydrogen selenate**,  
 $[\text{Co}(\text{NH}_3)_6]_2\text{H}(\text{SeO}_4)_2 + 2\frac{1}{2}\text{H}_2\text{O}$ .  
 Not decomp. by  $\text{H}_2\text{O}$ . (Klobb.)
- Luteocobaltic ammonium selenate**,  
 $[\text{Co}(\text{NH}_3)_6]_2(\text{SeO}_4)_2 \cdot (\text{NH}_4)_2\text{SeO}_4 + 4\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ .  
 $[\text{Co}(\text{NH}_3)_6]_2(\text{SeO}_4)_2 \cdot (\text{NH}_4)_2\text{SeO}_4 + 8\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . (Klobb.)
- **sulphocyanide**,  $\text{Co}(\text{NH}_3)_6(\text{SCN})_2$ .  
 Decomp. by hot  $\text{H}_2\text{O}$ . (Miolati, Z. anorg. 1900, 23. 211.)
- **mercuric sulphocyanide**,  
 $\text{Co}(\text{NH}_3)_6(\text{SCN})_2 \cdot 2\text{Hg}(\text{SCN})_2$ .  
 Decomp. by  $\text{H}_2\text{O}$ .  
 Cryst. from dil.  $\text{NH}_4\text{SCN} + \text{Aq}$ . (Miolati.)
- **platinum sulphocyanide**,  
 $[\text{Pt}(\text{SCN})_4]_2[\text{Co}(\text{NH}_3)_6(\text{SCN})_2]$ .  
 Decomp. by hot  $\text{H}_2\text{O}$ . (Miolati.)
- **silver sulphocyanide**,  
 $\text{Co}(\text{NH}_3)_6(\text{SCN})_2 \cdot 2\text{AgSCN}$ .  
 Decomp. by hot  $\text{H}_2\text{O}$ . (Miolati.)
- **sulphate**,  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2 \cdot 5\text{H}_2\text{O}$ .  
 Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .  
 $+ 6\text{H}_2\text{O}$  (Krol, B. 4. 711.)
- **hydrogen sulphate**,  
 $\text{Co}(\text{NH}_3)_6\text{H}(\text{SO}_4)_2$ .  
 Decomp. by alcohol to sulphate (Jørgensen, Z. anorg. 1898, 17. 458.)  
 $4[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2 \cdot 5\text{H}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$  with decomp. into the normal sulphate.  
 When pulverized it seems to dissociate slowly in contact with abs. alcohol. (Klobb, Bull. Soc. 1901, (3) 25. 1025.)
- **ammonium sulphate**,  
 $[\text{Co}_2(\text{NH}_3)_{12}]_2(\text{SO}_4)_2 \cdot (\text{NH}_4)_2\text{SO}_4 + 8\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$  with decomp. (Klobb.)
- **cerium sulphate**,  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2 \cdot \text{Ce}_2(\text{SO}_4)_2 + 1\frac{1}{2}\text{H}_2\text{O}$ .  
 Very sl. sol. in cold, and practically insol. in boiling  $\text{H}_2\text{O}$ . Sol. in acids. (Gibbs, Am. Ch. J. 16. 660.)  
 $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2 \cdot 3\text{Ce}(\text{SO}_4)_2 + \text{H}_2\text{O}$  As above. (Wing, Sil. Am. J. (2) 49. 363.)
- **lanthanum sulphate**,  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2 \cdot \text{La}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$ .  
 Sl. sol. in  $\text{H}_2\text{O}$ . (Wing.)
- **thallic sulphate**,  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2 \cdot \text{Tl}_2\text{O}(\text{SO}_4)_2 + 5\text{H}_2\text{O}$ .  
 Decomp. by cold  $\text{H}_2\text{O}$ . (Gibbs.)
- **sulphate bromaurate**,  
 $\text{Co}(\text{NH}_3)_6(\text{SO}_4)(\text{AuBr}_4)$ .  
 Very sl. sol. in  $\text{H}_2\text{O}$  with apparent decomp. Insol. in alcohol. (Jørgensen.)

**Luteocobaltic sulphate chloraurate,**Sl sol in  $\text{H}_2\text{O}$ . (Jørgensen.)

— cobaltic sulphite,  $[\text{Co}(\text{NH}_3)_2(\text{SO}_3)_2]_2$ ,  $\text{Co}_2(\text{SO}_3)_2 + \text{H}_2\text{O} = \text{dichrocobaltic sulphite}$ ,  $[\text{Co}(\text{NH}_3)_2(\text{SO}_3)_2 + 2\text{H}_2\text{O}]$ , which see.

$[\text{Co}(\text{NH}_3)_2(\text{SO}_3)_2]_2$ ,  $2\text{Co}_2(\text{SO}_3)_2 + 15\text{H}_2\text{O} = \text{diamine cobaltic sulphite}$ ,  $[\text{Co}(\text{NH}_3)_2(\text{SO}_3)_2 + 5\text{H}_2\text{O}]$ , which see.

**Luteorhodium bromide,  $\text{Rh}(\text{NH}_3)_6\text{Br}_2$ .**

Less sol in  $\text{H}_2\text{O}$  than the chloride. (Jørgensen, J. pr. (2) 44. 51.)

— chloride,  $\text{Rh}(\text{NH}_3)_6\text{Cl}_3$ .

Sol in 7 to 8 pts.  $\text{H}_2\text{O}$  at  $8^\circ$ . (J.)

+  $\text{H}_2\text{O}$ . Extremely efflorescent. (J.)

— rhodium chloride,  $\text{Rh}(\text{NH}_3)_6\text{Cl}_3$ ,  $\text{RhCl}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. 5. 174.)

— chloroplatinate,  $2\text{Rh}(\text{NH}_3)_6\text{Cl}_3$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol in warm  $\text{HCl} + \text{Aq}$ . (J.)  $\text{Rh}(\text{NH}_3)_6\text{Cl}_3$ ,  $\text{PtCl}_4 + \frac{1}{2}\text{H}_2\text{O}$ . Decomp by  $\text{H}_2\text{O}$  into chloride and above salt (J.)

— nitrate,  $\text{Rh}(\text{NH}_3)_6(\text{NO}_3)_3$ .

Sol. in 48 to 49 pts.  $\text{H}_2\text{O}$  at ord temp  $\text{HNO}_3 + \text{Aq}$  diluted with 5 vols  $\text{H}_2\text{O}$  ppts the salt completely from aqueous solution (Jørgensen, J. pr. (2) 44. 51.)

$\text{Rh}(\text{NH}_3)_6(\text{NO}_3)_3$ ,  $\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$  or dil alcohol. (Jørgensen, J. pr. (2), 44. 63.)

— orthophosphate,  $\text{Rh}(\text{NH}_3)_6\text{PO}_4 + 4\text{H}_2\text{O}$ .

Sl. sol in cold  $\text{H}_2\text{O}$ . (J.)

— sodium pyrophosphate,  $[\text{Rh}(\text{NH}_3)_6]_2(\text{P}_2\text{O}_7)_2 \cdot \text{Na}_2 + 23\text{H}_2\text{O}$ .

Nearly wholly insol in  $\text{H}_2\text{O}$ . Wholly insol in  $\text{NH}_4\text{OH} + \text{Aq}$ . (J.)

— sulphate,  $[\text{Rh}(\text{NH}_3)_6]_2(\text{SO}_4)_3 + 5\text{H}_2\text{O}$ .

Sol. in 43 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (J.)

**Magnesium, Mg.**

Does not decomp.  $\text{H}_2\text{O}$  at ord temp., but decomp slowly at  $100^\circ$ .  $\text{H}_2\text{O}$  containing acids dissolves Mg easily. Sol. in cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Difficultly sol. in cold  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Bunsen.) Cold nitrosulphuric acid does not attack. (Bunsen.) Cold  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{KOH} + \text{Aq}$ , or  $\text{NaOH} + \text{Aq}$  do not attack (Maack, Phipps.) Sol. in  $\text{NH}_4\text{Cl}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Wöhler.)

Very rapidly sol. in  $\text{K}_2\text{S}_2\text{O}_8 + \text{Aq}$  and  $(\text{NH}_4)_2\text{S}_2\text{O}_8 + \text{Aq}$  with violent evolution of gas (Levi, Gazz. ch. it. 1908, 38. (1), 533.)

Attacked by aqueous solution of  $\text{KCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{NaCl}$ ,  $\text{LiCl}$ ,  $\text{CuCl}_2$ ,  $\text{CdCl}_2$ ,  $\text{CoCl}_2$ ,  $\text{PbCl}_2$ ,  $\text{HgCl}_2$ ,  $\text{FeCl}_3$ ,  $\text{CrCl}_3$ ,  $\text{PtCl}_4$ ,  $\text{AuCl}_3$ ,  $\text{CuSO}_4$ ,  $\text{ZnSO}_4$ ,  $\text{FeSO}_4$ , and  $\text{MnSO}_4$ .

Sl. attacked by hot  $30\%$   $\text{CaCl}_2 + \text{Aq}$ , not by  $30\%$   $\text{MgCl}_2 + \text{Aq}$ ,  $\text{BaCl}_2 + \text{Aq}$  and  $\text{SrCl}_2 + \text{Aq}$  (Tommasi, Bull. Soc. 1899, (3), 21. 880.)

Not attacked by  $\text{NH}_4\text{F} + \text{Aq}$ , very slowly by solutions of  $\text{BaCl}_2$ ,  $\text{CaCl}_2$ ,  $\text{KCl}$ ,  $\text{K}_3\text{Fe}(\text{CN})_6$ ,  $\text{NaNO}_2$ ,  $\text{Na}_2\text{S}_2\text{O}_3$  and  $\text{Na}_2\text{HPO}_4$ . Solutions of  $\text{NaC}_2\text{H}_3\text{O}_2$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ , alum and chrome alum attack vigorously. Solutions of  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{NH}_4\text{Cl}$ ,  $(\text{NH}_4)_2\text{C}_2\text{O}_4$ ,  $(\text{NH}_4)_2\text{S}$  and  $\text{Na}_2\text{CO}_3$  attack even more vigorously. (Moumoun, C R 1900, 130. 140.)

Insol in liquid  $\text{NH}_3$  (Gore, Am. Ch. J. 1898, 20. 828.)

Insol in liquid  $\text{HF}$ . (Franklin, Z. anorg. 1905, 46. 2.)

Somewhat sol. in liquid  $\text{NH}_3$ , if a clean metallic surface is in contact with the pure solvent. (Kraus, J. Am. Chem. Soc. 1907, 29. 1561.)

$\frac{1}{2}$  gram oleic acid dissolves 0.0104 g. Mg in 6 days (Gates, J. phys. Chem. 1911, 15. 143.)

**Magnesium arsenide,  $\text{Mg}_3\text{As}_2$ .**

Decomp on air. (Parkinson, Chem. Soc. 5. 127.)

**Magnesium azoimide,  $\text{Mg}(\text{N}_3)_2$ .**

Decomp. by hot  $\text{H}_2\text{O}$ . (Curtius, J. pr. 1898, (2) 58. 292.)

**Magnesium boride,  $\text{Mg}_2\text{B}_3$ .**

Sol in  $\text{HCl} + \text{Aq}$ . (Winkler, B. 23. 774.)

**Magnesium bromide,  $\text{MgBr}_2$ .**

Deliquescent. Very sol in  $\text{H}_2\text{O}$  with evolution of heat.

Sat  $\text{MgBr}_2 + \text{Aq}$  contains at:

—18°	+17°	48°	62°	97°
53	58	60	9	62

5 85.8%  $\text{MgBr}_2$ . (Étard, A. ch. 1894, (7), 2. 541.)

See also  $\text{MgBr}_2 + 6\text{H}_2\text{O}$ .

Sp. gr. of  $\text{MgBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing.

5	10	15	20	25 % $\text{MgBr}_2$
1.043	1.087	1.137	1.191	1.247

30	35	40	45	50 % $\text{MgBr}_2$
1.31	1.377	1.451	1.535	1.625

(Kremers, Pogg. 108. 118, calculated by Gerlach, Z. anal. 8. 285.)

$\text{MgBr}_2 + \text{Aq}$  is sl. decomp. by evaporation.

Solubility of  $\text{MgBr}_2$  in alcohols.

$\text{MgBr}_2$  forms with methyl alcohol a complex,  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{OH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{CH}_3\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{CH}_3\text{OH}$
0	42.6	130	63.6
20	44.6	140	66.8
40	46.7	150	70.2
60	48.9	160	74.0
80	51.4	170	78.5
100	55.5	180	84.5
110	58.0	185	88.0
120	60.7	190 mpt.	100

(Menschutkin, Z. anorg. 1907, 52, 11.)

$\text{MgBr}_2$  forms with ethyl alcohol a complex,  $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$
0	17.2	80	73.8
10	24.9	85	76.2
20	32.7	90	78.7
30	40.3	95	82.3
40	47.8	100	86.7
50	55.1	103	90.0
60	62.2	106	94.4
70	68.8	108.5 mpt.	100
75	71.4		

(Menschutkin.)

$\text{MgBr}_2$  forms with propyl alcohol a complex,  $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$  in  $\text{C}_3\text{H}_7\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$
0	77.9	43	93.0
10	81.5	46	94.3
20	85.1	48	95.8
30	89.5	50	97.8
40	92.0	52 mpt.	100

(Menschutkin.)

$\text{MgBr}_2$  forms with isobutylalcohol a complex,  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_4\text{H}_9\text{OH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_4\text{H}_9\text{OH}$  in  $\text{C}_4\text{H}_9\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_4\text{H}_9\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_4\text{H}_9\text{OH}$
0	55.8	60	82.4
10	60.5	65	84.2
20	65.2	71	88.0
30	69.8	75	92.0
40	74.3	77	94.6
50	78.5	80 mpt.	100

(Menschutkin.)

$\text{MgBr}_2$  forms with isomylalcohol a complex,  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$  in  $\text{C}_5\text{H}_{11}\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$
0	70.2	38	88.7
10	75.6	40	90.0
20	80.2	42	92.0
30	84.5	44	94.2
35	86.7	46 mpt.	100

(Menschutkin.)

Solubility in ether at  $t^\circ$ .

$t^\circ$	% $\text{MgBr}_2$	% $\text{MgBr}_2 \cdot 2\text{C}_2\text{H}_5\text{O}$
-8	0.6	1.08
0	0.8	1.44
+10	1.27	2.3
14	1.64	2.95
16	1.93	3.48
18	2.3	4.14
20	2.7	4.86
22 mpt.	3.22	5.80

(Menschutkin, Z. anorg. 1906, 49, 38.)

Solubility of  $\text{MgBr}_2 \cdot 2\text{C}_2\text{H}_5\text{O}$  in ether at  $t^\circ$ .

"Lower solution" = the melted  $\text{MgBr}_2 \cdot 2\text{C}_2\text{H}_5\text{O}$  which does not mix with the ether above.

$t^\circ$	Composition of lower solution		Composition of the upper layer	
	% $\text{MgBr}_2$	% $\text{MgBr}_2 \cdot 2\text{C}_2\text{H}_5\text{O}$	% $\text{MgBr}_2$	% $\text{MgBr}_2 \cdot 2\text{C}_2\text{H}_5\text{O}$
-10	42.0	75.7	1.8	3.2
0	41.0	73.9	2.3	4.1
+10	40.1	72.2	2.8	5.0
20	39.3	70.8	3.3	5.9
30	38.7	69.8	3.8	6.8
40	38.2	68.8	4.3	7.7
50	37.8	68.0	4.7	8.5
60	37.6	67.7	5.1	9.2
70	37.6	67.7	5.4	9.7
80	37.8	68.0	5.6	10.0
90	38.1	68.6	5.7	10.2

(Menschutkin.)

Solubility of  $\text{MgBr}_2$  in formic acid  
 $\text{MgBr}_2$  forms with formic acid a complex,  
 $\text{MgBr}_2 \cdot 6\text{HCOOH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{HCOOH}$  in  $\text{HCOOH}$   
 at  $t^\circ$ .

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6\text{HCOOH}$
0	49.8
20	57.5
40	65.1
60	73.1
70	78.1
80	86.0
86	95.0
88 mpt.	100

(Menschutkin, Z. anorg. 1907, 54, 90.)

Solubility of  $\text{MgBr}_2$  in acetic acid.  
 $\text{MgBr}_2$  forms with acetic acid a complex,  
 $\text{MgBr}_2 \cdot 6\text{CH}_3\text{COOH}$

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{COOH}$  in  
 $\text{CH}_3\text{COOH}$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6\text{CH}_3\text{COOH}$
17	0.3
30	1.5
50	4.5
60	7.9
70	16.2
80	38.5
85	49.5
90	57.7
100	71.8
105	80.0
110	89.5
112 mpt.	100.0

(Menschutkin)

Solubility of  $\text{MgBr}_2$  in acetic anhydride  
 $\text{MgBr}_2$  forms with acetic anhydride a complex,  
 $\text{MgBr}_2 \cdot 6(\text{CH}_3\text{CO})_2\text{O}$ .

Solubility of  $\text{MgBr}_2 \cdot 6(\text{CH}_3\text{CO})_2\text{O}$  in  
 $(\text{CH}_3\text{CO})_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6(\text{CH}_3\text{CO})_2\text{O}$
0	26.4
30	30.0
60	37.7
90	44.5
120	57.8
130	69.8
135	85.0
136-137 mpt.	100

(Menschutkin, Z. anorg. 1909, 61, 112.)

Solubility of  $\text{MgBr}_2$  in acetone.  
 $\text{MgBr}_2$  forms with acetone a complex,  
 $\text{MgBr}_2 \cdot 3\text{CH}_3\text{COCH}_3$ .

Solubility of  $\text{MgBr}_2 \cdot 3\text{CH}_3\text{COCH}_3$  in  
 $\text{CH}_3\text{COCH}_3$  at  $t^\circ$ .

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 3\text{CH}_3\text{COCH}_3$
0	0.2
30	0.8
60	1.45
70	2.0
72	3.7
73	5.5
74	14.0
75	50.0
76	71.6
80	83.3
84	89.8
88	95.2
92 mpt.	100

(Menschutkin, Z. anorg. 1907, 53, 30.)

Solubility of  $\text{MgBr}_2$  in acetamide.  
 $\text{MgBr}_2$  forms with acetamide a complex,  
 $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$  in  
 $\text{CH}_3\text{CONH}_2$  at  $t^\circ$ .

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$
50.5	56.0
70	57.8
90	60.5
110	65.0
130	71.5
150	80.0
160	85.5
165	90.0
169 mpt.	100.0

(Menschutkin, Z. anorg. 1909, 61, 106.)

Solubility of  $\text{MgBr}_2$  in acetanilide.  
 $\text{MgBr}_2$  forms with acetanilide a complex,  
 $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$  in  
 $\text{CH}_3\text{CONHC}_6\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$
107.5	9.0
140	19.3
170	29.6
185	39.0
195	49.0
200	59.5
205	73.2
209 mpt.	100.0

(Menschutkin, Z. anorg. 1909, 61, 109.)

Solubility of  $\text{MgBr}_2$  in aniline.

$\text{MgBr}_2$  forms with aniline three complexes;  $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$ ;  $\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$ ;  $\text{MgBr}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$ .

Solubility of these complexes in aniline.

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$  in  $\text{C}_6\text{H}_5\text{NH}_2$

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$
10	3 2
30	3 9
50	5 1
70	7 5
90	12 8
100	18 5
103 5	27 5

Solubility of  $\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$  in  $\text{C}_6\text{H}_5\text{NH}_2$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$
103 1	24 0
120 1	24 3
140	24 9
160	26 0
180	28 3
200	33 5
220	45 0
230	55 0
237	76 3

Solubility of  $\text{MgBr}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$  in  $\text{C}_6\text{H}_5\text{NH}_2$

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$
237	76 3
250	77 3
260	78 1
270	79 0

(Menschutkin, Z. anorg. 1907, 52, 159.)

Solubility of  $\text{MgBr}_2$  in benzaldehyde.

$\text{MgBr}_2$  forms with benzaldehyde a complex,  $\text{MgBr}_2 \cdot 3\text{C}_6\text{H}_5\text{CHO}$ .

Solubility of  $\text{MgBr}_2 \cdot 3\text{C}_6\text{H}_5\text{CHO}$  in  $\text{C}_6\text{H}_5\text{CHO}$  at  $t^\circ$ .

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 3\text{C}_6\text{H}_5\text{CHO}$	$t^\circ$	% by wt $\text{MgBr}_2 \cdot 3\text{C}_6\text{H}_5\text{CHO}$
0	0 7	140	17 8
30	1 3	145	37 5
60	1 9	146	65 0
80	2 5	148	84 5
100	3 4	153	93 2
120	6 0	159 mpt.	100
130	9 5		

(Menschutkin, Z. anorg. 1907, 53, 26.)

Solubility of  $\text{MgBr}_2$  in methylal.

$\text{MgBr}_2$  forms with methylal a complex,  $\text{MgBr}_2 \cdot 2\text{CH}_2(\text{OCH}_3)_2$ .

Solubility of  $\text{MgBr}_2 \cdot 2\text{CH}_2(\text{OCH}_3)_2$  in  $\text{CH}_2(\text{OCH}_3)_2$  at  $t^\circ$ .

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 2\text{CH}_2(\text{OCH}_3)_2$
20	0 3
40	0 45
60	0 6
80	0 75
100	0 9
106	1 1
106	86 2
108	90 8
110	95 4
112 mpt.	100

(Menschutkin, Z. anorg. 1907, 53, 32.)

Solubility of  $\text{MgBr}_2$  in dimethylecarbinol.

$\text{MgBr}_2$  forms with dimethylecarbinol a complex,  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$ .

Solubility of  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$  in  $(\text{CH}_3)_2\text{CHOH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$
0	40 0	110	62 5
20	42 2	120	67 3
40	45 0	130	74 0
60	48 5	136	83 6
80	53 3	138	90 00
100	59 0	139 mpt.	100

(Menschutkin.)

Solubility of  $\text{MgBr}_2$  in trimethylecarbinol

$\text{MgBr}_2$  forms with trimethylecarbinol a complex,  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$

Solubility of  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$  in  $(\text{CH}_3)_3\text{COH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$
24 4	0 06	65	50 5
25	1 0	70	62 5
35	9 5	75	77 0
45	19 1	77 5	85 0
55	32 2	79	91 5
60	40 5	80 mpt.	100

(Menschutkin.)

Solubility of  $\text{MgBr}_2$  in phenylhydrazine.

$\text{MgBr}_2$  forms with  $\text{C}_6\text{H}_5\text{NHNH}_2$  a complex,  $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NHNH}_2$ .

Solubility of $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NHNH}_2$ in $\text{C}_6\text{H}_5\text{NHNH}_2$ at $t^\circ$	
$t^\circ$	% by wt. of $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NHNH}_2$
20	3.0
40	7.0
60	16.1
80	33.0
90	54.8
100	54.8
140	60.8
180	68.4
200	73.4

(Menschutkin, Z. anorg. 1907, 62, 102.)

Solubility of  $\text{MgBr}_2$  in urea. $\text{MgBr}_2$  forms with urea a complex,  $\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$ .Solubility of  $\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$  in urea at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$
108.5	24.2
115	29.8
120	35.0
125	41.0
127	45.5
130	60.0

(Menschutkin, Z. anorg. 1909, 61, 116.)

 $\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$  decomposes at  $130^\circ$  giving  $\text{MgBr}_2$  and  $4\text{CO}(\text{NH}_2)_2$ .Solubility of  $\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$  in urea at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$
130	58.0
145	60.7
160	67.2
165	71.4
170	83.7
171	96.0

(Menschutkin, Z. anorg. 1909, 61, 116.)

Solubility of  $\text{MgBr}_2$  in urethane. $\text{MgBr}_2$  forms with urethane a complex,  $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$ .Solubility of  $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$  in  $\text{NH}_2\text{COOC}_2\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$
35	43.3
50	45.6
70	51.3
80	56.2
85	59.8
90	66.5
*91.5	75.5

\* Mpt. of  $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$ .

(Menschutkin, Z. anorg. 1909, 61, 113.)

 $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$  decomposes at  $90.5-91^\circ$  forming  $\text{MgBr}_2$  and  $4\text{NH}_2\text{COOC}_2\text{H}_5$ .Solubility of  $\text{MgBr}_2 \cdot 4\text{NH}_2\text{COOC}_2\text{H}_5$  in  $\text{NH}_2\text{COOC}_2\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 4\text{NH}_2\text{COOC}_2\text{H}_5$
91	69.4
100	73.8
110	80.0
115	84.1
120	90.0
123 mpt	100.0

(Menschutkin.)

 $+6\text{H}_2\text{O}$ Solubility of  $\text{MgBr}_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 + 6\text{H}_2\text{O}$	$t^\circ$	% by weight of $\text{MgBr}_2 + 6\text{H}_2\text{O}$
0	76.0	120	89.0
20	78.1	140	92.0
40	80.2	160	94.9
60	82.3	160	98.0
80	84.4	164 mpt.	100
100	86.6		

(Menschutkin, Z. anorg. 1907, 62, 153.)

Sp. gr. of solution sat. at  $18^\circ = 1.655$ , and contains 60.8%  $\text{MgBr}_2$  (Mylius and Funk, B. 1897, 30, 1718.)Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

Sol. in alcohol. Sol. in acetone. (Naumann, B. 1904, 37, 4328; Erdmann, C. C. 1899, II, 1014.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

 $+10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Panfiloff, Chem. Soc. 26, 234.)**Magnesium manganous bromide,  $\text{MgBr}_2 \cdot 2\text{MnBr}_2 + 12\text{H}_2\text{O}$ .**

Deliquescent. (Saunders, Am. Ch. J. 14, 150.)

**Magnesium mercuric bromide,  $\text{MgBr}_2 \cdot \text{HgBr}_2$ .**

Deliquescent.

 $\text{MgBr}_2 \cdot 2\text{HgBr}_2$ . Not deliquescent.**Magnesium molybdenyl bromide,  $\text{MgBr}_2 \cdot \text{MoOBr}_3 + 7\text{H}_2\text{O}$ .**

(Weinland and Knoll, Z. anorg. 1905, 44, 112.)

**Magnesium potassium bromide,  $\text{MgBr}_2 \cdot 2\text{KBr} + 6\text{H}_2\text{O}$ .**Easily sol. in  $\text{H}_2\text{O}$ , from which  $\text{KBr}$  crystallizes at  $75$  to  $87^\circ$ . Alcohol dissolves out  $\text{MgBr}_2$ . (Lowig, Repert. 29, 261.)

Formula is  $\text{MgBr}_2$ ,  $\text{KBr} + 6\text{H}_2\text{O}$ . Deliquescent. (Lorch, J. pr. (2) 28, 338.)

Magnesium stannic bromide.

See Bromostannate, magnesium.

Magnesium chloride,  $\text{MgCl}_2$

Deliquescent. Very sol in  $\text{H}_2\text{O}$  with evolution of heat. The solution decomposes on evaporation losing  $\text{HCl}$ , when less than 6 mols.  $\text{H}_2\text{O}$  are present to 1 mol.  $\text{MgCl}_2$  (Cassene, C. R. 37, 350.)

Anhydrous. Sol in 1.857 pts  $\text{H}_2\text{O}$  at  $15^\circ$ . (Gerlach.)

Sol in 1 pt. cold  $\text{H}_2\text{O}$ . (Fourcroy)  
Sat.  $\text{MgCl}_2 + \text{Aq}$  at  $12.5^\circ$  contains 64.8%  $\text{MgCl}_2$  (Hassenzahl)  
100 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 200 pts  $\text{MgCl}_2$  (Ure's Diet)

100 pts.  $\text{H}_2\text{O}$  dissolve 52.2 pts.  $\text{MgCl}_2$  at  $0^\circ$  and sp. gr. of sat. solution = 1.3019 at  $15^\circ$ . (Engel, Bull. Soc. (2) 47, 318.)

1000 mols.  $\text{H}_2\text{O}$  dissolve 103 mols  $\text{MgCl}_2$  at  $25^\circ\text{C}$ . (Lowenherz, Z. phys. Ch. 1894, 13, 479.)

100 mols.  $\text{MgCl}_2 + \text{Aq}$  contain at  $t^\circ$ .

$t^\circ$  67.5 68.5 68.7 79.5 79.95  
Mol.  $\text{MgCl}_2$  11.53 11.92 11.71 12.28 12.39

$t^\circ$  116.67 152.6 181-2 186  
Mol.  $\text{MgCl}_2$  16.2 18.24 23.8 24.1-24.4  
(Vant Hoff and Meyerhoffer, B. A. B. 1897, 73.)

Solubility of  $\text{MgCl}_2$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	$\text{MgCl}_2$	Solid phase
-10	11.4	Ice
-20	16.	"
-30	19.4	"
-33.6	20.6	Ice + $\text{MgCl}_2 \cdot 12\text{H}_2\text{O}$
-20	26.7	$\text{MgCl}_2 \cdot 12\text{H}_2\text{O}$
-18.4	30.5	"
-16.8	31.6	$\text{MgCl}_2 \cdot 12\text{H}_2\text{O} + \text{MgCl}_2 \cdot 8\text{H}_2\text{O}$
-3.4	34.3	$\text{MgCl}_2 \cdot 8\text{H}_2\text{O} + \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
0	34.6	"
10	34.9	"
20	35.3	"
22	35.6	"
40	36.5	"
60	37.9	"
80	39.8	"
100	42.2	"
116.7	46.1	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O} + \text{MgCl}_2 \cdot 4\text{H}_2\text{O}$
152.6	49.1	$\text{MgCl}_2 \cdot 4\text{H}_2\text{O}$
181.5	55.8	$\text{MgCl}_2 \cdot 4\text{H}_2\text{O} + \text{MgCl}_2 \cdot 2\text{H}_2\text{O}$
186	56.1	$\text{MgCl}_2 \cdot 2\text{H}_2\text{O}$

(Landolt-Bornstein, Tab. 5th Ed. 1912. 480.)

See also  $\text{MgCl}_2 + 6\text{H}_2\text{O}$ .

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $15^\circ$ .

$\text{MgCl}_2$	Sp. gr.	$\text{MgCl}_2$	Sp. gr.	$\text{MgCl}_2$	Sp. gr.
1	1.0081	13	1.1130	25	1.2274
2	1.0169	14	1.1220	26	1.2378
3	1.0253	15	1.1311	27	1.2482
4	1.0338	16	1.1401	28	1.2586
5	1.0422	17	1.1498	29	1.2690
6	1.0510	18	1.1592	30	1.2794
7	1.0597	19	1.1686	31	1.2903
8	1.0684	20	1.1780	32	1.3012
9	1.0772	21	1.1879	33	1.3121
10	1.0859	22	1.1977	34	1.3230
11	1.0949	23	1.2076	35	1.3340
12	1.1040	24	1.2175		..

(Gerlach, Z. anal. 8. 231.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $18^\circ$ .

$\text{MgCl}_2$	Sp. gr.	$\text{MgCl}_2$	Sp. gr.	$\text{MgCl}_2$	Sp. gr.
5	1.0416	20	1.1764	34	1.3210
10	1.0359	30	1.2779		..

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $0^\circ$ .  $S$  = pts salt in 100 pts. of solution;  $S_1$  = mols salt in 100 mols. solution.

$S$	$S_1$	Sp. gr.
29.2056	7.230	1.2788
20.9293	4.762	1.1927
15.7989	3.423	1.1427
11.3249	2.355	1.1007
6.2008	1.233	1.0545

(Charpy, A. ch. (6) 29, 23.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $19.5^\circ$ .

Pts $\text{MgCl}_2$ in 100 pts $\text{H}_2\text{O}$	Sp. gr.	Pts $\text{MgCl}_2$ in 100 pts $\text{H}_2\text{O}$	Sp. gr.
10.7	1.0826	35.3	1.2388
22.0	1.1692	51.5	1.3235

(Kremers, Pogg. 104. 155.)

Sp. gr of  $\text{MgCl}_2 + \text{Aq}$  at  $14^\circ$ .

$\frac{\% \text{MgCl}_2}{\% \text{H}_2\text{O}}$	Sp gr	$\frac{\% \text{MgCl}_2}{\% \text{H}_2\text{O}}$	Sp gr	$\frac{\% \text{MgCl}_2}{\% \text{H}_2\text{O}}$	Sp gr
0	0.9993	17	1.0682	34	1.1407
1	1.0033	18	1.0724	35	1.1451
2	1.0073	19	1.0765	36	1.1495
3	1.0113	20	1.0807	37	1.1540
4	1.0154	21	1.0849	38	1.1584
5	1.0194	22	1.0891	39	1.1628
6	1.0234	23	1.0933	40	1.1673
7	1.0274	24	1.0976	41	1.1718
8	1.0314	25	1.1018	42	1.1763
9	1.0355	26	1.1061	43	1.1809
10	1.0395	27	1.1103	44	1.1855
11	1.0435	28	1.1146	45	1.1901
12	1.0476	29	1.1189	46	1.1948
13	1.0517	30	1.1232	47	1.1995
14	1.0558	31	1.1275	48	1.2042
15	1.0599	32	1.1319		
16	1.0641	33	1.1363		

(Oudemans, Z. anal. 7. 420.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $24^\circ$ .

$\frac{\% \text{MgCl}_2}{\% \text{H}_2\text{O}}$	Sp gr	$\frac{\% \text{MgCl}_2}{\% \text{H}_2\text{O}}$	Sp gr	$\frac{\% \text{MgCl}_2}{\% \text{H}_2\text{O}}$	Sp gr
2	1.0069	30	1.1062	53	1.2167
4	1.0138	32	1.1137	60	1.2252
6	1.0207	34	1.1212	62	1.2338
8	1.0276	36	1.1288	64	1.2425
10	1.0345	38	1.1364	66	1.2513
12	1.0415	40	1.1441	68	1.2602
14	1.0485	42	1.1519	70	1.2692
16	1.0556	44	1.1598	72	1.2783
18	1.0627	46	1.1677	74	1.2875
20	1.0698	48	1.1756	76	1.2968
22	1.0770	50	1.1836	78	1.3063
24	1.0842	52	1.1918	80	1.3159
26	1.0915	54	1.2000		
28	1.0988	56	1.2083		

(Gerlach, Z. anal. 8. 283. Calculated from Schuff.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{MnCl}_2 + \text{Aq}$ .	Sp. gr.
1-normal	1.1375
$\frac{1}{2}$ "	1.0188
$\frac{1}{4}$ "	1.0091
$\frac{1}{8}$ "	1.0043

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$ .

$\frac{1}{2} \text{MgCl}_2 \text{ g in 1000 g of solution}$	Sp gr $10^\circ/10^\circ$
0	1.000000
0.4400	1.000372
0.8801	1.000741
1.7780	1.001458
3.4533	1.002888
7.4691	1.006219
14.7187	1.012235
29.6307	1.024647

(Dijken, Z. phys. Ch. 1897, 24. 108.)

Sp. gr. of  $\text{MgCl}_2$  at  $20^\circ$ .

p = per cent strength of solution; d = observed density; w = volume conc. in grams per cc.  $\left(\frac{\text{pd}}{100} = w\right)$

p	d	w
28.83	1.2500	0.36237
25.59	1.2241	0.31327
20.31	1.1735	0.23842
15.79	1.1324	0.17877
10.185	1.0833	0.11033
8.058	1.0650	0.08583
5.919	1.0473	0.06198
3.913	1.0304	0.04022
3.903	1.0240	0.03210
1.743	1.0126	0.01765

(Barnes, J. Phys. Chem. 1898, 2. 546.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	Concentration of $\text{MgCl}_2 + \text{Aq}$	Sp. gr.
23	1 pt. $\text{MgCl}_2$ in 8.1874 pts. $\text{H}_2\text{O}$	1.0906
24	1 pt. " " 102.1 " "	1.0065

(Hittorf, Z. phys. Ch. 1902, 39. 628.)

Sp. gr. of  $\text{MgCl}_2$  at  $0^\circ$ .

G.  $\text{MgCl}_2$  in 100 ccm. of solution 6.7158 9.9506  
Sp. gr. 1.0591 1.0845

G.  $\text{MgCl}_2$  in 100 ccm. of sol. 13.8111 20.004  
Sp. gr. 1.1106 1.1605

(Bremer, C. C. 1902, I. 293.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $20^\circ$  containing M g. mois.  $\text{MgCl}_2$  per l.

M 0.00493 0.007327 0.01 0.03104  
Sp. gr. 1.000344 1.000524 1.000842 1.002756

M 0.05108 0.07171 0.10 0.25  
Sp. gr. 1.004224 1.006036 1.008505 1.020966

M 0.50 0.75 0.9415  
Sp. gr. 1.038496 1.056905 1.069617

(Jones and Pearce, Am. Ch. J. 1907, 38. 699.)

MgCl<sub>2</sub>+Aq containing 10% MgCl<sub>2</sub> boils at 101.6°; containing 20% MgCl<sub>2</sub> boils at 106.2°; containing 30% MgCl<sub>2</sub> boils at 115.6°. (Gerlach.)

Sat. MgCl<sub>2</sub>+Aq forms a crust at 122.5°, and contains 52.9 pts. MgCl<sub>2</sub> to 100 pts H<sub>2</sub>O. (Gerlach, Z. anal. 26. 426.)

B.-pt. of MgCl<sub>2</sub>+Aq. P=pts. MgCl<sub>2</sub> to 100 pts H<sub>2</sub>O.

B-pt	P	B-pt.	P	B-pt	P
101°	4 9	111°	34 6	121°	50 8
102	9 2	112	36 6	122	52 2
103	13 2	113	38 4	123	53 6
104	16 7	114	40 2	124	55 0
105	19 9	115	41 8	125	56 4
106	22 5	116	43 4	126	57 7
107	25.0	117	44 9	127	59 0
108	27.5	118	46.4	128	60 3
109	29.9	119	47.9	129	61 6
110	32 8	120	49 4	130	62 9

(Gerlach, Z. anal. 26. 440.)

B.-pt. of MgCl<sub>2</sub>+Aq containing % MgCl<sub>2</sub>.

% MgCl <sub>2</sub>	B-pt	% MgCl <sub>2</sub>	B-pt
4 6	101°	11.6	103°
8 4	102	14.3	104

(Skinner, Chem. Soc. 61. 341.)

Sol. in KCl+Aq at 50°. (Uhlrig, C. C. 1913, II. 749.)

Sol. in 7 pts alcohol at 15° (Bergmann)  
moderate heat (B)

100 pts alcohol of given sp gr dissolve pts. MgCl<sub>2</sub>

Sp. gr	Pts MgCl <sub>2</sub>	Sp gr.	Pts. MgCl <sub>2</sub>
0.900	21 25	0.844	36 25
0.848	23 75	0.817	50 00

(Kurwan)

MgCl<sub>2</sub>+6H<sub>2</sub>O is sol in 5 pts alcohol of 0.90 sp gr and in 2 pts alcohol of 0.817 sp gr

Sol in 0.1825 pt strong alcohol at 52° (Wenzel.)

B.-pt. of an alcoholic solution of MgCl<sub>2</sub>.

% MgCl <sub>2</sub>	B.-pt.
5.56	78 43° +0.73°
8 53	" +1 34
9 62	" +1 77
13.84	" +3.54

(Skinner, Chem. Soc. 61. 341.)

Even more sol. in acetic ether than CaCl<sub>2</sub>. (Cann, C. R. 102. 363.)

Sol. in boiling amyl alcohol. (Riggs, Sill. Am. J. 144. 103.)

Sol. in anhydrous pyridine Sol. in 97%, 95% and 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

Insol. in CS<sub>2</sub>. (Arcetowski, Z. anorg. 1894, 6. 257.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+2H<sub>2</sub>O. Very deliquescent (Ditte, A. ch. 1881, (5) 22. 560.)

+4H<sub>2</sub>O. (van't Hoff and Meyerhoffer.)

+6H<sub>2</sub>O. Deliquescent. Sol. in 0.6 pt. cold, and 0.273 pt. hot H<sub>2</sub>O. (Caesarea, l. c.)

Solubility in H<sub>2</sub>O at t°.

t°	1000 mols H <sub>2</sub> O dissolve mols MgCl <sub>2</sub>	100 g. H <sub>2</sub> O dissolve g. MgCl <sub>2</sub>
3 5	99 6	52.65
25 0	104 5	55.26
50.0	110.6	58 66

(Biltz and Marcus, Z. anorg. 1911, 71. 169.)

Solubility in KCl+NH<sub>4</sub>Cl+Aq at 25° has been studied. (Biltz and Marcus, Z. anorg. 1911, 71. 178.)

When the solid phases are MgSO<sub>4</sub>+6H<sub>2</sub>O and MgCl<sub>2</sub>+6H<sub>2</sub>O, 1000 mols H<sub>2</sub>O dissolve 104 mols. MgCl<sub>2</sub> and 14 mols. MgSO<sub>4</sub> at 25°. (Löwenherz, Z. phys. Ch. 1894, 13. 480.)

Solubility of MgCl<sub>2</sub>+6H<sub>2</sub>O in (NH<sub>4</sub>)MgCl<sub>2</sub>+6H<sub>2</sub>O+Aq at t°.

t°	Per 1000 mols H <sub>2</sub> O	
	Mols NH <sub>4</sub> Cl	Mols MgCl <sub>2</sub>
3.5	0 5	99.5
25.0	0 5	103.8
50.0	0.8	111.2

(Biltz and Marcus, Z. anorg. 1911, 71. 170.)

Solubility data of MgCl<sub>2</sub>+KCl+MgKCl<sub>3</sub> are given by van't Hoff and Meyerhoffer. (Z. phys. Ch. 1899, 30. 64.)

+8H<sub>2</sub>O. Pptd. from an aqueous solution which contains about 10 mols. H<sub>2</sub>O to 1 mol. MgCl<sub>2</sub>.

+12H<sub>2</sub>O. Pptd. from an aq. solution which contains 1 mol. MgCl<sub>2</sub> in about 12.06 mols. of H<sub>2</sub>O. (Bogorodsky, C. C. 1899, I. 246.)

Magnesium manganous chloride, MgCl<sub>2</sub>, 2MnCl<sub>2</sub>+12H<sub>2</sub>O.

Deliquescent. Very sol. in H<sub>2</sub>O and alcohol. (Saunders, Am. Ch. J. 14. 148.)

2MgCl<sub>2</sub>, MnCl<sub>2</sub>+12H<sub>2</sub>O Ppt. Deliquesces in the air. (Gossner, C. C. 1904, I. 707.)

Magnesium mercuric chloride, MgCl<sub>2</sub>, HgCl<sub>2</sub>+6H<sub>2</sub>O.

Very deliquescent. More sol. than the following salt. (v. Bonsdorff, Pogg. 17. 133.)

MgCl<sub>2</sub>, 3HgCl<sub>2</sub>+5H<sub>2</sub>O. Sol. in H<sub>2</sub>O with-

out decomp. Easily sol. in alcohol. (v. Bonsdorff.)

**Magnesium phosphoryl chloride,  $\text{MgCl}_2\text{POCl}_2$**

Deliquescent. Sol in  $\text{H}_2\text{O}$  with evolution of heat and decomposition. Very al. sol. in warm  $\text{POCl}_3$ . (Casselmann, A. 98. 223.)

**Magnesium potassium chloride,  $\text{MgCl}_2 \cdot 2\text{KCl} + 6\text{H}_2\text{O}$**

Deliquescent, forming a solution of  $\text{MgCl}_2$ , while  $\text{KCl}$  remains undissolved. 100 pts.  $\text{H}_2\text{O}$  dissolve 64.5 pts. at  $18^\circ$ . 20 pts. salt dissolved in 80 pts.  $\text{H}_2\text{O}$  lower the temp.  $1.75^\circ$ . (Bischof.) Alcohol dissolves out  $\text{MgCl}_2$ . Decomp. into the two salts by solution in  $\text{H}_2\text{O}$ . (Marcet.)

A sat. solution in contact with solid  $\text{KCl}$  and  $\text{KCl}$ ,  $\text{MgCl}_2$ ,  $\text{H}_2\text{O}$  at  $50^\circ$  contains 79.5 mol.  $\text{MgCl}_2$  and 14.9 mol.  $\text{KCl}$  per 1000 mol.  $\text{H}_2\text{O}$ . A sat. solution in contact with solid  $\text{MgCl}_2$ ,  $6\text{H}_2\text{O}$  and  $\text{KCl}$ ,  $\text{MgCl}_2$ ,  $\text{H}_2\text{O}$  at  $50^\circ$  contains 111.9 mol.  $\text{MgCl}_2$  and 1.2 mol.  $\text{KCl}$  per 1000 mol.  $\text{H}_2\text{O}$ . (Uhlir, Chem. Soc. 1913, 104. (2) 775; C. B. Miner. 1913, 417.)

Min. *Carnallite*.

**Magnesium rubidium chloride,  $\text{MgCl}_2 \cdot \text{RbCl} + 6\text{H}_2\text{O}$**

Not decomp. by a small quantity of  $\text{H}_2\text{O}$ . (Feit and Kubiersky, Ch. Ztg. 16. 335.)

**Magnesium sodium chloride,  $\text{MgCl}_2 \cdot \text{NaCl} + 2\text{H}_2\text{O}$**

Sol. in  $\text{H}_2\text{O}$ . (Poggiale.)

**Magnesium thallie chloride,  $2\text{TlCl}_2 \cdot \text{MgCl}_2 + 6\text{H}_2\text{O}$**

Hydroscopic. Can be cryst. from  $\text{H}_2\text{O}$ . (Gewecke, A. 1909, 366. 224.)

**Magnesium stannic chloride.**

See Chlorostannate, magnesium.

**Magnesium vanadium chloride,  $\text{MgCl}_2 \cdot \text{VCl}_3 + \text{H}_2\text{O}$**

Difficultly sol. in  $\text{H}_2\text{O}$  and alcohol. (Stahler, B. 1904, 37. 4412.)

**Magnesium zinc chloride,  $\text{MgCl}_2 \cdot \text{ZnCl}_2 + 6\text{H}_2\text{O}$**

Deliquescent; sol. in  $\text{H}_2\text{O}$ . (Warner, C. N. 27. 271.)

**Magnesium chloride ammonia,  $\text{MgCl}_2 \cdot 4\text{NH}_3$**   
Easily decomp. (Clark, A. 78. 369.)

**Magnesium chloride hydroxylamine,  $\text{MgCl}_2 \cdot 2\text{NH}_2\text{OH} + 2\text{H}_2\text{O}$**

100 g. of solution in  $\text{H}_2\text{O}$  contain 44.4% at  $20^\circ$ . (Antonow, J. Russ. Phys. Chem Soc. 1905, 37. 478.)

**Magnesium fluoride,  $\text{MgF}_2$**

1 l.  $\text{H}_2\text{O}$  dissolves 76 mg.  $\text{MgF}_2$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

87 mg. are dissolved in 1 l. of sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Scarcely sol. in acids. (Gay-Lussac and Thénard.) Insol. in excess of  $\text{HF}$ . When precipitated, is sol. in aqueous solution of ammonium and magnesium salts. Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ , from which it is precipitated by alcohol.

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Min. *Sellaite*.

**Magnesium potassium fluoride,  $\text{MgF}_2 \cdot \text{KF}$**

Decomp. by  $\text{H}_2\text{SO}_4$ . (Dubon, C. R. 1895, 120. 679.)

$\text{MgF}_2$ , 2KF. Decomp. by  $\text{H}_2\text{SO}_4$ . (Dubon.)

**Magnesium sodium fluoride,  $\text{MgF}_2 \cdot \text{NaF}$**

Insol. in  $\text{H}_2\text{O}$ . (Geuther, J. B. 1865. 173.)

**Magnesium stannic fluoride.**

See Fluostannate, magnesium.

**Magnesium titanium fluoride.**

See Fluotitanate, magnesium.

**Magnesium zirconium fluoride.**

See Fluozirconate, magnesium.

**Magnesium hydrosulphide,  $\text{MgS}_2\text{H}_2$**

Known only in aqueous solution, which decomposes on warming. Solution containing 16%  $\text{MgS}_2\text{H}_2$  has sp. gr. 1.118 at  $12^\circ$ . (Divers and Shimidzu, Chem. Soc. 45. 699.)

**Magnesium hydroxide,  $\text{MgO}_2\text{H}_2$**

$\text{MgO}$  is sol. in 55,368 pts.  $\text{H}_2\text{O}$  at ordinary temp., and also at  $100^\circ$ . (Fresenius, A. 59. 117.)

$\text{MgO}$  is sol. in 5143 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  (Fyfe), in 5300 pts. at  $15.8^\circ$  (Henry, J. Pharm. 19. 2), in 7900 pts. (Kirwan), in 16,300 pts. (Dalton), in 100,000-200,000 pts. cold  $\text{H}_2\text{O}$  (Bancroft), in 39,000 pts. boiling  $\text{H}_2\text{O}$  (Fyfe, Ed. Phil. J. 5. 305.)

Calculated from electrical conductivity of  $\text{MgO}_2\text{H}_2 + \text{Aq}$ , 1 l.  $\text{H}_2\text{O}$  dissolves 9 mg.  $\text{MgO}_2\text{H}_2$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

Calculated from electrical conductivity, 1 l.  $\text{H}_2\text{O}$  dissolves 0.076 g.  $\text{MgO}_2\text{H}_2$  at  $18^\circ$ . (Dupré and Brutus, Z. angew. Ch. 1903, 16. 55.)

Presence of  $\text{CaO}_2\text{H}_2$  or  $\text{CaSO}_4$  does not decrease the solubility (Henry.) Presence of the salts of the alkali metals, especially ammonium salts, increase the solubility. Insol. in conc.  $\text{Na}_2\text{SO}_4$ ,  $\text{NaNO}_3$ ,  $\text{NaCl}$ , or  $\text{KNO}_3 + \text{Aq}$ . (Karsten.) Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , but insol. in  $\text{KOH} + \text{Aq}$ . (Odling.)

Easily sol. in acids. Sol. in an aqueous solution of sugar. Boiling alcohol dissolves traces.

Solubility of  $MgO_2H_2$  in  $NH_4Cl + Aq$  at  $29^\circ$ .

Conc of $NH_4Cl + Aq$ (Normal)	Acid required for liberating $NH_3$ in 25cc. (Normal)	Normality of		G per l	
		$MgO_2H_2$	$NH_4Cl$	$MgO_2H_2$	$NH_4Cl$
0.7	0.09835	0.156	0.388	4.55	20.86
0.466	0.1108	0.108	0.250	3.15	13.39
0.35	0.09835	0.084	0.172	2.60	9.21
0.23	0.1108	0.0598	0.106	1.80	5.67
0.17	0.1108	0.049	0.0771	1.43	4.13

(Hers and Muhs, Z. anorg. 1909, 38, 140)

Solubility of  $MgO_2H_2$  in  $NH_4NO_3 + Aq$  at  $29^\circ$ .

Conc of $NH_4NO_3 + Aq$ (Normal)	Acid required for liberating $NH_3$ in 25cc. (Normal)	Normality of		G per l	
		$MgO_2H_2$	$NH_4NO_3$	$MgO_2H_2$	$NH_4NO_3$
0.85	0.1108	0.0833	0.1834	2.43	14.60
0.175	0.1108	0.0495	0.076	1.45	6.09

(Hers and Muhs.)

Completely insol in 16%  $NaCl + Aq$  in presence of 0.8 g.  $NaOH$ . (Maigret, Bull. Soc. (3) 33, 631.)

Solubility of  $MgO_2H_2$  in  $NaCl + NaOH + Aq$ .

G. $NaCl$ per l	G $MgO$ per l of solution with added	
	0.8 g $NaOH$ per l	4.0 g $NaOH$ per l
125	0.07	0.03
140	0.045	..
160	None	None

(Maigret.)

Freshly pptd.  $Mg(OH)_2$  is sol in  $Th(NO_3)_4 + Aq$  forming a colloidal solution. (Halla, Z. anorg. 1912, 79, 262.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329; Erdmann, C. C. 1899, II, 1014.)

See also Magnesium oxide.

Min. Brucite. Sol. in cold citric acid +  $Aq$  (Bolton, C. N. 37, 14.)

$2MgO, 3H_2O$ . (Bender, B. 3, 932.)

Magnesium iodide,  $MgI_2$ .

Very deliquescent.

Solubility in  $H_2O$ . See  $MgI_2 + 6$ , and  $8H_2O$ .

Sp. gr. of  $MgI_2 + Aq$  at  $19.5^\circ$  containing:

5	10	15	20	25	30%	MgI <sub>2</sub>
1.043	1.088	1.139	1.194	1.254	1.32	
35	40	45	50	55	60%	MgI <sub>2</sub>
1.395	1.474	1.568	1.668	1.78	1.915	

(Kremers, Pogg. 111, 62, calculated by Gerlach, Z. anal. 8, 285.)

$MgI_2 + Aq$  decomp. slightly on evaporation.

Very sol in liquid  $NH_3$ . (Franklin, Am Ch. J. 1898, 20, 828.)

Sol. in alcohol, ether, and wood-spirit.

Solubility of  $MgI_2$  in alcohols.

$MgI_2$  forms with methyl alcohol a complex,  $MgI_2, 6CH_3OH$ .

Solubility of  $MgI_2, 6CH_3OH$  in  $CH_3OH$  at  $t^\circ$ .

$t^\circ$	% by weight of $MgI_2, CH_3OH$	$t^\circ$	% by weight of $MgI_2, 6CH_3OH$
0	49.6	120	66.2
20	52.6	140	69.5
40	55.3	160	73.2
60	58.0	180	77.1
80	60.6	200	81.5
100	63.3		

(Menschutkin, Z. anorg. 1907, 52, 15.)

$MgI_2$  forms with ethyl alcohol a complex,  $MgI_2, 6C_2H_5OH$

Solubility of  $MgI_2, 6C_2H_5OH$  in  $C_2H_5OH$  at  $t^\circ$ .

$t^\circ$	% by weight of $MgI_2, 6C_2H_5OH$	$t^\circ$	% by weight of $MgI_2, 6C_2H_5OH$
0	21.9	120	82.7
20	33.2	130	87.2
40	44.4	135	90.0
60	55.3	140	93.3
80	65.5	143	96.0
100	74.7	145	98.0
110	78.8	146.5 mpt	100

(Menschutkin.)

$MgI_2$  forms with dimethylcarbinol a complex,  $MgI_2, 6(CH_3)_2CHOH$ .

Solubility of  $MgI_2, 6(CH_3)_2CHOH$  in  $(CH_3)_2CHOH$  at  $t^\circ$ .

$t^\circ$	% by weight of $MgI_2, 6(CH_3)_2CHOH$	$t^\circ$	% by weight of $MgI_2, 6(CH_3)_2CHOH$
10	57.1	110	76.2
30	60.0	120	79.4
50	63.3	130	84.8
70	67.0	136	91.7
90	71.2	138 mpt.	100

(Menschutkin)

Solubility of  $MgI_2$  in ether at  $t^\circ$ .

$t^\circ$	% $MgI_2$	% $MgI_2, 2C_4H_{10}O$
5.4	1.45	2.2
11.8	2.43	3.7
15.6	3.46	5.3
18.1	5.4	8.3
20.4	7.55	11.6
22.2	11.28	17.3

(Menschutkin, Z. anorg. 1906, 49, 41.)

t°	% MgI <sub>2</sub>	% MgI <sub>2</sub> , 2C <sub>4</sub> H <sub>10</sub> O
	in lower layer	
14 8	35 5	54 4
17 6	35 5	54 4
20	35 8	54 8
28 4	35 5	54 4
33	35 7	54 7
35	35 3	54 1
in upper layer		
18 6	13 57	20 8
23 2	14 4	22 1
24 4	14 6	22 4
32 4	15 82	24 2
in solution when two layers mix		
37 3	19 4	29 3
38 5	22 45	34 4
38 5	26 07	39 9
38 5	29 8	45 7
38 5	32 8	50 3

(Menschutkin)

Solubility of MgI<sub>2</sub> in acetic acid.MgI<sub>2</sub> forms with acetic acid a complex, MgI<sub>2</sub>, 6CH<sub>3</sub>COOH.Solubility of MgI<sub>2</sub>, 6CH<sub>3</sub>COOH in CH<sub>3</sub>COOH at t°.

t°	% by wt. MgI <sub>2</sub> , 6CH <sub>3</sub> COOH
20	0 6
40	2 0
60	5 0
70	9 5
75	13 0
80	18 5
85	27 1
95	42 0
105	54 5
115	65 0
125	73 8
135	85 0
140	94 0
142 mpt.	100 0

(Menschutkin, Z. anorg. 1907, 54. 93.)

Solubility of MgI<sub>2</sub> in acetoneMgI<sub>2</sub> forms with acetone a complex, MgI<sub>2</sub>, 6CH<sub>3</sub>COCH<sub>3</sub>.Solubility of MgI<sub>2</sub>, 6CH<sub>3</sub>COCH<sub>3</sub> in CH<sub>3</sub>COCH<sub>3</sub> at t°.

t°	% by wt MgI <sub>2</sub> , 6CH <sub>3</sub> COCH <sub>3</sub>
0	4 9
30	6 7
50	8 3
60	10 2
70	15 2
80	28 6
85	40 0
90	59 2
95	80 0
100	92 5
105	98 5
106.5 mpt.	100

(Menschutkin, Z. anorg. 1907, 53. 30)

Solubility of MgI<sub>2</sub> in acetal.MgI<sub>2</sub> forms with acetal a complex, MgI<sub>2</sub>, 2CH<sub>3</sub>CH(OC<sub>2</sub>H<sub>5</sub>)<sub>2</sub>.Solubility of MgI<sub>2</sub>, 2CH<sub>3</sub>CH(OC<sub>2</sub>H<sub>5</sub>)<sub>2</sub> in CH<sub>3</sub>CH(OC<sub>2</sub>H<sub>5</sub>)<sub>2</sub> at t°.

t°	% by wt MgI <sub>2</sub> , 2CH <sub>3</sub> CH(OC <sub>2</sub> H <sub>5</sub> ) <sub>2</sub>
20	0 15
60	0 45
77	0 6
77	92 0
79	93 7
81	95 5
83	97 3
86 mpt.	100

(Menschutkin, Z. anorg. 1907, 53. 33.)

Solubility of MgI<sub>2</sub> in acetamide.MgI<sub>2</sub> forms with acetamide a complex, MgI<sub>2</sub>, 6CH<sub>3</sub>CONH<sub>2</sub>.Solubility of MgI<sub>2</sub>, 6CH<sub>3</sub>CONH<sub>2</sub> in CH<sub>3</sub>CONH<sub>2</sub> at t°.

t°	% by wt. of MgI <sub>2</sub> , 6CH <sub>3</sub> CONH <sub>2</sub>
49	56 5
80	63 4
110	70 5
130	76 0
150	82 1
160	85 5
170	90 8
175	96 2
177 mpt.	100 0

(Menschutkin, Z. anorg. 1909, 61. 108.)

Solubility of  $MgI_2$  in acetonitrile.  
 $MgI_2$  forms with acetonitrile a complex,  
 $MgI_2 \cdot 6CH_3CN$ .

Solubility of  $MgI_2 \cdot 6CH_3CN$  in  $CH_3CN$   
 at  $t^\circ$

$t^\circ$	% by wt $MgI_2 \cdot 6CH_3CN$
0	37.2
30	49.8
50	58.2
70	67.9
80	76.5
89	91.3

(Menschutkin, Z. anorg. 1909, 61. 110.)

Solubility of  $MgI_2$  in benzaldehyde.  
 $MgI_2$  forms with benzaldehyde a complex,  
 $MgI_2 \cdot 6C_6H_5CHO$

Solubility of  $MgI_2 \cdot 6C_6H_5CHO$  in  $C_6H_5CHO$   
 at  $t^\circ$

$t^\circ$	% by wt. $MgI_2 \cdot 6C_6H_5CHO$
0	3.2
20	3.8
40	5.3
60	7.7
80	11.0
100	18.5
110	26.5
120	40.0
125	53.0
130	74.5
133	86.0
136	94.2
139 mpt.	100

(Menschutkin, Z. anorg. 1907, 53. 28.)

Solubility of  $MgI_2$  in methyl acetate.  
 $MgI_2$  forms with methyl acetate a complex,  
 $MgI_2 \cdot 6CH_3COOCH_3$ .

Solubility of  $MgI_2 \cdot 6CH_3COOCH_3$  in  
 $CH_3COOCH_3$  at  $t^\circ$

$t^\circ$	% by wt. $MgI_2 \cdot 6CH_3COOCH_3$
0	0.4
30	0.55
60	0.75
90	0.9
100	1.8
103	2.4
103	74.2
110	81.7
120	98.0
121 mpt.	100.0

(Menschutkin, Z. anorg. 1909, 61. 101.)

Solubility of  $MgI_2$  in methyl acetate.  
 $MgI_2$  forms with ethyl acetate a complex,  
 $MgI_2 \cdot 6CH_3COOC_2H_5$

Solubility of  $MgI_2 \cdot 6CH_3COOC_2H_5$  in  
 $CH_3COOC_2H_5$  at  $t^\circ$

$t^\circ$	% by wt $MgI_2 \cdot 6CH_3COOC_2H_5$
0	3.2
20	4.8
40	8.6
50	13.7
55	21.5
60	33.0
65	63.5
70	90.5
75	97.7
78.5 mpt	100.0

(Menschutkin.)

Solubility of  $MgI_2$  in ethyl formate.  
 $MgI_2$  forms with ethyl formate a complex,  
 $MgI_2 \cdot 6HCOOC_2H_5$ .

Solubility of  $MgI_2 \cdot 6HCOOC_2H_5$  in  
 $HCOOC_2H_5$  at  $t^\circ$

$t^\circ$	% by wt $MgI_2 \cdot 6HCOOC_2H_5$
0	15.1
10	17.4
20	20.5
30	25
40	31.8
50	44
60	68
70.5 mpt.	100

(Menschutkin.)

Solubility of  $MgI_2$  in isoamylacetate.  
 $MgI_2$  forms with isoamylacetate a complex,  
 $MgI_2 \cdot 6CH_3COO(iso)C_4H_{11}$

Solubility of  $MgI_2 \cdot 6CH_3COO(iso)C_4H_{11}$  in  
 $CH_3COO(iso)C_4H_{11}$  at  $t^\circ$

$t^\circ$	% by wt $MgI_2 \cdot 6CH_3COO(iso)C_4H_{11}$
0	7.7
20	11.5
40	20.9
45	25.5
50	33.2
55	47.8
57.5	63.0
60 mpt.	100.0

(Menschutkin.)

Solubility of  $MgI_2$  in isobutyl acetate.  
 $MgI_2$  forms with isobutylacetate a complex,  
 $MgI_2 \cdot 6CH_3COOC_4H_9$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$  in  $\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$ .

$t^\circ$	% by wt. $\text{MgI}_2$ $6\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$
0	10.5
20	13.6
40	17.6
50	20.4
60	24.9
70	33.7
75	40.5
80	52.0
85	89.0
87.5 mpt	100.0

(Menschutkin.)

Solubility of  $\text{MgI}_2$  in propyl acetate.

$\text{MgI}_2$  forms with propyl acetate a complex,  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_3\text{H}_7$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_3\text{H}_7$  in  $\text{CH}_3\text{COOC}_3\text{H}_7$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgI}_2$ $6\text{CH}_3\text{COOC}_3\text{H}_7$
0	4.1
20	5.4
30	6.5
35	7.8
40	19.0
45	46.0
50	72.5
55	88.2
60	96.0
65 mpt.	100.0

(Menschutkin.)

Solubility of  $\text{MgI}_2$  in urethane.

$\text{MgI}_2$  forms with urethane a complex,  $\text{MgI}_2 \cdot 6\text{NH}_4\text{COOC}_2\text{H}_5$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{NH}_4\text{COOC}_2\text{H}_5$  in  $\text{NH}_4\text{COOC}_2\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgI}_2$ $6\text{NH}_4\text{COOC}_2\text{H}_5$
32	51.8
50	59.4
70	70.7
80	78.8
84	85.0
87 mpt.	100.0

(Menschutkin.)

+6H<sub>2</sub>O.

Solubility of  $\text{MgI}_2 \cdot 6\text{H}_2\text{O}$  in H<sub>2</sub>O at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgI}_2 \cdot 6\text{H}_2\text{O}$	$t^\circ$	% by weight of $\text{MgI}_2 \cdot 6\text{H}_2\text{O}$
43°	89.8	160°	91.7
80°	90.3	200°	93.4
120°	90.9	215°	94.3

(Menschutkin, Z. anorg. 1907, 52. 156.)

+8H<sub>2</sub>O Sp gr of solution of  $\text{MgI}_2 \cdot 8\text{H}_2\text{O}$  sat. at 18° containing 59.7%  $\text{MgI}_2 = 1.909$ . (Mylhus, B. 1897, 30. 1718.)

Solubility of  $\text{MgI}_2 \cdot 8\text{H}_2\text{O}$  in H<sub>2</sub>O at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgI}_2 \cdot 8\text{H}_2\text{O}$
0	76.0
20	81.0
40	88.0
43.5	90.8

(Menschutkin.)

+10H<sub>2</sub>O Sol. in H<sub>2</sub>O. (Panfiloff, C. C. 1894, II. 610.)

Magnesium mercuric iodide,  $\text{MgI}_2$ ,  $\text{HgI}_2$ .

Known only in solution.

+9H<sub>2</sub>O. Very deliquescent. (Duboin, C. R. 1906, 142. 1338.)

Very sol. in ethyl, methyl, propyl, butyl, isobutyl, amyl, isopropyl and allyl alcohols, ethyl, amyl, propyl and isobutyl acetates, ethyl cyanide and acetone. Sol. in benzyl alcohol. Decomp. by glycerine. Sl. sol. in ethyl benzoate, amyl benzoate, nitrobenzene. Decomp. by ethyl ovalate. Insol. in toluene, benzene, ethyl iodide,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethylene bromide, monochloro and monobromobenzene. (Duboin, A. ch 1909, (8) 16. 276.)

$\text{MgI}_2 \cdot 2\text{HgI}_2$ . Decomp. by H<sub>2</sub>O into  $\text{HgI}_2$  and above compound, which remains in solution. (Boullay.)

+7H<sub>2</sub>O. Sat. solution in H<sub>2</sub>O at 17.8° has the composition  $\text{MgI}_2$ , 1.29  $\text{HgI}_2$ , 11.06 H<sub>2</sub>O. (Duboin, C. R. 1906, 142. 1338.)

Magnesium potassium iodide,  $\text{MgI}_2$ ,  $\text{KI} + 6\text{H}_2\text{O}$ .

Deliquescent. (Lerch, J. pr. (2) 28. 338.)

Very hygroscopic. (de Schulten, Bull. Soc 1900 (3) 23. 158.)

Magnesium iodide ammonia,  $\text{MgI}_2$ ,  $6\text{NH}_3$ .

Practically insol. in liquid  $\text{NH}_3$ . (Franklin, J. Am. Chem. Soc. 1913, 35. 1459.)

Magnesium nitride,  $\text{Mg}_3\text{N}_2$ .

Decomp. by moist air or H<sub>2</sub>O. Sol. in dil. or conc.  $\text{HCl} + \text{Ag}$ , or  $\text{HNO}_3 + \text{Ag}$ . Sol. in warm  $\text{H}_2\text{SO}_4$ . Insol. in alcohol, ethyl iodide, or phosphorus oxychloride. (Briegleb and Geuther, A. 123. 236.)

Decomp. by H<sub>2</sub>O. (Smits, R. t. c. 1894, 12. 198.)

Easily decomp. H<sub>2</sub>O when finely powdered. (Rossel, C. R. 1895, 121. 942.)

Magnesium suboxide (?).

Decomp. H<sub>2</sub>O. Sol. in dil. acids. (Beetz, Pogg. 127. 45.)

Magnesium oxide,  $\text{MgO}$ .

Sol. in 50,000-100,000 pts H<sub>2</sub>O (Bunsen, C. R. 41. 510), in 55,308 pts. cold or hot H<sub>2</sub>O (Fresenius, A. 59. 123), in 100,000-200,000 pts H<sub>2</sub>O (Bunsen), in 18,000 pts H<sub>2</sub>O at ord temp (Dalton); in 7900 pts H<sub>2</sub>O at ord temp (Kewenau), in 5760 pts H<sub>2</sub>O at 15.5°, and 36,000 pts. at 100° (Fyfe)

Calc. from electrical conductivity of MgO + Aq. 1 pt. MgO is sol. in 172,000 pts. H<sub>2</sub>O at 18°. (Dupré, *Zet. angew. Ch.* 1903, 16, 55.) "Heavy" MgO is more sol. in H<sub>2</sub>O than "light" MgO. The temp. of preparation affects the rate of solution, the rate being diminished as the temp. of preparation is increased (Anderson, *Chem. Soc.* 1905, 87, 265.)

Easily sol. in acids, even in H<sub>2</sub>SO<sub>4</sub> + Aq.

Solubility in P<sub>2</sub>O<sub>5</sub> + Aq at 25°.

Composition of the solution		Sp. gr. 25°/25°	Solid phase
G MgO per l	G P <sub>2</sub> O <sub>5</sub> per l		
0 207	0 486		
0 280	0 732		
0 553	1 917		
1 438	4 85		
2 23	7 35	1 006	
4 73	16 84	1 017	
11 19	38 59	1 042	
17 33	61 21	1 069	
26 09	93 09	1 109	
37 40	130 7	1 144	
75 5	261 8	1 285	
109 5	439 0		
122 6	498 4	1 470	
129 9	546 5	..	
140 0	584 0		
146 8	623 3	1 595	
147 3	625 9		
150 3	645 8		
155 5	680 7		
87 1	779 6	1 626	
77 1	809 6	1 644	
70 6	835 1	1 654	

(Cameron, *J. phys. Chem.* 1907, 11, 364.)

Sol. in NH<sub>4</sub> salts, NaCl, or KCl + Aq. (Fiesenius)

Solubility in MgCl<sub>2</sub> + Aq at 25°.

% MgCl <sub>2</sub>	% MgO as Mg(OH) <sub>2</sub>
2 36	0 0008
4 47	0 00028
6 79	0 00048
9 02	0 00080
13 14	0 00115
15 15	0 00195
17 53	0 00240
18 52	0 00250
22 04	0 00245
23 78	0 00235
26 13	0 00230
26 88	0 00250
28 34	0 00230
29 80	0 00240
30 04	0 00250
34 22	0 0030

(Robinson, *J. phys. Chem.* 1909, 13, 676.)

More sol. in K<sub>2</sub>SO<sub>4</sub> and Na<sub>2</sub>SO<sub>4</sub> + Aq than in H<sub>2</sub>O (Warrington.)

Insol. in liq. NH<sub>3</sub>. (Franklin, *Am. Ch. J.* 1898, 20, 828.)

Sol. in methyl alcohol to form a colloidal solution containing 1.6% MgO. (Neuberg and Rewald (*Biochem. Z.* 1908, 9, 547.)

Insol. in methyl acetate (Naumann, *B.* 1909, 42, 3790); ethyl acetate. (Naumann, *B.* 1904, 37, 3602.)

Insol. in acetone. (Naumann, *B.* 1904, 37, 4329.)

Insol. in acetone and in methylal. (Eidmann, *C. C.* 1899, II, 1014.)

Solubility in (calcium succinate + sugar) + Aq.

1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 0.30 g. MgO, containing 296.5 g. sugar and 24.2 g. CaO dissolves 0.24 g. MgO; containing 174.4 g. sugar and 14.1 g. CaO dissolves 0.22 g. MgO. (Bodenbender, *J. B.* 1865, 600)

See also Magnesium hydroxide.

*Min. Periclase.*

Magnesium peroxide, MgO<sub>2</sub>.

Sol in 14,550 pts. H<sub>2</sub>O at 20°. (Foregger and Philipp, *J. Soc. Chem. Ind.* 1906, 25, 298.)

5MgO, 2MgO<sub>2</sub> + 3H<sub>2</sub>O.

3MgO, 2MgO<sub>2</sub> + 3H<sub>2</sub>O.

2MgO, 2MgO<sub>2</sub> + 3H<sub>2</sub>O.

4MgO, 2MgO<sub>2</sub> + 3H<sub>2</sub>O.

Above salts are decomp. by H<sub>2</sub>O.

(Carrasco, *Gazz. ch. it.* 1909, 39, (1) 47.)

Magnesium oxybromide, MgBr<sub>2</sub>, 3MgO + 12H<sub>2</sub>O.

Decomp. in the air and also by H<sub>2</sub>O, alcohol and most reagents. (Taassily, *C. R.* 1897, 125, 607.)

Magnesium oxychloride, Mg<sub>2</sub>OCl<sub>2</sub> + 16H<sub>2</sub>O.

Easily decomp. by H<sub>2</sub>O and alcohol. (André, *A. ch.* (6) 3, 80.)

+ 6H<sub>2</sub>O. (André.)

2MgO, HCl, 5H<sub>2</sub>O or 3MgO, MgCl<sub>2</sub> + 10H<sub>2</sub>O. Solubility determinations show that this salt is the solid phase in equilibrium at 25° with solutions of MgCl<sub>2</sub> and MgO containing from 10–15% MgCl<sub>2</sub>. (Robinson, *J. phys. Chem.* 1909, 13, 677.)

Mg<sub>2</sub>O<sub>2</sub>Cl<sub>2</sub> + 6, 8, 14, or 17H<sub>2</sub>O. Decomp. by H<sub>2</sub>O, which dissolves out MgCl<sub>2</sub>. (Bender, *B.* 3, 932.)

Mg<sub>11</sub>O<sub>10</sub>Cl<sub>2</sub> + 14, or 18H<sub>2</sub>O. (Krause, *A.* 165, 38.)

Mg<sub>10</sub>O<sub>9</sub>Cl<sub>2</sub> + 24H<sub>2</sub>O = 9MgO, MgCl<sub>2</sub> + 24H<sub>2</sub>O. H<sub>2</sub>O removes all MgCl<sub>2</sub> by long digestion. (Bender, *A.* 159, 341.)

+ 10, and 15H<sub>2</sub>O. (Bender.)

Magnesium oxysulphide, Mg<sub>2</sub>OS.

(Reichel, *J. pr.* (2) 12, 55.)

**Magnesium phosphide,  $Mg_3P_2$ .**

Decomp. by  $H_2O$ , dil.  $HCl$ +Aq, or  $HNO_3$ +Aq. (Parkinson, Chem. Soc. 5. (2) 125 and 309.)

Insol. in moderately dil. cold  $HCl$ +Aq, or boiling dil.  $H_2SO_4$ +Aq. Difficultly and slowly sol. in aqua regia. (Blunt, Chem. Soc. 3. (2) 106.)

Decomp. by  $H_2O$ ,  $HCl$ , conc.  $H_2SO_4$ , and by  $HNO_3$ . (Gautier, C. R. 1899, 128. 1169.)

**Magnesium silicide,  $Mg_2Si$ .**

Slowly decomp. by warm  $H_2O$ . Slowly decomp. by cold, rapidly by hot  $NH_4Cl$ +Aq. Decomp. by cold dil.  $HCl$ +Aq. (Geuther, J. pr. 95. 425.)

$Mg_2Si$ . Decomp. by  $HCl$ +Aq with residue of  $Si$ . (Wöhler, A. 107. 113.)

Slowly decomp. by  $H_2O$  at ord. temp. Violently decomp. by  $HCl$ . (Lebeau and Bossuet, C. R. 1908, 146. 284.)

**Magnesium sulphide,  $MgS$ .**

Decomp. by  $H_2O$ . (Reichel, J. pr. (2) 12. 55.)

$Si$  sol. in  $H_2O$  with rapid decomp. (Fremy.)

Sol. in acids with decomp.

*Anhydrous. Crystalline.* Only very sl. sol. in cold  $H_2O$ . Sol. in  $HNO_3$  and  $H_2SO_4$  at ord. temp. Sol. in  $PCl_5$  and in chromyl chloride. (Mourlot, C. R. 1898, 127. 182.)

**Magnesium polysulphide,  $MgS_x$ .**

Known only in solution. (Reichel.)

**Magnus' green salt.**

See Platodiamine chloroplatinite.

**Manganese, Mn.**

Decomposes  $H_2O$  even in the cold, more rapidly when hot. (Regnault.)

Decomposes cold water violently. (Bunsen.)

Sol. in all dil. acids. Slowly sol. in cold  $H_2SO_4$ . (John.)

Insol. in cold, but rapidly sol. in hot  $H_2SO_4$ . Very easily sol. in dil.  $H_2SO_4$ , or  $HCl$ +Aq,  $HNO_3$ , or  $HCl$ + $H_2O_2$ +Aq. (Brunner.)

Pure manganese is unaltered in dry air, even when finely powdered. Slowly attacked by cold, quickly by hot  $H_2O$ . Very sl. attacked by cold  $H_2SO_4$ , rapidly on warming, rapidly attacked by cold dil.  $H_2SO_4$ +Aq; violently by conc.  $HNO_3$ +Aq; and rapidly by dil.  $HNO_3$ ,  $HCl$ ,  $HCl$ + $H_2O_2$ +Aq, and also  $NaOH$ +Aq. Sol. in  $NH_4Cl$ +Aq (Prelinger, W. A. B. 102, 2b. 359.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0276 g. Mn in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

**Manganese antimonide,  $MnSb$ .**

Sol. in hot aqua regia. (Wedekind, B. 1907, 40. 1266.)

**Manganese azoimide, basic,  $Mn(OH)N_3$ .**

Only sl. sol. in  $H_2O$  with decomp. (Curtius, J. pr. 1898, (2) 58. 293.)

**Manganese bismuthide,  $MnBi$ .**

Very sensitive towards acids with the exception of conc.  $HCl$ . (Wedekind, B. 1911, 44. 2665.)

**Manganese boride,  $MnB$ .**

Attacked by cold  $H_2O$  and by acids, (Jassoneix, C. R. 1904, 139. 1210.)

Easily attacked by  $HCl$ ,  $H_2SO_4$ , and  $HF$  with evolution of  $BH_3$ . (Wedekind, B. 1905, 38. 1231.)

$MnB_2$ . Sol. in acids, with evolution of  $H_2$ . (Troost and Hautefeuille, A. ch. (5) 9. 65.)

Slowly decomp. by  $H_2O$ . Sol. in dil.  $HCl$  and other dil. acids with evolution of  $BH_3$ . (Wedekind, B. 1905, 38. 1229.)

**Manganese bromide,  $MnBr_2$ .**

*Anhydrous.* Very deliquescent.

Sat.  $MnBr_2$ +Aq contains at:

—21° +7° 11° 18° 38° 52°  
52.1 56.5 57.0 59.1 62.7 64.2%  $MnBr_2$ ,

64° 76° 89° 97° 105°

68.2 70.1 69.7 69.2 70.2%  $MnBr_2$ .

(Etard, A. ch. 1894, (7) 2. 541.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

+ $H_2O$ . (Lescœur, A. ch. 1894, (7) 2. 104.)

+4 $H_2O$ . More deliquescent than  $MnCl_2$ .

Melts in crystal water when heated. (Berthelot.)

+6 $H_2O$ . (Kuznetsoff, C. C. 1897, II. 329.)

**Manganous mercuric bromide.**

Deliquescent.

**Manganous palladium bromide.**

See Bromopalladate, manganous.

**Manganous stannic bromide.**

See Bromostannate, manganous.

**Manganese carbide,  $MnC$ .**

(Brown, J. pr. 17. 492.)

$MnC_3$ .

$MnC_4$ . (Troost and Hautefeuille, A. ch. (5) 9. 60.)

Decomp. by  $H_2O$  and by dil. acids (Moissan, C. R. 1896, 122. 422.)

**Manganous chloride,  $MnCl_2$ .**

*Anhydrous.* Deliquescent.

100 pts. H <sub>2</sub> O at t° dissolve pts. MnCl <sub>2</sub> :			
t°	Pts MnCl <sub>2</sub>	t°	Pts MnCl <sub>2</sub>
10	62 16	87 5	122 22
31.25	85 72	106 25	123.81
62.5	122 22	...	...

or, sat. MnCl<sub>2</sub>+Aq at t° contains:

t°	% MnCl <sub>2</sub>	t°	% MnCl <sub>2</sub>
10	38 33	87 5	55 0
31.25	46 15	106 25	55 32
62.5	55 0	...	...

(Brandes, Pogg 22. 263)

See also below under +2H<sub>2</sub>O, and +4H<sub>2</sub>O.

Sp. gr. of MnCl<sub>2</sub>+Aq at 15°. a=sp. gr. if % is MnCl<sub>2</sub>; b=sp. gr. if % is MnCl<sub>2</sub>+4H<sub>2</sub>O.

%	a	b	%	a	b
5	1 045	1 0285	40	1 443	1 250
10	1 091	1 057	45	1 514	1 290
15	1 138	1 088	50	...	1 331
20	1 189	1 116	55	...	1 375
25	1 245	1 147	60	...	1 419
30	1 306	1 180	65	...	1 463
35	1 372	1 214	70	...	1 508

(Gerlach, Z. anal. 28. 476.)

Sp. gr. of MnCl<sub>2</sub>+Aq at room temp.

% MnCl <sub>2</sub>	Sp gr
8 007	1 0960
15.650	1 1963
30 330	1 3372
40 132	1 4530

(Wagner, W. Ann. 1883, 18. 273.)

Sp. gr. of MnCl<sub>2</sub>+Aq at t°.

t°	% MnCl <sub>2</sub>	Sp gr
14.5	5 0	1 0457
14 5	11 99	1 1076
14 0	14 98	1 1379
14 5	19.92	1 1891
14 0	23 10	1 2246
14.6	28 51	1 2888

(Long, W. Ann. 1880, 11. 38.)

Sp. gr. of MnCl<sub>2</sub>+Aq at 25°.

Concentration of MnCl <sub>2</sub> +Aq	Sp gr
1-normal	1 0513
1/2-	1 0259
1/4-	1 0125
1/8-	1 0063

(Wagner, Z. phys. Ch 1890, 5. 38.)

Solubility of MnCl<sub>2</sub>+KCl in H<sub>2</sub>O at t°.

t°	% MnCl <sub>2</sub>	% KCl	Solid phase
6	40 23 35 94 .	9 41 23 06	MnCl <sub>2</sub> , 4H <sub>2</sub> O MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O+KCl KCl
28 4	44 46 43 28 38.65 .	8.66 13.79 26 91	MnCl <sub>2</sub> , 4H <sub>2</sub> O MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O+KCl KCl
52 8	50 14	6.01	MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , 2H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O
62.6	51 86 49.95 44.05 36 85	6.67 12.49 18.77 31 57	MnCl <sub>2</sub> , 2H <sub>2</sub> O MnCl <sub>2</sub> , 2H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O+MnCl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O MnCl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O+MnCl <sub>2</sub> , 4KCl - KCl

(Suss, Z. Kryst. Min. 1912, 51. 262.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch J. 1898, 20. 828.)

Solutions of MnCl<sub>2</sub> in 75% alcohol saturated at t° contain:

t°	% MnCl <sub>2</sub>	t°	% MnCl <sub>2</sub>
10	23 1	43 75	37 5
25	36.1	57.5 (B.-pt.)	32 2

Solutions of  $\text{MnCl}_2$  in absolute alcohol saturated at  $t^\circ$  contain:

$t^\circ$	% $\text{MnCl}_2$	$t^\circ$	% $\text{MnCl}_2$
11 25	33 3	76 25	36 2
37 5	33 3	(B.-pt.)	

(Brandes, *l. c.*)

$\text{MnCl}_2$  crystallises from above solutions on standing.

When 15–20 vols. ether are added to 1 vol. absolute alcohol sat. with  $\text{MnCl}_2$ ,  $\text{MnCl}_2$  is completely pptd. (Doberener)

Insol. in oil of turpentine.

Sol. in urethane. (Castor, *Z. anorg.* 1899, 20, 61.)

Sl. sol. in benzonitrile. (Naumann, *B.* 1914, 47, 1369.)

Difficultly sol. in methyl acetate. (Naumann, *B.* 1909, 42, 3790.)

Insol. in ethyl acetate. (Naumann, *B.* 1910, 43, 314.)

+ $\text{H}_2\text{O}$ . Solubility in  $\text{HCl} + \text{Aq}$  decreases with increasing amt. of  $\text{HCl}$ . It is greater when hot than cold, but is not inconsiderable even when  $\text{HCl}$  is conc. 1 l. conc.  $\text{HCl} + \text{Aq}$  sat. at  $12^\circ$  dissolves 190 g.  $\text{MnCl}_2$  from  $\text{MnCl}_2 + \text{H}_2\text{O}$ . (Ditte, *C. R.* 1881, 92, 243.)

+ $\frac{3}{2}\text{H}_2\text{O}$ .  $\text{MnCl}_2 + 4\text{H}_2\text{O}$  effloresces to  $\text{MnCl}_2 + \frac{3}{2}\text{H}_2\text{O}$  in a dry atmosphere and under low pressure and not to  $\text{MnCl}_2 + 2\text{H}_2\text{O}$ . (Sabatier, *Bull. Soc.* 1894, (3) 11, 547.)

+ $2\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{MnCl}_2$ per 100 pts. $\text{H}_2\text{O}$	Sp. gr. of sat. solution
60	108 6	1 6108
70	110 6	1 6134
80	112 7	

(Dawson and Williams, *Z. phys. Ch.* 1899, 31, 63.)

Sat. aqueous solution of  $\text{MnCl}_2 + 2\text{H}_2\text{O}$ . Contains 51.86%  $\text{MnCl}_2$  at  $62.6^\circ$ . (Suss, *Z. Krist.* 1912, 51, 262.)

+ $4\text{H}_2\text{O}$ . Deliquescent.

100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve:

$t^\circ$	Pts. $\text{MnCl}_2 + 4\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{MnCl}_2 + 4\text{H}_2\text{O}$
8	151	87 5	641
31.25	265	106.25	656
62.5	641		...

(Brandes, *l. c.*)

Sol. in 0.8 pt.  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Abi.)

Pptd. from solution in 9.17 mols.  $\text{H}_2\text{O}$ . (Kuznetsoff, *C. C.* 1899, I, 246.)

Sat. aq. solution contains at

$-22^\circ$	$-5^\circ$	$+7^\circ$	$17^\circ$	$19^\circ$	
34 7	37.8	40.4	41.2	42.3%	$\text{MnCl}_2$
35°	55°	57°	80°	100°	140°
44 4	48.2	50.0	51.0	53.7	54.7% $\text{MnCl}_2$

(Étard, *A. ch.* 1894, (7) 2, 537.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{MnCl}_2$ per 100 pts. $\text{H}_2\text{O}$	Sp. gr. of sat. solution
25	77 18	1 4991
30	80 71	1 5049
40	88 59	1 5348
50	98 15	1 5744
*57.65	105.40	1 6097

\* Temp. of transition into  $\text{MnCl}_2 + 2\text{H}_2\text{O}$ . (Dawson and Williams, *Z. phys. Ch.* 1899, 31, 63.)

Sat. aqueous solution of  $\text{MnCl}_2 + 4\text{H}_2\text{O}$  contains 40.23%  $\text{MnCl}_2$  at  $6^\circ$ , 44.6%  $\text{MnCl}_2$  at  $28.4^\circ$ . (Suss, *Z. Krist.* 1912, 51, 262.)

100 pts. 75% alcohol dissolve at  $t^\circ$ :

$t^\circ$	Pts. $\text{MnCl}_2 + 4\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{MnCl}_2 + 4\text{H}_2\text{O}$
10	53	43 75	144
25	132	87 5	100 1

(Brandes, *l. c.*)

Insol. in absolute ether, which also does not abstract crystal  $\text{H}_2\text{O}$ .

Insol. in boiling oil of turpentine (Brandes).

Sol. in conc.  $\text{HNO}_3 + \text{Aq}$  + $5\text{H}_2\text{O}$ . (Müller-Erbach, *B.* 1889, 22, 3181.)

+ $6\text{H}_2\text{O}$ . Pptd. from solution in 11.7 mols.  $\text{H}_2\text{O}$  at  $-21^\circ$ . (Kuznetsoff, *C. C.* 1899, I, 246.)

**Manganese trichloride,  $\text{MnCl}_3$ .**

Immediately decomp. by  $\text{H}_2\text{O}$ ; sol. in abs. ether and in abs. alcohol. (Holmes, *J. Am. Chem. Soc.* 1907, 29, 1285.)

**Manganese tetrachloride,  $\text{MnCl}_4$ .**

Has not been isolated.

Sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Nicklès, *J. B.* 1865, 225.)

Composition is  $\text{Mn}_2\text{Cl}_6$ . (Christensen, *J. pr.* (2) 34, 41.)

**Manganese hydrogen tetrachloride (chloromanganic acid),  $\text{MnCl}_4 \cdot 2\text{HCl}$ .**

Sol. in ether; decomp. by  $\text{H}_2\text{O}$ . (Franke, (2) 36, 31.)

**Manganese heptachloride,  $\text{MnCl}_7(?)$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Dumas, *Berz. J. B.* 7, 112.)

Has the formula  $\text{MnO}_2\text{Cl}$  (?) (Aschoff, J. pr. 81. 29.)

**Manganous mercuric chloride**,  $\text{MnCl}_2, \text{HgCl}_2 + 4\text{H}_2\text{O}$ .

Deliquescent in moist air. Easily sol. in  $\text{H}_2\text{O}$ . (v. Bunsdoff)  
 $\text{MnCl}_2, 2\text{HgCl}_2$ . (Varet, C. R. 1896, 123, 422.)

**Manganous potassium chloride**,  $\text{MnCl}_2, \text{KCl} + 2\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ , but is decomp. thereby. (Rensen and Saunders, Am. Ch. J. 14. 129.)

$\text{MnCl}_2, 2\text{KCl} + 2\text{H}_2\text{O}$  (Suss, Z. Kryst. 1912, 61. 262.)

**Manganic potassium chloride**,  $\text{MnCl}_3, 2\text{KCl} + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  apparently without decomp. (Rice, Chem. Soc. 1898, 73. 281.)

$\text{MnCl}_3, 2\text{KCl}$  Very easily decomp. (Meyer and Best, Z. anorg. 1899, 22. 186.)

$\text{MnCl}_3, \text{MnCl}_2, 5\text{KCl}$  Easily decomp. (Meyer and Best, Z. anorg. 1899, 22. 185.)

**Manganous rubidium chloride**,  $\text{MnCl}_2, 2\text{RbCl}$ .

(Godeffroy.)  
 $+3\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  Insol. in alcohol, conc.  $\text{HCl}$  + ppt. anhydrous salt from aqueous solution. (Godeffroy, Arch. Pharm. (3) 12. 40.)

Contains only  $2\text{H}_2\text{O}$ . (Saunders, Am. Ch. J. 14. 139.)

**Manganous thallic chloride**,  $\text{MnCl}_2, 2\text{TlCl}_3 + 8\text{H}_2\text{O}$ .

Can be cryst. from  $\text{H}_2\text{O}$ . (Gewecke, A. 1909, 366. 224.)

**Manganous stannic chloride.**

See Chlorostannate, manganous.

**Manganous chloride hydrazine**,  $\text{MnCl}_2, 2\text{N}_2\text{H}_4$ .

Ppt. (Fransen, Z. anorg. 1908, 60. 285.)

**Manganous chloride hydroxylamine**,  $\text{MnCl}_2, 2\text{NH}_2\text{OH}$ .

Very stable; insol. in alcohol. (Feldt, B. 1894, 27. 405.)

**Manganous fluoride**,  $\text{MnF}_2$ .

Only sol. in  $\text{H}_2\text{O}$  containing  $\text{HF}$ . (Berzelius.)

Insol. in  $\text{H}_2\text{O}$ ; decomp. by boiling with  $\text{H}_2\text{O}$ ; sl. sol. in liquid  $\text{NH}_3$ ; easily sol. in cold or hot conc.  $\text{HNO}_3$  and  $\text{HCl}$ ; slowly sol. in dil.  $\text{HCl}$ ; decomp. by fused  $\text{K}_2\text{CO}_3$ ,  $\text{KOH}$ ,  $\text{KNO}_3$ , and  $\text{KClO}_3$ ; insol. in alcohol and

ether. Slowly sol. in acetic acid. (Moissan, C. R. 1900, 130. 1160.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

Insol. in acetone (Naumann, B. 1904, 37. 4329.)

**Manganese trifluoride**,  $\text{MnF}_3$ .

Completely sol. in a little  $\text{H}_2\text{O}$ , but decomp. by dilution or boiling. (Berzelius.)

$+6\text{H}_2\text{O}$ . Efflorescent (Christensen, J. pr. (2) 35. 57.)

Sol. in  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ ; decomp. by  $\text{H}_2\text{O}$ ; insol. in most organic solvents. (Moissan, C. R. 1900, 130. 626.)

**Manganomanganic fluoride**,  $\text{Mn}_2\text{F}_7 + 10\text{H}_2\text{O}$ .

Sol. in a little  $\text{H}_2\text{O}$ , but decomp. by dilution. (Nickles, C. R. 67. 448.)

**Manganese tetrafluoride**,  $\text{MnF}_4$ .

Not isolated. Sol. in absolute alcohol or ether; decomp. by  $\text{H}_2\text{O}$ . (Nickles, C. R. 65. 107.)

Probably does not exist. (Christensen, J. pr. (2) 35. 161.)

**Manganese heptafluoride**,  $\text{MnF}_7$  (?)

Sol. in  $\text{H}_2\text{O}$  with decomp. (Wöhler.)

**Manganese sesquifluoride with MF.**

See also Fluomanganate, M.

**Manganic nickel fluoride**,  $2\text{NiF}_2, \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$ .

(Christensen, J. pr. (2) 34. 41.)

**Manganic potassium fluoride**,  $\text{Mn}_2\text{F}_6, 4\text{KF} + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl}$  + Aq, dil.  $\text{HNO}_3$  + Aq, conc.  $\text{H}_2\text{SO}_4$  + Aq,  $\text{H}_3\text{PO}_4$  + Aq,  $\text{H}_2\text{C}_2\text{O}_4$  + Aq,  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  + Aq, and dil.  $\text{HF}$  + Aq. (Christensen, J. pr. (2) 35. 72.)

$\text{MnF}_3, 2\text{KF}$ . Difficultly sol. in  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$ . (Nickles, C. R. 65. 107.)

True composition is  $\text{Mn}_2\text{F}_6, 4\text{KF}$ , also with  $2\text{H}_2\text{O}$ . (Christensen, J. pr. (2) 34. 41.)

$\text{MnF}_3, 4\text{KF}$ . (Nickles.)

See also Fluomanganate, potassium.

**Manganic rubidium fluoride.**

See Fluomanganate, rubidium.

**Manganic silver fluoride**,  $2\text{AgF}, \text{Mn}_2\text{F}_6 + 14\text{H}_2\text{O}$ .

Sol. in  $\text{HF}$  + Aq. (Christensen, J. pr. (2) 34. 41.)

**Manganic sodium fluoride**,  $\text{Mn}_2\text{F}_6, 4\text{NaF}$ .

Decomp. by much  $\text{H}_2\text{O}$ . Not as sol. in  $\text{HF}$  + Aq as the K salt. (Christensen, J. pr. (2) 35. 161.)

**Manganomanganic thallos fluoride,  $5\text{TlF}$ ,  $2\text{MnF}_2$ ,  $\text{MnF}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ .  
 Sl. sol. in dil., easily sol. in conc.  $\text{HF}$ .  
 Sol. in conc.  $\text{HCl}$ , dil.  $\text{HNO}_3$ , and cold or hot conc.  $\text{H}_2\text{SO}_4$ .  
 Sol. in warm  $\text{H}_2\text{O}_2$  containing  $\text{H}_2\text{SO}_4$ .  
 Sol. in dil. tartaric and oxalic acids.  
 (Ephraïm, B. 1909, 42, 4458.)

**Manganous stannic fluoride.**

See Fluostannate, manganous.

**Manganic zinc fluoride,  $2\text{ZnF}_2$ ,  $\text{Mn}_2\text{F}_4 + 8\text{H}_2\text{O}$** 

See Fluomanganate, zinc.

**Manganous zirconium fluoride.**

See Fluozirconate, manganous.

**Manganous fluoride ammonia,  $3\text{MnF}_2$ ,  $2\text{NH}_3$ .**

(Moissan, C. R. 1900, 130, 1161.)

**Manganous hydroxide,  $\text{MnO}_2\text{H}_2$ .**

$2.15 \times 10^{-3}$  g.-mol. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $18^\circ$  (Sackun, Z. Elektrochem., 1909, 15, 846).  
 Solubility in  $\text{H}_2\text{O} = 0.6 \times 10^{-4}$  g. mol. (Herz, Z. anorg. 1899, 22, 284.)  
 1 l.  $\text{H}_2\text{O}$  dissolves  $2 \times 10^{-4}$  mol.  $\text{MnO}_2\text{H}_2$  (Tamm, Z. phys. Ch. 1910, 74, 500).

Very sl. sol. in  $\text{H}_2\text{O}$  or alkalies. (Fresenius.) Easily sol. in acids. Insol. in  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq}$ . Sol. in  $\text{NH}_4$  salts +  $\text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $\text{NaOH} + \text{Aq}$  in presence of glycerine. (Donath, Dmg. 229, 542.)

Not pptd. by  $\text{NH}_4\text{OH} + \text{Aq}$  in presence of  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ ; by  $\text{KOH} + \text{Aq}$  in presence of cane sugar; by  $\text{KOH} + \text{Aq}$  in presence of Na citrate.  
 Solubility of  $\text{MnO}_2\text{H}_2$  in organic Na salts +  $\text{Aq}$ . (0.5 normal.)

Na tartrate, 0.0083 mol. per l.  
 Na malate, 0.0042 " " "  
 Na citrate, 0.0126 " " "  
 (Tamm, Z. phys. Ch. 1910, 74, 496.)  
 Min. *Pyrochroite*.

**Manganomanganic hydroxide,  $\text{Mn}_2\text{O}_4$ ,  $\tau\text{H}_2\text{O}$ .**

Not attacked by boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ . Behaves towards acids as  $\text{Mn}_2\text{O}_3$ .

**Manganic hydroxide,  $\text{Mn}_2\text{O}_3$ ,  $\text{H}_2\text{O}$ .**

Insol. in hot or cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .  
 Sol. in conc.  $\text{H}_2\text{SO}_4$  at somewhat over  $100^\circ$ . (Carlus.)

Sol. in tartaric, oxalic, and malic acids, with subsequent decomp. Insol. in formic, acetic, benzoic, or hippuric acids. (Hermann, Pogg. 74, 303.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Insol. in cane sugar +  $\text{Aq}$ . (Peschier.)

Min. *Manganite*. Sol. in conc.  $\text{HCl} + \text{Aq}$ . Sl. sol. in conc.  $\text{H}_2\text{SO}_4$ .

**Manganese dihydroxide,  $\text{MnO}_2$ ,  $\text{H}_2\text{O}$** 

See Manganous acid.

**Manganous iodide,  $\text{MnI}_2$ .**

*Anhydrous*. Nearly insol. in  $\text{AsB}_{13}$ . (Walden, Z. anorg. 1902, 29, 374.)

Sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25, 212.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

+  $4\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Kuznetsoff, C. C. 1900, II, 525.)

+  $9\text{H}_2\text{O}$  (Kuznetsoff.)

**Manganous mercuric iodide,  $\text{MnI}_2$ ,  $2\text{HgI}_2 + 6\text{H}_2\text{O}$** 

Decomp. by  $\text{H}_2\text{O}$ . Sol. without decomp. in alcohol and acetone. (Dobroserdoff, C. C. 1901, I, 363.)

$3\text{MnI}_2$ ,  $5\text{HgI}_2 + 20\text{H}_2\text{O}$

A sat. solution in  $\text{H}_2\text{O}$  at  $17^\circ$  has composition 1.4  $\text{MnI}_2$ ,  $\text{HgI}_2 + 10.22 \text{H}_2\text{O}$  and sp. gr. = 2.98. (Duboin, C. R. 1906, 142, 1338.)

Very sol. without decomp. in methyl, propyl, isopropyl, isobutyl, and allyl alcohols, ethyl acetate and ethyl cyanide. Somewhat less sol. in amyl, propyl and isobutyl acetates, acetone, acetic acid, formic acid (with ppt of  $\text{HgI}_2$ ), ethyl benzoate, ethyl oxalate, butyl alcohol, amyl alcohol and nitrobenzene. Sl. decomp. by glycerine. Insol. in ethyl nitrate, ethylene bromide, toluene, benzene,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethyl iodide, monobrom- and monochlorobenzene. (Duboin, A. ch. 1909, (8), 16, 273.)

**Manganese nitride,  $\text{Mn}_3\text{N}_2$ .**

Sol. in  $\text{HNO}_3$  only on heating.  $\text{HCl} + \text{Aq}$  dissolves only in presence of Pt. Aqua regia dissolves slowly.  $\text{H}_2\text{SO}_4$  acts only when hot and conc. Insol. in acetic acid. (Prelinger, M. 1894, 15, 398.)

$\text{Mn}_3\text{N}_2$ . Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in  $\text{HCl}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ . with decomp. (Prelinger, M. 1894, 15, 398.)

$\text{Mn}_2\text{N}_3$ . Easily attacked by acids and alkalies (Wedekind, B. 1908, 41, 3772.)

**Manganous oxide,  $\text{MnO}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. Readily sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ .

**Manganic oxide (Manganese sesquioxide),  $\text{Mn}_2\text{O}_3$ .**

Decomp. by boiling with  $\text{HNO}_3 + \text{Aq}$  into  $\text{MnO}$ , which dissolves, and  $\text{MnO}_2$ , which is insol. (Berthier); also by boiling with dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Turner.) Sol. in hot conc.  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$ . Sol. in cold  $\text{HCl} + \text{Aq}$  without decomp. If perfectly pure, is insol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but if it contains any  $\text{MnO}$ , it dissolves. (Rose.) Insol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

Solubility in (calcium sucrate + sugar) + Aq  
 1 l solution containing 418.6 g sugar and 34.3 g. CaO dissolves 0.50 g.  $Mn_2O_3$ ; containing 206.5 g. sugar and 24.2 g. CaO dissolves 0.37 g.  $Mn_2O_3$ ; containing 174.4 g. sugar and 14.1 g. CaO dissolves 0.32 g.  $Mn_2O_3$ . (Bodenbender, J. B. 1865. 600.)

Min. *Braunite*.

Colloidal. Solution in  $H_2O$  containing 0.21 g. to a litre is precipitated by  $KNO_3$  + Aq (1 : 1000);  $K_2SO_4$  + Aq (1 : 1100);  $(NH_4)_2SO_4$  + Aq (1 : 1500);  $NaCl$  + Aq (1 : 1580);  $MgSO_4$  + Aq (1 : 40,983);  $BaCl_2$  + Aq (1 : 58,823);  $MnSO_4$  + Aq (1 : 147,929);  $(NH_4)_3Al(SO_4)_3$  + Aq (1 : 382,318);  $K_2Cr_2(SO_4)_4$  + Aq (1 : 416,668);  $HCl$  + Aq (1 : 61,350);  $HC_2H_3O_2$  (1 : 17,202);  $H_2SO_4$  (1 : 62,500). (Spring and de Boeck, Bull. Soc. (2) 48. 170.)

#### Manganomanganic oxide, $Mn_2O_4$ .

Insol in  $H_2O$ . Boiling dil. or conc.  $HNO_3$  + Aq dissolves out  $MnO$  (Berthier); also boiling dil.  $H_2SO_4$  + Aq (Turner.) Sol in hot  $HCl$  + Aq. (Otto.)  $NH_4Cl$  + Aq dissolves out  $MnO$ . (Rose.) Sol. without decomp. in hot very conc.  $H_3PO_4$  + Aq, and cold conc.  $H_2SO_4$ ,  $HCl$ , oxalic, and tartaric acids + Aq

Min. *Hausmannite*

#### Manganese dioxide, $MnO_2$ .

Min. *Pyrolusite*. Insol in  $H_2O$ . Very slowly sol. in conc.  $H_2SO_4$  with evolution of  $O_2$ . Sol in cold  $HCl$  + Aq; decomp. by hot  $HCl$  + Aq. Sol in aqua regia. Sol. in  $SO_2$  + Aq or  $N_2O_5$  + Aq. (Karsten.)

Insol. in  $HNO_3$ , or dil.  $H_2SO_4$  + Aq, except in presence of organic reducing substances. Decomp. by citric acid, and more easily by oxalic acid. (Bolton.)

Sl sol in hot conc. but insol. in dil.  $HNO_3$  + Aq. (Deville.) When pure it is insol. in cold dil.  $H_2SO_4$  + Aq, but if a small quantity of  $MnO$  is added much  $MnO_2$  dissolves. (Carius.)

Not decomp. by boiling  $NH_4Cl$  + Aq.

Easily sol. in a mixture of nitrososulphuric acid and conc.  $HCl$  + Aq. (Borntrager, Rep. anal. Ch. 1887. 741.)

Insol. in acetone (Naumann, B. 1904, 37. 4329, Eidmann, C. C. 1899, II 1014.)

#### Manganese oxides, $Mn_2O_3$ , $Mn_2O_{11}$ , etc.

See Manganite, manganous.

#### Manganese trioxide, $Mn_2O_3$ .

Deliquescent. Sol. in  $H_2O$ , with subsequent decomp. Decomp. by ether. Sol. in conc.  $H_2SO_4$ . (Franke, J. pr. (2) 36. 31.)

#### Manganese tetroxide, $MnO_4$ (?).

Sl. sol. in  $H_2O$  with decomp. Decomp. by  $H_2SO_4$ , or ether (Franke, J. pr. (2) 36. 166.)

#### Manganese heptoxide, $Mn_2O_7$ .

Very unstable, takes up  $H_2O$  from air. Sol. in  $H_2O$  with evolution of heat and rapid decomposition. Sol. in conc.  $H_2SO_4$  without decomp. (Aschoff.)

#### Manganese oxychloride, $3Mn_2O_3, MnCl_2$ .

Insol. in  $H_2O$ . (Saint-Gilles, C. R. 55. 329.)  $MnCl_2, MnO$  (?). (Gorgeu, A. ch (6) 4. 515.)

$MnO_2Cl$ . See Manganyl chloride.

#### Manganic oxyfluoride, $MnOF_2$ .

Sol. in absolute ether.  
 $MnOF_2, 2HF$  = fluoxymanganic acid.  
 (Nicklès, C. R. 659. 107.)

#### Manganic oxyfluoride potassium fluoride.

See Fluoxymanganate, potassium.

#### Manganic sesquioxifluoride potassium fluoride.

See Sesquifluoxymanganate, potassium.

#### Manganous oxyiodide, $MnI_2, MnO + 6H_2O$

Sol. in  $H_2O$  with decomp. (Kuznetsoff, C. C. 1913, I. 1659.)

#### Manganous oxysulphide, $MnO, MnS$ .

Sol. in acids. (Arfvedson, Pogg. 1. 50.)

#### Manganese phosphide, $Mn_2P_3$

Insol. in dil. acids; sol. in hot conc.  $HNO_3$ . (Wedekind, B. 1907, 40. 1268.)

Sol. in aqua regia; insol. in  $HNO_3$ . (Granger, C. R. 1897, 124. 191.)

$Mn_2P_3, HCl$  + Aq. dissolves out  $Mn_2P_3$  and leaves  $Mn_2P_3$ , which is sol. in  $HNO_3$  + Aq. (Wöhler and Merkel, A. 86. 371.)

Not attacked by boiling  $H_2O$  or by  $HCl$ . Easily sol. in warm  $HNO_3$ , or aqua regia. (Wedekind and Veit, B. 1907, 40. 1268.)

$\alpha Mn_2P_3, \gamma Mn_2P_3$ . Easily sol. in aqua regia; partly sol. in  $H_2SO_4$ , or  $HCl$  + Aq. (Struve, J. pr. 79. 321.)

$Mn_2P_3$ . Insol. in  $HCl$  + Aq. Sol. in  $HNO_3$  + Aq. (Schrotter, W. A. B. 1849, 1. 305.)

#### Manganous phosphoselenide, $MnS, P_2Se$ .

Insol. in  $H_2O$ . Sol. in  $HCl$  + Aq or  $HNO_3$  + Aq. Insol. in cold, sl. decomp. by hot alkalis + Aq. (Hahn, J. pr. 93. 436.)

$2MnSe, P_2Se_2$ . Insol. in cold, slowly sol. in hot  $HCl$  + Aq. Not decomp. by alkalis.  
 $2MnS, P_2Se_2$ . Easily decomp. by acids. (Hahn.)

**Manganese selenide,  $MnSe$ .**

Decomp. by  $H_2O$  and min. acids. (Wedekind, B. 1911, 44. 2067.)

(*type*) Sl decomp by  $H_2O$  at  $100^\circ$ ; easily sol. in dil acids (Fonze-Diacon, C. R. 1900, 130. 1025.)

**Manganese silicide.**

Sol. in HF; only very sl sol. in other acids. (Warren, C. N. 1898, 78. 319.)

$Mg_2Si_2$  Sol in  $HCl + Aq$  with evolution of  $SiH_4$ . (Wöhler, A. 106. 54.)

$Mn_2Si$  Insol in  $H_2O$ . (Vigououx, C. R. 1895, 121. 772.)

Easily sol in HF (Wedekind, B. 1911, 44. 2068.)

Easily sol in dil acids, HF and  $HNO_3$  Insol. in  $KOH + Aq$ . (Vigououx, A. ch 1897, (7) 12. 179.)

Easily sol. in HF when heated; in  $HCl$  when red hot. Sol in dil min. acids with decomp. (Vigououx, C. R. 1895, 121. 772.)

Insol. in  $HNO_3$ , sol in dil. or conc.  $HCl$  Slowly decomp. by alkali hydroxides. (Lebeau, C. R. 1903, 136. 91.)

$Mn_2Si$  Easily sol in molten alkali. (Vigououx, C. R. 1895, 121. 772.)

$MnSi$  Slowly attacked by hot conc.  $HCl$  Not acted upon by dil. or conc.  $HNO_3$  or  $H_2SO_4$ . (Lebeau, C. R. 1903, 136. 91.)

$MnSi_2$  Not attacked by  $HNO_3$  or  $H_2SO_4$  Easily sol. in cold HF; decomp. by conc alkalis +  $Aq$ . (Lebeau, C. R. 1903, 136. 233.)

**Manganous sulphide,  $MnS$** 

*Anhydrous*. Insol. in  $H_2O$ . Sol in weak acids, even in acetic acid.

1 l.  $H_2O$  dissolves  $71.60 \times 10^{-6}$  moles  $MnS$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Min. *Alabundite*. Sol. in  $HCl + Aq$ . +  $\frac{1}{2}H_2O$ . *Green*. Decomp. by boiling with  $H_2O$ . Sol in weak acids, as acetic or sulphurous acid. Very sl. sol. in  $(NH_4)_2S + Aq$ . (Wackenroder.)

Sol. in  $NH_4$  salts +  $Aq$ . 100 ccm. of sat.  $NH_4Cl + Aq$  at  $12^\circ$  dissolve 0.43 g.  $MnS$  (Clermont and Guyot, C. R. 85. 37.)

+  $\frac{1}{2}H_2O$ . *Flesh-colored*. Less sol. in  $NH_4$  salts, or acetic acid +  $Aq$  than the preceding salt 100 ccm. of sat.  $NH_4Cl + Aq$  at  $12^\circ$  dissolve 0.088 g. (Clermont and Guyot.)

Neither green nor flesh-coloured  $MnS$  contains  $H_2O$ . (Antony and Donnini, Gazz. ch. it. 23. 560.)

$MnS$  is not pptd. in presence of alkali citrates, tartrates, or grape sugar; cane or milk sugar do not prevent precipitation. (Spiller.) Not pptd. in presence of  $Na_2P_2O_7$ . (Rose.)

**Manganese sulphide,  $Mn_2S_3$** 

Decomp. by  $H_2O$  Sol. in cold dil acids. (Gautier and Hallopeau, C. R. 1889, 108. 809.)

**Manganese disulphide,  $MnS_2$** 

(Senarmont, J. pr. 51. 385.)

Min. *Hauerite* Decomp. by hot  $HCl + Aq$  with separation of S

**Manganous phosphorus sulphide,  $MnS, P_2S_5$** 

Sol in  $HCl + Aq$  with decomp. (Bezelus, A. 46. 147.)

**Manganous potassium sulphide,  $3MnS, K_2S$** 

Nearly insol in water, alcohol, or ether. Easily sol in acids (Völcker, A. 59. 35.)

**Manganous sodium sulphide,  $3MnS, Na_2S$** 

Insol in  $H_2O$ , alcohol, or ether Sol. in dil acids, and  $SO_2 + Aq$ . (Völcker.)

$2MnS, Na_2S$  Decomp by  $H_2O$ . (Schneider, Pogg. 151. 446.)

**Manganese telluride,  $MnTe$** 

Decomp. by  $H_2O$  and min. acids. (Wedekind, B. 1911, 44. 2067.)

**Manganic acid,  $H_2MnO_4$** 

Known only in solution, which decomposes rapidly. (Franke, J. pr. (2) 36. 31.)

**Barium manganate,  $BaMnO_4$** 

Insol. in  $H_2O$ ; decomp. by acids (Mitschlich.)

**Didymium manganate,  $Dy_2(MnO_4)_3$** 

Insol. in  $H_2O$ . Sol in  $H_2SO_4 + Aq$ . (Frerichs and Smith, A. 191. 331.)

Does not exist. (Cleve, B. 11. 912.)

**Lanthanum manganate,  $La_2(MnO_4)_3$** 

Ppt. (Frerichs and Smith, A. 191. 331.)

Does not exist (Cleve, B. 11. 912.)

**Manganese manganate,  $Mn_2O_3, MnO_2 = 3MnO_2$** 

See Manganese dioxide.

**Lead manganate,  $PbMnO_4 + 2H_2O$** 

Ppt. (Jolles, C. C. 1888. 58.)

**Potassium manganate,  $K_2MnO_4$** 

Sol. in water containing alkalis without decomp., but decomp. by pure  $H_2O$ . Can be recrystallised from dil.  $KOH + Aq$ .

## Solubility in KOH + Aq at t°

Solvent	t°	Mol. $K_2MnO_4$ in 1 l of sat. solution
2-N KOH	0	0 907
	10	1 013
	20	1 140
	30	1 252
	45	1 424
4-N KOH	0	0 554
	17	0 681
	25	0 733
	30	0 772
	40	0 852
	45	0 889
	51	0 938
	60	1 003
	70	1 074
	80	1 143
6-N KOH	0	0 155
	15	0 224
	23	0 261
	30	0 303
	40	0 362
	45	0 388
	60	0 469
	70	0 528
	80	0 587
8-N KOH	0	0 063
	10	0 070
	20	0 078
	30	0 096
	40	0 119
	50	0 142
	60	0 167
	70	0 196
	80	0 222
10-N KOH	0	0 0145
	10	0 0152
	20	0 0160
	30	0 0215
	40	0 0305
	50	0 0462
	63	0 0620
	70	0 0700
	80	0 0830

(Sackur, Z. Elektrochem. 1912, 18. 724.)

Sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Potassium manganate permanganate,  $K_2MnO_4$ ,  $KMnO_4$ .

Sol. without decomp. in 20% KOH + Aq (Gorgeu, A. ch. (3) 61. 355.)

Sodium manganate,  $Na_2MnO_4 + 10H_2O$ .Sol. in  $H_2O$ , with partial decomp. (Genete, J. pr. 82. 58)Strontium manganate,  $SrMnO_4$ .Insol. in  $H_2O$ . (Fromherz.)

## Permanganic acid.

See Permanganic acid.

Manganicyanhydric acid,  $H_3Mn(CN)_3$ .

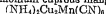
Not known in the free state

Barium manganicyanide,  $Ba_3[Mn(CN)_6]_2$ Sol in  $H_2O$ . (Fittig and Eaton)Barium potassium manganicyanide barium cyanide,  $2KBaMn(CN)_6$ ,  $3Ba(CN)_2 + 8H_2O$ Decomp. by  $H_2O$ . (Lehmann, Dissert. 1898.)Calcium manganicyanide,  $Ca_3[Mn(CN)_6]_2$ .Sol in  $H_2O$ . (Fittig and Eaton)Potassium manganicyanide,  $K_3Mn(CN)_6$ .Sol. in  $H_2O$ . (Christensen, J. pr. (2) 31. 163.)Sodium manganicyanide,  $Na_3Mn(CN)_6 + 2H_2O$ .Sol in  $H_2O$ . (Fittig and Eaton)

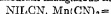
## Manganimanganic acid.

Barium manganimanganate,  $Ba_3Mn_2O_8 + H_2O$ Insol. in  $H_2O$ . Identical with Rosenstich's "basic barium manganate," (J Pharm 1864, 46. 344). (Auger and Billy, C. R. 1904, 138. 501)Lithium manganumanganate,  $Li_4Mn_2O_8 + H_2O$ .Insol in  $H_2O$ . (Auger and Billy.)Manganiperiodic acid,  $H_2O$ ,  $Mn_2O_3$ ,  $I_2O_7$ .Wholly insol. in  $H_2O$ , in hot dil. or conc.  $HNO_3$ , and in hot dil.  $H_2SO_4$ . (Price, Am. Ch. J. 1903, 30. 182.)Potassium manganiperiodate,  $K_2O$ ,  $Mn_2O_3$ ,  $I_2O_7$ .Apparently entirely insol. and unchanged when boiled with  $H_2O$ , dil. or conc.  $HNO_3$ , or dil.  $H_2SO_4$ . (Price.)Sodium manganiperiodate,  $Na_2O$ ,  $Mn_2O_3$ ,  $I_2O_7$ .Apparently insol. and unchanged when treated with boiling  $H_2O$ , boiling dil. or conc.  $HNO_3$ , and boiling dil.  $H_2SO_4$ . (Price.)Manganocyanhydric acid,  $H_4Mn(CN)_6$ 

Most easily decomp. Sl. sol. in alcohol. Insol. in ether. (Descamps, A. ch. (5) 24. 185.)

**Ammonium cuprous manganocyanide,**

Sol. in  $\text{H}_2\text{O}$ ; decomp. by acids and alkalis; very unstable. (Straus, Z. anorg. 1895, 9. 14.)

**Ammonium manganous manganocyanide,**

Sol. in  $\text{NH}_4\text{CN} + \text{Aq.}$  (Fittig and Eaton, A. 145. 157.)

**Barium manganocyanide,  $\text{Ba}_2\text{Mn}(\text{CN})_6$** 

Sol. in cold  $\text{H}_2\text{O}$ . (Fittig and Eaton.)

**Calcium manganocyanide,  $\text{Ca}_2\text{Mn}(\text{CN})_6$** 

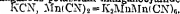
Very deliquescent. Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol (Fittig and Eaton.)

**Cuprous potassium manganocyanide,**

Sol. in  $\text{H}_2\text{O}$  with sl. decomp. Easily decomp. by acids and alkalis. (Straus, Z. anorg. 1895, 9. 12.)

**Cuprous sodium manganocyanide,**

Sol. in  $\text{H}_2\text{O}$  with only sl. decomp. Partially decomp. by acids. (Straus.)

**Manganous potassium manganocyanide,**

Ppt. Sol. in  $\text{KCN} + \text{Aq}$

**Potassium manganocyanide,  $\text{K}_2\text{Mn}(\text{CN})_6 + 3\text{H}_2\text{O}$** 

Very efflorescent. Sol. in  $\text{H}_2\text{O}$ ; decomp. by boiling.

**Potassium manganocyanide chloride,**

Easily sol. in  $\text{H}_2\text{O}$ . (Descamps.)

**Sodium manganocyanide,  $\text{Na}_2\text{Mn}(\text{CN})_6 + 8\text{H}_2\text{O}$** 

Very efflorescent. Easily sol. in  $\text{H}_2\text{O}$  (Fittig and Eaton.)

**Strontium manganocyanide,  $\text{Sr}_2\text{Mn}(\text{CN})_6$** 

As the Ba comp. (Descamps.)

**Permanganomolybdic acid.**

See Permanganomolybdic acid.

**Permanganotungstic acid.**

See Permanganotungstic acid.

**Manganosulphuric acid.**

See Sulphate, manganic.

**Manganous acid,  $\text{H}_2\text{MnO}_3 = \text{MnO}_2, \text{H}_2\text{O}$** 

Insol. in  $\text{H}_2\text{O}$ . (Franko, J. pr. (2) 36. 451.)  $2\text{MnO}_2, \text{H}_2\text{O}$  (?). Min. *Wad*.

**Barium manganite,  $\text{BaO}, 5\text{MnO}_2$** 

Sl. sol. in  $\text{HCl} + \text{Aq.}$ , less sol. in  $\text{HNO}_3 + \text{Aq.}$  (Rissler, Bull. Soc. (2) 30. 111.)  
 $\text{BaO}, 7\text{MnO}_2$ . (Rousseau, C. R. 104. 786.)  
 $\text{BaO}, 2\text{MnO}_2$  Insol. in  $\text{H}_2\text{O}$ .  
 $\text{BaO}, \text{MnO}_2$  Insol. in  $\text{H}_2\text{O}$ . (Rousseau, C. R. 102. 425.)  
 $\text{Ba}(\text{H}_2\text{MnO}_4)_2$ . (Morawski and Stingl, J. pr. (2) 18. 92.)

**Calcium manganite,  $\text{CaO}, 5\text{MnO}_2$** 

Easily sol. in  $\text{HCl} + \text{Aq.}$ , less in  $\text{HNO}_3 + \text{Aq.}$  (Rissler.)  
 $3\text{CaO}, \text{MnO}_2$  (?). Decomp. by  $\text{H}_2\text{O}$  Sol. in  $\text{HCl} + \text{Aq}$  with evolution of Cl. Scarcely sol. in cold  $\text{HNO}_3$ , but sol. on heating. (Dufau, A. ch. 1897, (7) 12. 275.)  
 $2\text{CaO}, \text{MnO}_2$  Sol. in dil. min. acids. (Rousseau, C. R. 116. 1060.)  
 $\text{CaO}, 2\text{MnO}_2$  (Rousseau, C. R. 102. 425.)  
 $\text{CaO}, 3\text{MnO}_2$ .  
 $\text{CaO}, \text{MnO}_2$  Sol. in fuming  $\text{HCl} + \text{Aq.}$ , but not in dil.  $\text{HNO}_3 + \text{Aq}$  (Rousseau, C. R. 116. 1060.)

**Chromium manganite,  $\text{Cr}_2\text{O}_3, 3\text{MnO}_2 = \text{Cr}_2(\text{MnO}_3)_3$** 

Slowly decomp. by acids. (Gröger, Z. anorg. 1905, 44. 458.)

**Cobaltous manganite,  $\text{CoO}, \text{MnO}_2 + 2\text{H}_2\text{O}$** 

Ppt. (Salinger, Z. anorg. 1903, 33. 352.)  
 $+ 4\text{H}_2\text{O}$ . Ppt. (Salinger.)

**Cobalt copper manganite,  $\text{CoO}, \text{CuO}, 2\text{MnO}_2 + 4\text{H}_2\text{O}$** 

Min. *Asbolite*. Sol. in  $\text{HCl} + \text{Aq.}$  with evolution of Cl.

**Cupric manganite,  $\text{CuO}, 4\text{MnO}_2$** 

(Gorgeu, Bull. Soc. 1903, (3) 29. 1187.)  
 $\text{CuO}, 8\text{MnO}_2 + 3\text{H}_2\text{O}$  (Baubigny, C. R. 1897, 124. 955.)

**Cupric manganous manganite,  $4\text{CuO}, \text{MnO}, 7\text{MnO}_2 + 8\text{H}_2\text{O}$** 

Ppt. (Salinger, Dissert. 1902.)  
 $\text{Mn}_2\text{O}_3, 3\text{CuO}$  Sol. in  $\text{HCl} + \text{Aq.}$  (Schneider, Ann. Ch. J. 9. 269.)

**Lead manganite,  $\text{PbO}, 5\text{MnO}_2$** 

Not attacked by conc. acids; sol. in aqua regia (Rissler.)

**Magnesium manganite,  $2\text{MgO}, \text{MnO}_2$** 

(Lemoine, Ann. Min. (7) 3. 5.)  
 $+ 2\text{H}_2\text{O}$ . (Vollard.)

**Manganous manganite,  $\text{Mn}_2\text{O}_3 = \text{MnO}, 2\text{MnO}_2$** 

(Reissig, A. 103. 27.)  
 $\text{Mn}_2\text{O}_3 = \text{MnO}, 5\text{MnO}_2$ . (Veley, Chem. Soc. 38. 581.)

$3\text{MnO}_2, 2\text{MnO}$ . Decomp. by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Franké, J. pr. (2) 36. 166)  
 $3\text{MnO}_2, \text{MnO} + \text{H}_2\text{O}$ . Min. *Vermiculite*

**Manganous zinc manganite**,  $\text{MnO}, \text{ZnO}, \text{MnO}_2$ .  
 (Gorgeu, Bull. Soc. 1903, (3) 29. 1168.)  
 $2\text{MnO}, \text{ZnO}, 2\text{MnO}_2$ . (Gorgeu.)

**Potassium manganite**,  $\text{K}_2\text{O}, 2\text{MnO}_2$   
 Insol. in  $\text{H}_2\text{O}$ .  
 $\text{K}_2\text{O}, 5\text{MnO}_2$   
 $\text{K}_2\text{O}, 7\text{MnO}_2 + 3\text{H}_2\text{O}$   
 $\text{K}_2\text{O}, 8\text{MnO}_2 + 3\text{H}_2\text{O} = \text{KH}_3\text{Mn}_4\text{O}_{10}$ . (Morawski and Stungl, J. pr. (2) 18. 91.)  
 Does not exist. (Wright and Menke, Chem. Soc. 37. 22)  
 $\text{K}_2\text{O}, 10\text{MnO}_2$   
 $\text{K}_2\text{O}, 16\text{MnO}_2 + 6\text{H}_2\text{O}$  Sol. in conc.  $\text{HCl} + \text{Aq}$ . (Rousseau, C. R. 114. 72)

**Silver manganite**,  $\text{AgH}_3\text{Mn}_4\text{O}_{10}$   
 (Morawski and Stungl, J. pr. (2) 18. 92)  
 $\text{Ag}_2\text{MnO}_2$  Ppt. (Gorgeu, C. R. 110. 958.)

**Silver (argentous) manganite**,  $\text{Ag}_4\text{O}, \text{Mn}_2\text{O}_3$  (?)  
 Insol. in cold dil.  $\text{HNO}_3 + \text{Aq}$ , and separates  $\text{Mn}_2\text{O}_3$  on warming. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Rose, Pogg. 101. 229.)

**Silver (argentoargentite) manganite**,  $\text{Ag}_4\text{O}, 2\text{Ag}_2\text{O}, \text{Mn}_2\text{O}_3$  (?)  
 (Rose.)

**Sodium manganite**,  $\text{Na}_2\text{O}, 5\text{MnO}_2$ .  
 Insol. in  $\text{H}_2\text{O}$ . (Rousseau, C. R. 103. 261.)  
 $\text{Na}_2\text{O}, 12\text{MnO}_2$  Insol. in  $\text{H}_2\text{O}$ . (Rousseau.)  
 $+ 4\text{H}_2\text{O}$ . (Rousseau, C. R. 112. 525)  
 $\text{Na}_2\text{O}, 8\text{MnO}_2 + 5\text{H}_2\text{O}$ . (Rousseau.)  
 $\text{Na}_4\text{O}, 16\text{MnO}_2 + 8\text{H}_2\text{O}$ . (Rousseau.)

**Strontium manganite**,  $\text{MnO}_2, \text{SrO}$ .  
 Insol. in  $\text{H}_2\text{O}$ .  
 $2\text{MnO}_2, \text{SrO}$ , Insol. in  $\text{H}_2\text{O}$  (Rousseau, C. R. 101. 167)  
 $\text{MnO}_2, 5\text{SrO}$  Sol. in  $\text{HCl}$ , or  $\text{HNO}_2 + \text{Aq}$ . (Rassler, Bull. Soc. (2) 30. 110.)

**Zinc manganite**,  $\text{ZnO}, 5\text{MnO}_2$ .  
 Insol. in  $\text{H}_2\text{O}$  (Rassler)  
 $\text{ZnO}, 4\text{MnO}_2$ . (Gorgeu, Bull. Soc. 1903, (3) 29. 1168.)  
 $3\text{ZnO}, \text{MnO}_2 + 7\frac{1}{2}\text{H}_2\text{O}$ . (Salinger, Dissert. 1902.)  
 $27\text{ZnO}, 2\text{MnO}_2 + 25\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Salinger.)

**Manganyl chloride**,  $\text{MnO}_2\text{Cl}$ .  
 Decomp. by  $\text{H}_2\text{O}$ . (Aschoff, J. pr. 81. 29.)

**Melanocobaltic chloride**,  
 $\text{Co}_2(\text{NH}_3)_9\text{Cl}_2\text{NH}_4\text{Cl}$ , or  
 $\text{Co}_2(\text{NH}_3)_9\text{Cl}_2\text{NH}_3$ .  
 Very sl. sol. in cold  $\text{H}_2\text{O}$  or very dil.  $\text{HCl} + \text{Aq}$ . Decomp. by long standing or warming. Cold conc.  $\text{HCl}$  or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  does not attack, but decomp. on warming.  $\text{HNO}_3 + \text{Aq}$  decomp. on warming. Sol. in cold  $\text{H}_2\text{SO}_4$  or  $\text{NH}_4\text{OH} + \text{Aq}$ ; from both solutions it can be precipitated by  $\text{HCl} + \text{Aq}$ . (Vortmann, B. 10. 1455.)

— chloroplatinate,  $[\text{Co}_2(\text{NH}_3)_9\text{NH}_2\text{Cl}_2]_2\text{PtCl}_4$ .  
 Ppt. (Vortmann, B. 15. 1902.)  
 $\text{Co}_2(\text{NH}_3)_9\text{NH}_2\text{Cl}_2(\text{OH})_3$ ,  $\text{PtCl}_4$  Ppt. (Vortmann.)

— mercuric chloride,  
 $\text{Co}_2(\text{NH}_3)_9(\text{NH}_2)\text{Cl}_2(\text{OH})_3, 3\text{HgCl}_2 + \text{H}_2\text{O}$ .  
 Ppt. Difficultly sol. in cold  $\text{H}_2\text{O}$ , quite easily in warm  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$ . (Vortmann.)

— chloride chromate,  
 $\text{Co}_2(\text{NH}_3)_9\text{NH}_2\text{Cl}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O}$ .  
 Sol. in hot  $\text{H}_2\text{O}$ . (Vortmann.)

**Mercuriammonium comps.**  
 See Mercury ammonium comps.

**Mercuriammonium bromide**,  $\text{Hg}(\text{NH}_2)\text{Br}$ .  
 See Dimercuriammonium ammonium bromide.

**Mercuriammonium chloride**,  $\text{Hg}(\text{NH}_2)\text{Cl}$ .  
 See Dimercuriammonium ammonium chloride.

**Mercuriammonium oxydimercuriammonium chloride**,  $4\text{Hg}(\text{NH}_2)\text{Cl}, \text{NH}_2(\text{HgOHg})\text{Cl}$ . (Millon.)  
 Correct composition is Dimercuriammonium ammonium chloride,  $\text{NHg}_2\text{Cl}, \text{NH}_4\text{Cl}$ , which see. (Balestra, Gazz. ch. it. 21, 2. 294.)

$\text{Hg}(\text{NH}_2)\text{Cl}, 2\text{NH}_2(\text{HgOHg})\text{Cl}$  (Millon.)  
 Correct composition is Dimercuriammonium mercuric chloride,  $2\text{NHg}_2\text{Cl}, \text{HgCl}_2 + \text{H}_2\text{O}$ , or Dimercuriammonium hydrogen chloride,  $\text{NHg}_2\text{Cl}, \text{HCl}$ . (Balestra.)

**Mercuriammonium nitrate**,  $2\text{NH}_3, 2\text{HgO}, \text{N}_2\text{O}_5 = \text{NH}_2\text{HgNO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Easily decomp. by  $\text{HCl}$ , or alkali sulphides +  $\text{Aq}$ . Sl. sol. in  $\text{HNO} + \text{Aq}$ . Insol. in  $\text{H}_2\text{SO}_4, \text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . (Mitscherlich.)

Is dimercuriammonium ammonium nitrate,  $\text{NHg}_2\text{NO}_3, \text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$ . (Pesci, Gazz. ch. it. 20. 485.)

**Mercuriammonium oxydimercuriammonium nitrate**,  $3\text{HgO}, 2\text{NH}_3, \text{N}_2\text{O}_5 = \text{NH}_4\text{HgNO}_3, (\text{NH}_4\text{OH})_2\text{NO}_3 + \text{H}_2\text{O}$ .

Decomp. by boiling with  $\text{H}_2\text{O}$ , which dissolves out  $\text{NH}_4\text{NO}_3$ . Sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  containing  $\text{NH}_4\text{OH}$  (Mitscherlich.)

Is dimercuriammonium ammonium nitrate,  $3\text{NH}_4\text{NO}_3, \text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$  (Pesci, Gazz. ch. it. 20. 485.)

**Mercuriammonium oxydimercuriammonium sulphate**,  $(\text{NH}_4\text{Hg})_2\text{SO}_4, 3(\text{NH}_4\text{OH})_2\text{SO}_4$ .

Boiling  $\text{H}_2\text{O}$  dissolves out  $\text{H}_2\text{SO}_4$ . Gradually decomp. by boiling  $\text{KOH} + \text{Aq}$ . Completely sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in conc. or dil.  $\text{HCl}$ , or very dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol in conc. or dil.  $\text{HNO}_3 + \text{Aq}$  or conc.  $\text{H}_2\text{SO}_4$  (Schneider.)

Correct formula is  $7(\text{NH}_4)_2\text{SO}_4, (\text{NH}_4)_2\text{SO}_4 + 12\text{H}_2\text{O}$ , dimercuriammonium ammonium sulphate. (Pesci, Gazz. ch. it. 20. 485.)

**Mercuridiammonium chloride (fusible white precipitate)**,  $\text{Hg}(\text{NH}_4)_2\text{Cl}_2$ .

Is dimercuriammonium ammonium chloride,  $\text{Hg}_2\text{NCl}, 3\text{NH}_4\text{Cl}$ , which see. (Rammelsberg J. pr. 38. 558.)

**Mercuridiammonium mercuric chloride**,  $\text{Hg}(\text{NH}_4)_2\text{Cl}_2, \text{HgCl}_2$ .

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. by boiling therewith. (Rose, Pogg. 20. 158.) Partly sol. in  $\text{H}_2\text{O}$ . (Kane)

**Mercuridiammonium iodide**,  $\text{Hg}(\text{NH}_4)_2\text{I}_2$ .

$\text{H}_2\text{O}$  extracts all the  $\text{NH}_3$ . Partly sol. in little alcohol. Partly sol. in ether without decomp. (Nessler.)

Correct composition is dimercuriammonium ammonium iodide,  $\text{NH}_4\text{HgI}, 3\text{NH}_4\text{I}$ . (Pesci, Gazz. ch. it. 20. 485.)

**Mercuridiammonium cupric iodide**,  $4\text{NH}_3, \text{CuI}_2, \text{HgI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol +  $\text{HC}_2\text{H}_3\text{O}_2$ . (Jørgensen, J. pr. (2) 2. 347.)  $2\text{Hg}(\text{NH}_4)_2\text{I}_2, \text{CuI}_2$  (Decomp. by  $\text{H}_2\text{O}$ . (Jørgensen))

**Mercuridiammonium iodide**,  $\text{Hg}(\text{NH}_4)_2\text{I}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Partly sol. in a little alcohol. Partly sol. in ether. (Nessler.)

Correct composition is dimercuriammonium ammonium iodide,  $\text{NH}_4\text{HgI}, 3\text{NH}_4\text{I}$ . (Pesci.)

**Mercuridiammonium mercuric iodide**,

$\text{Hg}(\text{NH}_4)_2, \text{HgI}_2$ , or  $\text{NH}_3, \text{HgI}_2$ .

Decomp. by  $\text{H}_2\text{O}$  or dil. acids. (Caillot and Corriol, J. Pharm. 9. 381.)

Correct composition is dimercuriammonium ammonium mercuric iodide,  $3\text{NH}_4\text{HgI}, 8\text{NH}_4\text{I}, 4\text{HgI}_2$ . (Pesci, Gazz. ch. it. 20. 485.)

**Mercuridiammonium sulphate**,  $\text{Hg}(\text{NH}_4)_2\text{SO}_4$ .

Decomp. with  $\text{H}_2\text{O}$ .

Does not exist. (Pesci, Gazz. ch. it. 20. 485.)

+  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$ , very dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , or  $\text{HNO}_3 + \text{Aq}$ . Insol in conc.  $\text{HNO}_3 + \text{Aq}$ . Sol in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  or  $\text{NH}_4\text{Cl} + \text{Aq}$ . Decomp. by  $\text{KOH} + \text{Aq}$ . (Schneider, J. pr. 75. 136.)

Correct composition is  $(\text{NH}_4)_2\text{SO}_4, 3(\text{NH}_4)_2\text{SO}_4 + 12\text{H}_2\text{O}$ , dimercuriammonium ammonium sulphate (Pesci.)

**Dimercuriammonium acetate**,

$\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ .

Insol in  $\text{H}_2\text{O}$  or alcohol. Sol. in  $\text{HCl}$  or  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Balestra, Gazz. ch. it. 22, 2. 563.)

**Dimercuriammonium ammonium acetate**,

$\text{NH}_4\text{C}_2\text{H}_3\text{O}_2, 3\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O}$ .

Dehuescent; sol. in a little  $\text{H}_2\text{O}$  without decomp., but decomp. into  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  and  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  by excess of  $\text{H}_2\text{O}$  (Balestra.)

— **arsenate**,  $\text{NH}_4\text{H}_2\text{AsO}_4$ .

(Hirzel, Zeit. Pharm. 1853. 3.)

— **bromate**,  $\text{NH}_4\text{BrO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Ppt. (Rammelsberg, Pogg. 55. 82.)

Is oxydimercuriammonium bromate,  $(\text{NH}_4\text{Hg}_2\text{O})\text{BrO}_3$ .

— **bromide**,  $\text{NH}_4\text{Br}$ .

Insol in  $\text{H}_2\text{O}$  or  $\text{HNO}_3$ . Sol in  $\text{HCl} + \text{Aq}$  (Pesci, Gazz. ch. it. 19. 509.)

Sol in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  with evolution of  $\text{NH}_3$  (Balestra, Gazz. ch. it. 22, 2. 558.)

Sol in ammoniacal solutions of ammonium salts and in aq. acids. (Franklin, J. Am. Chem. Soc. 1905, 27. 839.)

— **ammonium bromide**,  $\text{NH}_4\text{Br}, \text{NH}_4\text{Br}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Pesci, Gazz. ch. it. 19. 511.)

$4\text{NH}_4\text{Br}, 5\text{NH}_4\text{Br}$ . Decomp. by  $\text{H}_2\text{O}$ . Insol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Sol. in conc. or dil.  $\text{HCl} + \text{Aq}$ . Insol in  $\text{HNO}_3 + \text{Aq}$ . (Pesci.)

$\text{NH}_4\text{Br}, 3\text{NH}_4\text{Br}$ . Decomp. by  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . Insol in alcohol. (Pesci.)

Sol. in  $\text{NH}_4\text{Br}, \text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{I} + \text{Aq}$ ; sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ .

— **mercuric bromide**,  $2\text{NH}_4\text{Br}, \text{HgBr}_2$ .

Ppt. Sol. in  $\text{HBr}$  and in  $\text{HCl}$ . (Ray, Chem. Soc. 1902, 81. 649.)

— **carbonate**,  $(\text{NH}_4)_2\text{CO}_3 + 2\text{H}_2\text{O}$ .

Ppt. Not decomp. by  $\text{KOH} + \text{Aq}$ , but easily by  $\text{K}_2\text{S}$ , or  $\text{KI} + \text{Aq}$ . (Rammelsberg, J. pr. (2) 38. 567.)

**Dimercuriammonium chloride,  $\text{NH}_4\text{Hg}_2\text{Cl}_2$ .**

Not attacked by boiling  $\text{H}_2\text{O}$ . Sol. attacked by cold dil.  $\text{HCl} + \text{Aq.}$  but is gradually dissolved thereby. Decomp. by hot  $\text{KOH} + \text{Aq.}$  (Weyl.)

Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  with evolution of  $\text{NH}_3$ .

$+ \text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HNO}_3$ , and  $\text{HCl} + \text{Aq.}$  Not decomp. by  $\text{KOH} + \text{Aq.}$  Decomp. by  $\text{KCl}$ ,  $\text{NaCl}$ , or  $\text{KI} + \text{Aq.}$  (Rammelsberg, Pogg. 48. 181.)

— hydrogen chloride,  $\text{NH}_4\text{Hg}_2\text{Cl}_2$ ,  $2\text{HCl}$ .

Correct composition of mercuric chloramide chloride. (Balestra, Gazz. ch. it. 21, 2. 299.)

Decomp. by  $\text{H}_2\text{O}$ .  
 $\text{NH}_4\text{Hg}_2\text{Cl}_2$ ,  $\text{HCl}$ . Decomp. by  $\text{H}_2\text{O}$ . (Balestra, l. c.)

$\text{NH}_4\text{Hg}_2\text{Cl}_2$ ,  $4\text{HCl}$ . Sol. in  $\text{H}_2\text{O}$  (Ray, Proc. Chem. Soc. 1901, 17. 96.)

— ammonium chloride,  $\text{NH}_4\text{Hg}_2\text{Cl}_2$ ,  $\text{NH}_4\text{Cl}$ . (Insoluble white precipitate.)

Correct composition of what has been called mercuric chloramide,  $\text{Hg}(\text{NH}_4)\text{Cl}$ . (Rammelsberg, J. pr. 38. 558.)

Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Miklon, A. ch. (3) 18. 413.) Sol. in 600 pts.  $\text{H}_2\text{O}$ . (Wittstein.) Sol. in 719.98 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Abt.) Insol. in alcohol

Sol. in acids, even in  $\text{HCl} + \text{H}_2\text{O}_2 + \text{Aq.}$ , also in  $\text{NH}_4\text{NO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , and  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq.}$  (Pelouse and Fremy.)

Sol. in warm  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Brett.)

Sol. sol. in alkali chlorides  $+ \text{Aq.}$  which partially decomp. (Miehle, A. ch. (3) 6. 180.)

Decomp. by  $\text{KOH} + \text{Aq.}$  Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  with evolution of  $\text{NH}_3$ . (Balestra.)

When freshly prepared is sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Saha and Choudhury, Z. anorg. 1910, 67. 359.)

Sol. in excess of  $(\text{NH}_4)_2\text{HPO}_4 + \text{Aq.}$  Insol. in excess of  $\text{Na}_2\text{HPO}_4 + \text{Aq.}$  (Carnegie and Burt, C. N. 1897, 76. 175.)

Insol. in excess of  $\text{NH}_4\text{OH} + \text{Aq.}$  (Carnegie and Burt.)

$\text{NH}_4\text{Hg}_2\text{Cl}_2$ ,  $3\text{NH}_4\text{Cl}$  (Fusible white precipitate.)

Correct composition of what has been called mercuriammonium chloride,  $\text{Hg}(\text{NH}_4)_2\text{Cl}_2$ . (Rammelsberg, J. pr. (2) 38. 558.)

Decomp. by hot  $\text{H}_2\text{O}$ . Sol. in acids, even  $\text{HCl} + \text{H}_2\text{O}_2 + \text{Aq.}$  Not decomp. by cold, but by boiling  $\text{KOH} + \text{Aq.}$  (Weyl.)

Sol. in warm, less in cold  $\text{NH}_4\text{OH} + \text{Aq.}$  (Mitscherlich.)

Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  with evolution of  $\text{NH}_3$ . (Balestra.)

Sol. in 10%  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and acetic acid. (Hofmann and Marburg, A. 1899, 305. 198.)

**Dimercuriammonium mercuric chloride,  $2\text{NH}_4\text{Hg}_2\text{Cl}_2$ ,  $\text{Hg}_2\text{Cl}_2$ .**

Insol. in, and not decomp. by boiling  $\text{H}_2\text{O}$ , alkalis, conc.  $\text{HNO}_3$ , or dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Sol. in boiling  $\text{HCl} + \text{Aq.}$  (Mitscherlich, J. pr. 19. 453.)

Sol. decomp. by  $\text{H}_2\text{O}$ , readily by  $\text{KOH} + \text{Aq.}$  (Gaudechon, A. ch. 1911, (8) 22. 212.)

Ppt. Sol. in  $\text{HBr}$ . (Ray, Proc. Chem. Soc. 1902, 18. 86.)

— chloride ammonia,  $\text{NH}_4\text{Hg}_2\text{Cl}_2$ ,  $\frac{1}{2}\text{NH}_3$ .

Decomp. by water and by  $\text{NH}_4\text{OH} + \text{Aq.}$  (Gaudechon, A. ch. 1911, (8) 22. 212.)

— chromate.

See Oxymercuriammonium chromate.

— hydroxide,  $\text{NH}_4\text{Hg}_2\text{OH}$ .

Takes up  $\text{H}_2\text{O}$  to form  $\text{NH}_4\text{Hg}_2\text{OH} + \text{H}_2\text{O}$  or  $(\text{NH}_4\text{Hg}_2\text{OH})_2\text{OH}$ , oxymercuriammonium hydroxide, which also see.

Sol. in warm  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$

— iodate,  $\text{NH}_4\text{Hg}_2\text{IO}_3$ ,  $2\text{NH}_4\text{IO}_3$ .

Insol. in  $\text{HNO}_3$ . (Rammelsberg, J. pr. (2) 38. 568.)

— iodide,  $\text{NH}_4\text{Hg}_2\text{I}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq.}$  Decomp. by boiling with  $\text{KOH} + \text{Aq.}$  or  $\text{KCl} + \text{Aq.}$  (Weyl, Pogg. 121. 601.) Decomp. by hot  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  (Balestra.)

Decomp. by dilute  $\text{HCl}$ . Sol. in ammonium salts  $+ \text{Aq.}$  (Franklin, Z. anorg. 1905, 46. 21.)

$+ \text{H}_2\text{O}$ . See Oxymercuriammonium iodide.

— ammonium iodide,  $\text{NH}_4\text{Hg}_2\text{I}$ ,  $3\text{NH}_4\text{I}$ .

Correct composition of mercuriammonium iodide,  $\text{Hg}(\text{NH}_4)_2\text{I}_2$ . (Pesci, Gazz. ch. it. 20. 485.)

$3\text{NH}_4\text{Hg}_2\text{I}$ ,  $8\text{NH}_4\text{I}$ ,  $4\text{HgI}_2$ . Correct formula for mercuriammonium mercuric iodide,  $\text{Hg}(\text{NH}_4)_2\text{I}_2$ ,  $\text{HgI}_2$ . (Pesci.)

— nitrate,  $\text{NH}_4\text{Hg}_2\text{NO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Rammelsberg, J. pr. (2) 38. 566.)

Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  with evolution of  $\text{NH}_3$ . (Balestra, Gazz. ch. it. 22, 2. 560.)

$+ \text{H}_2\text{O}$ . (Hofmann and Marburg, A. 1899, 305. 212.)

Sol. in  $\text{HNO}_3$ . (Ray, Z. anorg. 1902, 33. 209.)

— ammonium nitrate,  $\text{NH}_4\text{Hg}_2\text{NO}_3$ ,  $\text{NH}_4\text{NO}_3$ ,  $+ \text{H}_2\text{O}$ .

Correct formula for mercuriammonium nitrate,  $\text{NH}_4\text{Hg}_2\text{NO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . (Pesci, Gazz. ch. it. 20. 485.)

$\text{NH}_4\text{Hg}_2\text{NO}_3$ ,  $2\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$ . Correct for-

mula for oxydmercuriammonium ammonium nitrate,  $(\text{NH}_4\text{OH})_2\text{NO}_3$ ,  $2\text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$ . (Pesci.)

$\text{NH}_4\text{NO}_3$ ,  $3\text{NH}_4\text{NO}_3$  Decomp by cold  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Pesci.)

$3\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$ . Correct formula for mercuriammonium oxydmercuriammonium nitrate,  $\text{NH}_4\text{HgNO}_3$ ,  $(\text{NH}_4\text{OH})_2\text{NO}_3 + \text{H}_2\text{O}$ . (Pesci.)

*Dimercuriammonium nitrite*,  $\text{NH}_4\text{Hg}_2\text{NO}_2$ .

Readily sol. in warm  $\text{HCl}$  or  $\text{HBr}$ . (Ray, Chem. Soc. 1902, 81. 648.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Ppt. Sol in  $\text{HCl}$ . (Ray, Proc Chem. Soc. 1902, 18. 85.)

+  $\text{H}_2\text{O}$ . (Hofmann and Marburg, A. 1899, 306. 214.)

— oxide,  $(\text{NH}_4)_2\text{O}$ .

Slowly decomp. by  $\text{H}_2\text{O}$ . Sol in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . Decomp. by hot  $\text{KOH}$ , or  $\text{KCl} + \text{Aq}$ . (Weyl, Pogg. 121. 601.)

Sol. in  $\text{KCN} + \text{Aq}$  by heating 4–5 hours at  $130^\circ$ . Not completely sol in  $\text{HCl}$  owing to formation of  $\text{Hg}_2\text{Cl}_2$ . (Gaudechon, C. R. 1907, 144. 1419.)

— phosphate,  $(\text{NH}_4)_2\text{PO}_4$ ,  $2\text{NH}_4\text{OH} + 10\text{H}_2\text{O}$

(Rammelsberg, J. pr. (2) 38. 567.)

See Oxydmercuriammonium phosphate.

— ammonium salicylate,  $2\text{NH}_4\text{C}_6\text{H}_4\text{OHCO}_2$ ,  $5\text{NH}_4\text{C}_6\text{H}_4\text{OHCO}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ ,  $\text{HCl}$ , or  $\text{KI} + \text{Aq}$ . (Balestra.)

— selenate,  $(\text{NH}_4)_2\text{SeO}_4 + 2\text{H}_2\text{O}$

Ppt. Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Cameron and Davy, C. N. 44. 63.)

— sulphate,  $(\text{NH}_4)_2\text{SO}_4 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ . Easily sol in  $\text{HCl} + \text{Aq}$ . (Rammelsberg, J. pr. (2) 38. 565.) Sol. (Kane), insol (Hirzel) in  $\text{HNO}_3 + \text{Aq}$ .

Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  with evolution of  $\text{NH}_3$ . (Balestra.)

+  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , sol in  $\text{HCl}$ . (Ray, Chem. Soc. 1905, 87. 9.)

— ammonium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,  $3(\text{NH}_4)_2\text{SO}_4 + 4\text{H}_2\text{O}$ .

Correct formula for mercuriammonium sulphate,  $2\text{NH}_3$ ,  $\text{HgO}$ ,  $\text{SO}_3 + \text{H}_2\text{O}$ . (Pesci, Gazz. ch. it. 20. 485.)

$5(\text{NH}_4)_2\text{SO}_4$ ,  $14(\text{NH}_4)_2\text{SO}_4 + 16\text{H}_2\text{O}$ . (Pesci.)

$7(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4 + 12\text{H}_2\text{O}$ . Correct formula for mercuriammonium oxydmercuriammonium sulphate,  $(\text{NH}_4\text{Hg}_2)_2\text{SO}_4$ ,  $3(\text{NH}_4\text{OH})_2\text{SO}_4$ . (Pesci.)

*Dimercuriammonium tartrate*,  $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{KI}$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , or  $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$ . (Balestra, Gazz. ch. it. 22, 2. 563.)

— ammonium tartrate,  $2(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6$ ,  $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6 + \text{H}_2\text{O}$

As above. (B.)

*Trimercuriammonium sulphate*,  $(\text{NH}_4)_3(\text{NH}_4\text{Hg}_2)_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Decomp by  $\text{H}_2\text{O}$ . (Millon.)

Does not exist (Pesci, Gazz. ch. it. 20. 485.)

*Dimercuriarsonium mercuric chloride*,  $\text{AsHg}_2\text{Cl}_2 = \text{AsHg}_2\text{Cl}$ ,  $\text{HgCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Decomp. by warm  $\text{HNO}_3 + \text{Aq}$ . (Rose, Pogg. 51. 423.)

*Mercurimidosulphonic acid*,  $(\text{HO}_2\text{S})_2\text{N}_2\text{Hg}$ .

Very unstable (Berglund, B. 9. 256.)

*Barium mercurimidosulphonate*,  $\text{Ba}_2(\text{SO}_3)_2\text{N}_2\text{Hg} + 5\text{H}_2\text{O}$

(Berglund, B. 9. 256.)

*Cadmium* —,  $\text{Cd}_2\text{HgN}_2(\text{SO}_3)_4 + 12\text{H}_2\text{O}$ .

Unstable; al sol. in  $\text{H}_2\text{O}$ . (Berglund, Bull. Soc. (2) 25. 452.)

*Cobalt* —,  $\text{Co}_3\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (B.)

*Copper* —,  $\text{Cu}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ . (B.)

*Magnesium* —,  $\text{Mg}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$ . (B.)

*Manganous* —,  $\text{Mn}_2\text{HgN}_2(\text{SO}_3)_4 + 10\text{H}_2\text{O}$ .

Unstable. (B.)

*Mercuric* —,  $(\text{Hg}_2\text{O})_2\text{HgN}_2(\text{SO}_3)_4$ .

Nearly insol in  $\text{H}_2\text{O}$ . (B.)

*Nickel* —,  $\text{Ni}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$

(B.)

*Potassium* —,  $(\text{KO}_2\text{S})_2\text{N}_2\text{Hg} + 4\text{H}_2\text{O}$

Precipitate. (Raschig, A. 241. 161.)

*Potassium silver* —,  $(\text{AgSO}_3)_2(\text{KSO}_3)_2\text{HgN}_2 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Berglund.)

*Sodium* —,  $(\text{NaSO}_3)_2\text{HgN}_2 + 5\text{H}_2\text{O}$ .

More sol. in  $\text{H}_2\text{O}$  than  $\text{K}$  salt. (Berglund.)

*Strontium* —,  $\text{Sr}_2(\text{SO}_3)_2\text{HgN}_2 + 15\text{H}_2\text{O}$ .

More sol. than  $\text{Ba}$  salt. (B.)

Zinc mercuridosulphonate,  
 $Zn_2(SO_4)_4HgN_2 + 15H_2O$ .  
 Very sol. in  $H_2O$ . (B)

Dimercuriphosphonium mercuric bromide,  $2PHg_2Br$ ,  $HgBr_2$ .  
 (Lemoult, C. R. 1907, 145. 1176)

Dimercuriphosphonium mercuric chloride,  $HgCl_2$ ,  $PHg_2Cl$ .  
 (Lemoult, C. R. 1907, 145. 1176.)  
 $+1\frac{1}{2}H_2O$ . Decomp. by hot, slowly by cold  $H_2O$  into  $Hg$ ,  $HCl$  and  $H_3PO_3$ . Decomp. by acids or alkalis. (Rose, Pogg. 40. 75.)

Dimercuriphosphonium mercuric iodide,  $HgI_2$ ,  $PHg_2I$ .  
 Slowly decomp. by cold or warm  $H_2O$ , quickly by  $MOH + Aq$ . Not attacked by  $HCl$  or  $H_2SO_4 + Aq$ . Rapidly attacked by  $HNO_3$  and aqua regia. (Lemoult, C. R. 1904, 139. 479.)

Dimercuriphosphonium mercuric nitrate,  $P_2Hg_3$ ,  $8HgO$ ,  $3N_2O_5 = 2[PHg_2NO_3]$ ,  $Hg(NO_3)_2$ ,  $3HgO$ .  
 (Rose, Pogg. 40. 75)

Dimercuriphosphonium mercuric sulphate,  $P_2Hg_3$ ,  $6HgO$ ,  $4SO_3 + 4H_2O = (PHg_2)_2SO_4$ ,  $3HgSO_4$ ,  $2HgO + 4H_2O$ .  
 Sol. in aqua regia. (Rose, Pogg. 40. 75)

### Mercuric acid.

Calcium mercurate (?).  
 (Berthollet, A. ch. 1. 61.)

Potassium mercurate,  $K_2O$ ,  $2HgO$ .  
 Gradually decomp. by  $H_2O$ ; less rapidly by absolute alcohol. (St. Meunier, C. R. 60. 557.)

Sodium mercurate,  $Na_2O$ ,  $HgO$ .  
 (Bettendorf, Bull. Soc. (2) 34. 328)

Mercurioammonium chloride,  
 $Hg(NH_2)Cl$   
 (Rose, Pogg. 20. 158)  
 Mixture of  $Hg$ ,  $HgNH_2Cl$ , and  $NH_4Cl$ .  
 (Barfoed, J. pr. (2) 39. 201.)

— nitrate,  $(NH_4)_2Hg(NO_3)_2$ , "Hahnemann's soluble mercury."  
 Sol. in hot  $HCl$  and  $HC_2H_3O_2 + Aq$ . Decomp. by  $NH_4OH + Aq$ , or  $NH_4$  salts +  $Aq$ . Probably mixture of mercurous salts and  $Hg$ .

Mercurodiammonium chloride,  
 $Hg_2(NH_2)_2Cl_2$ .  
 Easily decomp. (Rose, Pogg. 20. 158.)  
 Mixture of  $Hg$ ,  $NH_4HgCl$ , and  $NH_4Cl$ .  
 (Barfoed, J. pr. (2) 39. 201)

Mercurodiammonium fluoride,  
 $Hg_2(NH_2)_2F_2$  (?)  
 Decomp. by  $H_2O$ . (Finkener, Pogg. 110. 147.)

### Mercurosulphonic acid.

Mercurosulphonates,  $Hg(SO_3M)_2$ .  
 Correct composition for the double sulphites,  $HgSO_3$ ,  $M_2SO_3$ . (Divers and Shumidzu, Chem. Soc. 49. 583; Baith, Z. phys. Ch. 9. 195.)

### Mercuroxy-comps.

See Oxymercur- comps.

### Mercury, Hg.

Not attacked by  $H_2O$ . Not attacked by boiling conc  $HCl$  or dil  $H_2SO_4 + Aq$ . Easily sol. in dil or conc  $HNO_3 + Aq$ ; also in  $HBr$  or  $HI + Aq$ .

Not attacked by pure  $HNO_3$  unless heated, but readily attacked by cold dil.  $HNO_3 + Aq$  containing  $NO$ . (Millon.)

Anhydrous  $H_2SO_4$  attacks  $Hg$  gradually at ord. temp. (Berthelot, C. R. 1897, 126. 749.)

$H_2SO_4$  attacks only when hot and conc. (Ditte, A. ch. 1890, (6) 19. 68.)

Conc.  $H_2SO_4$  does not attack dry or moist  $Hg$  either with or without au. (Pitman, J. Am. Chem. Soc. 1898, 20. 100.)

$H_2SO_4$  attacks  $Hg$  at  $20^\circ$  if it contains 99.7%; does not attack if it contains only 95.6%. (Baskerville, J. Am. Chem. Soc. 1898, 20. 515.)

Insol. in  $H_2SO_4 + Aq$  alone or in presence of  $HCl$  or dil.  $H_2SO_4$ . (Berthelot, A. ch. 1898, (7) 14. 198)

Not attacked by  $HF + Aq$  at any temp. (Gay-Lussac.)

$HI$  dissolves  $Hg$  rapidly at ord temp (Norris and Cottrell, Am. Ch. J. 1896, 18. 99)

More rapidly attacked by  $HBr + Aq$  than by  $HCl + Aq$ . Rapidly acted upon by  $HI$  in absence of  $O$ . (Bailey, Chem. Soc. 1888, 53. 760)

Not attacked by pure  $HCl + Aq$ , but in presence of  $O$ ,  $Hg_2OCl_2 + H_2O$  is formed. Action is apparently less in sunlight than in the dark. (Bailey, Chem. Soc. 1888, 53. 759.)

Small amts. of ferric salts hinder action of  $HNO_3$  on  $Hg$ , but it is hastened by presence of  $Mn(NO_3)_2$  or  $NaNO_2$ . (Ray, Chem. Soc. 1911, 99. 1015.)

$HNO_3$  under 33% does not attack  $Hg$  if metal and acid are kept in motion and  $HNO_2$  is absent (Veley, B. 1895, 28. 928.)

Rapidly sol. in  $HClO$ . (Balard, Dissert. 1834.)

Alkali chlorides +  $Aq$  in presence of air decomp.  $Hg$ ; action is not increased by heat. (Mabie.)

Insol. in alkali chlorides +  $Aq$  in neutral or

alkaline solution. (Bhaduri, Z. anorg. 1897, 13, 407.)

Very sol. in conc. solution of I in KI + Aq. (Varet, Bull. Soc. 1897, (3) 17, 451.)

Slowly sol. in KCl or KI + Aq in presence of air. (Palmaer, Z. phys. Ch. 1907, 59, 136.)

Slowly sol. in Na<sub>2</sub>S + Aq in presence of air. (Palmaer, Z. phys. Ch. 1907, 59, 137.)

Hg is appreciably sol. in the sulpho salts of Mo, W, V, As, Sb and Sn. (Storch, B. 1883, 16, 2015.)

Persulphates in alkali or neutral solution attack Hg. (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub> in NH<sub>4</sub>OH solution has strongest action. This dissolves Hg by repeated shaking at high temp. (Tarugi, Gazz. ch. it. 1903, 33, (1) 127.)

Insol in KCN + Aq. (Elmer, J. pr. 1888, (2) 37, 442.)

Slowly sol. in KCN + Aq in presence of air. (Palmaer, Z. phys. Ch. 1907, 59, 136.)

Sol in considerable quantity in 6% KCN + Aq. (Goyder, C. N. 1894, 69, 268.)

Most sol. in K<sub>4</sub>Fe(CN)<sub>6</sub> + Aq when KOH is present. (Smith, J. Am. Chem. Soc. 1905, 27, 541.)

Hg dissolves in Br<sub>2</sub> in the presence of KBr sl. faster than in I<sub>2</sub> but in CuBr<sub>2</sub> much more slowly. (Van Name and Edgar, Am. J. Sci. 1910, (4) 29, 255.)

Not attacked by PCl<sub>5</sub> even at 350°. (Morgan, A. ch. 1885 (6) 8, 457.)

Insol in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20, 829.)

½ ccm. oleic acid dissolves 0.0075 g. Hg in 6 days. (Gates, J. phys. Chem. 1911, 15, 143.)

**Mercurous acetylide, Hg<sub>2</sub>C<sub>2</sub> + H<sub>2</sub>O.**

(Burkard and Travers, Chem. Soc. 1902, 81, 1271.)

**Mercuric acetylide, basic, 2HgO, 3HgC<sub>2</sub> + 2H<sub>2</sub>O.**

(Burkard and Travers, Chem. Soc. 1902, 81, 1272.)

**Mercuric acetylide, HgC<sub>2</sub>.**

Very sol. in HCl with evolution of H<sub>2</sub>C<sub>2</sub>. (Keiser, Am. Ch. J. 1893, 15, 535.)

+ ½ H<sub>2</sub>O. Insol. in H<sub>2</sub>O, alcohol and ether. Sol. in NH<sub>4</sub> acetate + Aq. and in KCN + Aq. Sl. attacked by cold HCl, easily by hot. Easily sol. in HNO<sub>3</sub>. Dil. H<sub>2</sub>SO<sub>4</sub> attacks slowly; conc. causes explosion. (Plimpton and Travers, Chem. Soc. 1894, 65, 267.)

**Mercuric acetylide chloride, HgC<sub>2</sub>, HgCl<sub>2</sub> + ½ H<sub>2</sub>O**

Not acted upon by dil. HCl. Decomp. by fuming HNO<sub>3</sub> or aqua regia. Insol. in alcohol and ether. (Keiser, Am. Ch. J. 1893, 15, 538.)

**Mercuric acetylide mercuriomercuric chloride, HgC<sub>2</sub>, HgCl, HgCl<sub>2</sub> + H<sub>2</sub>O.**

Insol. in all ordinary solvents. (Biltz and Mumm, B. 1904, 37, 4420.)

**Mercurous amido fluoride, HgNH<sub>2</sub>F.**

Insol. in H<sub>2</sub>O, HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>. Sol. in dil. HCl.

Probably *dimercuri ammonium ammonium fluoride*, NH<sub>4</sub>F, NH<sub>4</sub>P. (Böhm, Z. anorg. 1901, 43, 327.)

**Mercury ammonium comps.**

See—

**Mercurioammonium comps., NH<sub>2</sub>HgR.**

**Dimercuroammonium comps., NH<sub>2</sub>Hg<sub>2</sub>R.**

**Mercurous chloramide, Hg(NH<sub>2</sub>)Cl.**

**Dimercuri ammonium comps., NH<sub>2</sub>HgR.**

**Mercuric chlor-, brom-, etc., amide, Hg(NH<sub>2</sub>)<sub>2</sub>R.**

**Mercurihammonium comps., Hg(NH<sub>2</sub>)<sub>2</sub>R.**

**Mercuriammonium comps., HgNH<sub>2</sub>R.**

**Dimercurihammonium comps., Hg<sub>2</sub>N<sub>2</sub>H<sub>2</sub>R.**

**Trimercuri ammonium comps., N<sub>2</sub>H<sub>2</sub>Hg<sub>3</sub>R.**

**Oxydimercuri ammonium comps., (NH<sub>2</sub>Hg<sub>2</sub>O)R.**

**Mercurous arsinchloride, AsHgCl.**

Decomp. by H<sub>2</sub>O. (Capitaine, J. Pharm. 25, 559.)

**Mercurous arsinchloride chloride, AsHg<sub>2</sub>Cl<sub>2</sub> = 2AsHgCl, Hg<sub>2</sub>Cl<sub>2</sub> (?)**

Decomp. by H<sub>2</sub>O. (Capitaine.)

**Mercurous azoumide, HgN<sub>2</sub>.**

Wholly insol. in H<sub>2</sub>O. (Curtius, B. 24, 3321.)

1 l. H<sub>2</sub>O dissolves 0.25 g. (Wöhler and Krupko, B. 1913, 46, 2050.)

**Mercuric azoumide, HgN<sub>4</sub>.**

Sol. in H<sub>2</sub>O especially when hot. (Berthelot and Vieille, Bull. Soc. 1894, (3) 11, 747.)

Moderately sol. in H<sub>2</sub>O. (Wöhler and Krupko, B. 1913, 46, 2050.)

**Mercuric bromamide, Hg(NH<sub>2</sub>)Br.**

Insol. in H<sub>2</sub>O and alcohol. Sl. sol. in NH<sub>4</sub>OH + Aq. (Mitscherlich, J. pr. 19, 455.)

Correct composition is *dimercuri ammonium ammonium bromide*, Hg<sub>2</sub>NBr, NH<sub>4</sub>Br, which see. (Pesci, Gazz. ch. it. 19, 511.)

**Mercurous bromide, Hg<sub>2</sub>Br<sub>2</sub>.**

Solubility in H<sub>2</sub>O = 9.1 × 10<sup>-7</sup> g. equiv. per l. (Bodländer, Z. phys. Ch. 1898, 27, 61.)

Solubility in H<sub>2</sub>O = 7 × 10<sup>-4</sup> mols. per liter at 25°. (Sherrill, Z. phys. Ch. 193, 430, 735.)

Solubility in  $H_2O$  at  $25^\circ = 1.4 \times 10^{-7}$  equivalents per l (Thompson, J. Am. Chem Soc 1906, 28, 782.)

Insol in  $H_2O$  and dil acids. Decomp. by  $HCl + Aq$ . Sol in hot conc.  $H_2SO_4$  with evolution of  $SO_2$ . Sl. sol. in hot  $HNO_3 + Aq$  of 1.42 sp. gr. (Stromann, B 20, 2818.)

Decomp into Hg and  $HgBr_2$  by boiling with  $NH_4Br$ , or  $NH_4Cl + Aq$ , also by ammonium carbonate or succinate, but not by ammonium sulphate or nitrate. (Wittstein.)

Sol in  $Hg(NO_3)_2 + Aq$ . (Wackenroder, A 41, 317.)

Partially decomp by alkali chlorides +  $Aq$ ; when out of contact of air this decomp is slight and  $HgBr_2$  is formed, while in the air  $HgCl_2$  is the resulting product. Much more rapidly decomp. in hot than cold solutions. (Mishle, A. ch. (3) 5, 177.)

A solution of  $HgBr$  in 0.1-N  $KBr$  contains about 1 mg. Hg ions in 1300 l

Insol. in alcohol  
Insol. in benzonitrile (Naumann, B 1914, 47, 1370.)

Insol. in methyl acetate (Naumann, B, 1909, 42, 3790), ethyl acetate. (Naumann, B, 1910, 43, 314.)

Insol. in acetone. (Naumann, B 1904, 37, 4329); (Eidmann, C. C. 1899, II 1014.)

#### Mercuric bromide, $HgBr_2$ .

Sol in 250 pts.  $H_2O$  at ordinary temp., and 25 pts. boiling  $H_2O$  (Wittstein) Sol in 240 pts.  $H_2O$  at  $18.75^\circ$  (Abt.)

Sol in 94 pts.  $H_2O$  at  $9^\circ$ , and in 4-5 pts at  $100^\circ$ . (Lassaigne, J. chim. méd 12, 177.)

Solubility in g-equivalents per litre =  $2 \times 10^{-3}$ . (Bodlander, Z. phys. Ch. 1898, 27, 61.)

1 l.  $H_2O$  dissolves about 4 g. at ord temp. (Morse, Z. phys. Ch. 1902, 41, 731.)

1 l.  $H_2O$  dissolves 0.017 mol. at  $25^\circ$ . (Jander, Dissert. 1902.)

Solubility in  $H_2O$  at  $25^\circ = 0.017$  mol. liter (Sherrill, Z. phys. Ch. 1903, 43, 735.)

Solubility at ord. temp. = 0.8%; at bpt. = 8-9%. (Lanne, J. Pharm. 1904, (6) 20, 450.)

Solubility in cold  $H_2O = 4\%$ , but solution prepared by heating contains more Hg on account of decomp. into  $HBr$  and oxybromide. (Vicario, C. C. 1907, II, 1224.)

1 l.  $H_2O$  dissolves about 5-6 g. at ord temp. (Gaudechon, A. ch. 1911, (8) 22, 212.)

1 l. aqueous solution at  $25^\circ$  contains 0.017 mol. (Herz and Paul, Z. anorg. 1913, 83, 431.)

Decomp. by warm  $HNO_3$ , or  $H_2SO_4 + Aq$ . Sol. in warm  $H_2SO_4$ . (Ditte, A. ch. (5) 17, 124.)

1 mol. is sol in 1 mol. warm  $HI + Aq$ . in 1 mol. cold conc.  $HCl$  and in  $\frac{1}{2}$  mol. hot conc.  $HCl$  (Léwig.)

#### Solubility of $HgBr_2$ in $KBr + Aq$ at $25^\circ$ .

Mols per liter	
KBr	$HgBr_2$
0	0.017
0 05	0.055
0 10	0 088
0 5	0 0359 r
0 866	0 611
2	1 407
3	2 096
4	2 339

(Sherrill, Z. phys. Ch. 1903, 43, 705.)

#### Solubility in various salts + $Aq$ at $25^\circ$ .

Salt	In 10 cc. of the solution	
	Millimols $HgBr_2$	Millimols salt
NaBr	0 17	0
	0 78	1 18
	2 85	5 96
	5 40	11 42
	12 76	24 43
	15 50	29.97
	23 06	52 46
KBr	0 17	0
	0 98	2 09
	4 72	7 70
	13.60	23 80
	19.30	34 70
CaBr <sub>2</sub>	0.17	0
	1 17	0 72
	6 76	6 45
	13 88	18 62
	27 66	24 79
	36 66	37 54
SrBr <sub>2</sub>	0.17	0
	1 04	0 62
	4 71	3 28
	9 02	6 68
	17 70	14 01
	22 38	18 72
BaBr <sub>2</sub>	0.17	0
	3.70	2 74
	5.40	3 96
	7 59	5 79
	14 78	10 96

(Herz and Paul, Z. anorg. 1913, 82, 434.)

Solubility in 0.1-N  $Hg(NO_3)_2 + Aq$  is about 20 g. per liter. (Morse, Z. phys. Ch. 1902, 41, 731.)

Sol in  $KBr$  or  $NaBr + Aq$ . (Jander, Dissert. 1902.)

Solubility in 10 cc.  $Br_2 + Aq$  at  $25^\circ$ .

Millimol  $Br_2$  0 753 1.797 2 321  
 " Hg 0 1844 0.1947 0 2120  
 (Herz and Paul, Z. anorg. 1914, 85, 215.)

Sat. solution in liquid  $\text{SO}_2$  contains about 1.5%  $\text{HgBr}_2$  at  $159.4^\circ$  (Niggli, Z. anorg. 1912, 75, 182.)

Moderately sol. in liquid  $\text{NH}_3$  (Gore, Am. Ch. J. 1898, 20, 839.)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84, 27.)

1 ccm. of sat. solution in abs. alcohol at ord. temp. contains 0.0058 g.  $\text{HgBr}_2$ ; at bpt. contains 0.1262 g. (Hamper, Ch. Z. 1887, 11, 905)

#### Solubility of $\text{HgBr}_2$ in alcohols + Aq at $t^\circ$ .

Alcohol	$t^\circ$	G $\text{HgBr}_2$ per 100 g alcohol
Methyl alcohol	0	41.15
	10	49.5
	19	66.3
	22	60.9
	39	71.3
	65	90.8
	97	139.1
Ethyl alcohol	0	25.2
	10	26.3
	19	29.7
	39	31.9
	65	44.5
	89	66.9
Propyl alcohol	0	14.6
	10	15.6
	19	15.5
	39	20.8
	65	31.3
	86.5	42.7
Isobutyl alcohol	0	4.61
	10	5.63
	23	6.65
	39	9.58
	65	15.80

(Timofeev, Dissert. 1894.)

Much more sol. than  $\text{HgI}_2$  in alcohol 100 g. of solution sat. at  $0^\circ$  contain 13.33-13.05 g.  $\text{HgBr}_2$ , 16.53 g. at  $25^\circ$ , 22.63 g. at  $50^\circ$ . (Reinders, Z. phys. Ch. 1900, 32, 522)

#### Solubility of $\text{HgBr}_2$ in methyl alcohol + Aq at $25^\circ$ .

P = g. alcohol in 100 g. alcohol + Aq.  
 $\text{HgBr}_2$  = millimols.  $\text{HgBr}_2$  in 10 cc. of the solution.

P	$\text{HgBr}_2$	Sp gr	P	$\text{HgBr}_2$	Sp gr
0	0.167	1.0022	47.06	0.700	0.9401
10.60	0.201	0.9857	64.00	1.90	0.9386
30.77	0.358	0.9588	78.05	4.07	0.9744
37.21	0.422	0.9508	100	13.96	1.2275

(Herz and Anders, Z. anorg. 1907, 52, 165.)

#### Solubility of $\text{HgBr}_2$ in ethyl alcohol + Aq at $25^\circ$ .

P = g. alcohol in 100 g. alcohol + Aq.  
 $\text{HgBr}_2$  = millimols.  $\text{HgBr}_2$  in 10 cc. of the solution

P	$\text{HgBr}_2$	Sp gr
0	0.167	1.0022
20.18	0.187	0.9717
40.60	0.440	0.9435
70.01	1.829	0.9214
100	6.337	0.9873

(Herz and Anders.)

#### Solubility in mixtures of methyl and propyl alcohol at $25^\circ$ .

P = % propyl alcohol in the solvent  
 G = g.  $\text{HgBr}_2$  in 10 ccm. of the solution  
 S = Sp gr. of the sat. solution.

P	G	S $25^\circ/1^\circ$
0	5.02	1.227
11.11	4.728	1.1954
23.8	4.153	1.1524
65.2	2.530	1.0257
91.8	1.635	0.9437
93.75	1.586	0.9368
96.6	1.466	0.9275
100	1.873	0.9213

(Herz and Kuhn, Z. anorg. 1908, 60, 158.)

#### Solubility in mixtures of ethyl and propyl alcohol at $25^\circ$ .

P = % propyl alcohol in the solvent.  
 G = g.  $\text{HgBr}_2$  in 10 ccm. of the solution.  
 S = Sp gr. of the sat. solution.

P	G	S $25^\circ/4^\circ$
0	2.28	0.9873
8.1	2.225	0.9802
17.85	2.106	0.9740
56.6	1.763	0.9487
88.6	1.476	0.9269
91.2	1.464	0.9239
95.2	1.406	0.9227
100	1.378	0.9213

(Herz and Kuhn, Z. anorg. 1908, 60, 161.)

#### Solubility of $\text{HgBr}_2$ in mixtures of methyl and ethyl alcohol at $25^\circ$ .

P = % methyl alcohol in the mixtures.  
 $\text{HgBr}_2$  = g.  $\text{HgBr}_2$  in 10 ccm. of the solution.  
 $S_{25^\circ/4^\circ}$  = sp gr. of the sat. solution

P	$\text{HgBr}_2$	S $25^\circ/4^\circ$
0	2.28	0.9873
4.37	2.31	0.9932
10.4	2.54	1.009
41.02	3.33	1.080
80.09	4.57	1.185
84.77	4.68	1.193
91.25	4.86	1.211
100	5.02	1.227

(Herz and Kuhn, Z. anorg. 1908, 58, 163.)

Cold sat. solution in anhydrous ether contains 0.00567 g. in 1 cc.; hot solution contains 0.032 g. (Hampe, Ch. Z. 1887, 11. 905.)

Solubility in organic solvents at 18°-20°.  
100 g. chloroform dissolve 0.126 g.  $\text{HgBr}_2$ .  
100 g. tetrachloromethane dissolve 0.003 g.  $\text{HgBr}_2$ .

100 g. bromoform dissolve 0.679 g.  $\text{HgBr}_2$ .  
100 g. ethyl bromide dissolve 2.310 g.  $\text{HgBr}_2$ .

100 g. ethylene dibromide dissolve 2.340 g.  $\text{HgBr}_2$ .

(Sule, Z. anorg. 1900, 25. 401.)

#### Solubility in $\text{CS}_2$ at t°

t°	100 pts sat. solution contain pts $\text{HgBr}_2$
-10	0.049
5	0.068
0	0.087
+5	0.105
10	0.122
15	0.140
20	0.157
25	0.232
30	0.274

(Arcetowski, Z. anorg. 1894, 6. 267.)

100 g. boiling methyl acetate (bpt. 56.2-56.7°) dissolves 24 g.  $\text{HgBr}_2$ . (Schroeder and Steiner, J. pr. 1909, (2) 79. 49.)

1 g.  $\text{HgBr}_2$  is sol. in 4.56 g. methyl acetate at 18°. Sp. gr. 18°/4° of sat. solution = 1.09 (Naumann, B. 1909, 42. 3795.)

100 g. anhydrous ethyl acetate or sat. with  $\text{H}_2\text{O}$  at 18° dissolve 130.5-135 g.  $\text{HgBr}_2$ . (Hamers, Dissert. 1906.)

Solubility of  $\text{HgBr}_2$  in ethyl acetate + Aq at 25°.

P = g. ethyl acetate in 100 g. ethyl acetate + Aq.

$\text{HgBr}_2$  = millimols  $\text{HgBr}_2$  in 10 cc of the solution.

P	$\text{HgBr}_2$	Sp. gr.
0	0.167	1.0022
4.39	0.159	1.0018
96.76	7.42	1.1159
100	3.93	1.0113

(Herz and Anders, Z. anorg. 1907, 52. 172.)

1 pt.  $\text{HgBr}_2$  sol. in 7.66 pts ethyl acetate at 18°. (Naumann, B. 1910, 43. 315.)

Easily sol. in acetone (Oppenheim, B. 2. 572.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Acetone dissolves much more  $\text{HgBr}_2$  than  $\text{HgI}_2$ . 100 g. sat. solution at 25° contain 34.58 g.  $\text{HgBr}_2$ . (Reinders, Z. phys. Ch. 1900, 32. 514.)

Solubility in diethyl oxalate is much greater than that of  $\text{HgI}_2$  and is equal to 12% at 100°. (Remders, Z. phys. Ch. 1900, 32. 507.)

Solubility in benzene = 0.0194 mol per l. at 25°. (Sherrill, Z. phys. Ch. 1903, 43. 735.)

Sol. in allyl mustard oil. (Mathews, J. phys. Chem. 1905, 9. 647.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

#### Solubility in aniline.

S = temp. of solidification.

Mols $\text{HgBr}_2$ per 100	S	Mols $\text{HgBr}_2$ per 100	S	Mols $\text{HgBr}_2$ per 100	S
4.9	9°	25.4	115.5°	49.6	123
10	43.5	33.9	117	54.9	124
12.5	57	39.5	108	58.8	134
14.9	68	41.9	113	64.0	133
19.7	89	43.9	118		
23.4	106	46.2	121		

(Staronka, Anz. Ak. Wiss. Krakau, 1910, 372.)

#### Solubility of $\text{HgBr}_2$ in quinoline.

S = temp. of solidification

Mols $\text{HgBr}_2$ per 100	S	Mols $\text{HgBr}_2$ per 100	S	Mols $\text{HgBr}_2$ per 100	S
4.4	8.9	14.3	17.6		
88°	111°	127°	134°		

(Staronka, Anz. Wiss. Krakau, 1910. 372.)

Mol. weight determined in ethyl sulphide. (Werner, Z. anorg. 1897, 15. 30.)

+4 $\text{H}_2\text{O}$ . (Thomsen.)

#### Mercuric perbromide, $\text{HgBr}_4$ .

(Herz and Paul, Z. anorg. 1914, 85. 216.)

#### Mercuric hydrogen bromide (Bromomeric acid), $\text{HgBr}_3$ , $\text{HBr} = \text{HHgBr}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Neumann, M. 10. 236.)

#### Mercuric nickel bromide, basic, $\text{HgBr}_2 \cdot \text{NiBr}_2 \cdot 6\text{NiO} + 20\text{H}_2\text{O}$ .

(Mallhe, A. ch. 1902, (7) 27. 369.)

#### Mercuric platinum bromide.

See Bromoplatinate, mercuric.

#### Mercuric potassium bromide, $\text{HgBr}_2 \cdot \text{KBr}$ .

Sol. in  $\text{H}_2\text{O}$ , but decomp. by a large amount, with separation of one half of the  $\text{HgBr}_2$ . (v. Bonsdorff, Pogg. 19. 339.)

2 $\text{HgBr}_2 \cdot \text{KBr} + 2\text{H}_2\text{O}$ . Permanent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)

#### Mercuric sodium bromide, $\text{HgBr}_2 \cdot \text{NaBr}$ .

Deliquescent. (v. Bonsdorff.)

(Varet, C. R. 1890, 111, 527.)

$\text{HgBr}_2, 2\text{NaBr}$   
Very sol. in  $\text{H}_2\text{O}$  (Vicario, J. Pharm. 1907, (5) 26, 115.)  
 $2\text{HgBr}_2, \text{NaBr} + 3\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$  and alcohol. (Berthelot.)

**Mercuric strontium bromide,  $\text{HgBr}_2, \text{SrBr}_2$ .**  
Sol in all proportions of  $\text{H}_2\text{O}$  (Löwig, Mag. Pharm. 33, 7.)  
 $2\text{HgBr}_2, \text{SrBr}_2$ . Decomp. by  $\text{H}_2\text{O}$  into  $\text{HgBr}_2$  and  $\text{HgBr}_2, \text{SrBr}_2$ . (Löwig)

**Mercuric zinc bromide.**  
Deliquescent in moist air (v. Bonsdorff.)

**Mercuric zinc bromide cyanide ammonia.**  
See Cyanide zinc bromide ammonia, mercuric.

**Mercuric bromide ammonia,  $\text{HgBr}_2, 2\text{NH}_3$**   
Decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in min acids and acetic acid. (Naumann, B. 1910, 43, 316.)

**Mercuric bromide cadmium oxide,**  
 $\text{HgBr}_2, \text{CdO} + \text{H}_2\text{O}$   
(Mailhe, A. ch. 1902, (7) 27, 371.)

**Mercuric bromide cupric oxide,**  
 $\text{HgBr}_2, \text{CuO} + 3\text{H}_2\text{O}$   
(Mailhe, Bull. Soc. 1901, (3) 26, 791.)

**Mercuric bromide hydrazine,  $\text{HgBr}_2, \text{N}_2\text{H}_4$ .**  
(Hofmann and Marburg, A. 1899, 305, 215.)

**Mercuric bromide potassium chloride,**  
 $\text{HgBr}_2, 2\text{KCl}$   
Decomp. by  $\text{H}_2\text{O}$ . (Harth, Z. anorg. 1907, 14, 345.)

**Mercuric bromide zinc oxide,  $\text{HgBr}_2, \text{ZnO} + 3\text{H}_2\text{O}$ .**  
(Mailhe, C. R. 1901, 132, 1274.)

**Mercuric bromoiodide,  $\text{HgBrI}$ .**  
Sol in alcohol and ether. Can be recrystallised from ether without decomp. (Oppenheim, B. 2, 571.)

**Mercurous chloramide,  $\text{Hg}_2(\text{NH}_2)\text{Cl}$ .**  
Insol. in boiling  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Kane, A. ch. (2) 72, 215.)  
Mixture of  $\text{Hg}$  and  $\text{HgNH}_2\text{Cl}$ . (Barfoed, J. pr. (2), 39, 201.)

**Mercuric chloramide,  $\text{Hg}(\text{NH}_2)\text{Cl}$ .**  
Composition is *dimercuriammonium ammonium chloride*,  $\text{Hg}_2\text{NCl}, \text{NH}_4\text{Cl}$ , which see.

**Mercuric chloramide oxymercuriammonium chloride,  $4\text{Hg}(\text{NH}_2)\text{Cl}, (\text{NH}_4\text{OH})_2\text{Cl}$ .**  
(Millon.)

Correct composition is *dimercuriammonium ammonium chloride*,  $\text{NH}_4\text{Cl}, \text{NH}_4\text{Cl}$ , which see. (Balestra, Gazz. ch. it. 21, (2) 294.)  
 $\text{Hg}(\text{NH}_2)\text{Cl}, (\text{NH}_4\text{OH})_2\text{Cl}$ . (Millon.)  
True composition is *dimercuriammonium mercuric chloride*,  $2\text{Hg}_2\text{NCl}, \text{HgCl}_2 + \text{H}_2\text{O}$ ; or *dimercuriammonium hydrogen chloride*,  $\text{NH}_4\text{Cl}, \text{HCl}$  (Balestra.)

**Mercuric chloramide chloride,  $\text{Hg}(\text{NH}_2)\text{Cl}, \text{HgCl}_2$ .**

Properties as mercuric chloramide. Decomp. by cold  $\text{HCl} + \text{Aq}$ . (Millon.)  
True composition is *dimercuriammonium hydrogen chloride*,  $\text{NH}_4\text{Cl}, 2\text{HCl}$ . (Balestra, Gazz. ch. it. 21, (2) 294.)

**Mercuric chloramide chromate,**  
 $2\text{Hg}(\text{NH}_2)\text{Cl}, \text{HgCrO}_4$   
Decomp. by hot  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ . (Jager and Kruss, B. 22, 2048.)

**Mercurous chloride,  $\text{Hg}_2\text{Cl}_2$ .**  
Almost absolutely insol. in cold, but gradually sol. decomp. by boiling  $\text{H}_2\text{O}$ .  
Calculated from electrical conductivity of  $\text{Hg}_2\text{Cl}_2 + \text{Aq}$ , 1 l.  $\text{H}_2\text{O}$  dissolves 3.1 mg.  $\text{Hg}_2\text{Cl}_2$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12, 241.)  
1 l.  $\text{H}_2\text{O}$  dissolves 2 mg.  $\text{Hg}_2\text{Cl}_2$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50, 350.)  
1 l.  $\text{H}_2\text{O}$  dissolves 1.4 mg. at  $0.5^\circ$ ; 21 mg. at  $18^\circ$ , 2.8 mg. at  $24.6^\circ$ , 7 mg. at  $43^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64, 150.)

When finely divided, is 10% more sol. than when coarsely crystalline. (Sauer, Z. phys. Ch. 1904, 47, 184.)

Solubility in  $\text{H}_2\text{O} = 0.8 \times 10^{-6}$  g. mol (Ley, Z. Elektrochem. 1904, 10, 301.)

Sl. sol. with decomp. in boiling  $\text{H}_2\text{O}$  free from air, 20 ccm.  $\text{H}_2\text{O}$  affording 0.002 g.  $\text{Hg}_2\text{Cl}_2$  after boiling 1 hour with  $\text{Hg}_2\text{Cl}_2$ . (Mialhe, A. ch. (3) 5, 176.)  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$  containing 1 pt.  $\text{Hg}_2(\text{NO}_3)_2$  to 250,000 pts.  $\text{H}_2\text{O}$  give ppt of  $\text{Hg}_2\text{Cl}_2$  with  $\text{HCl} + \text{Aq}$ . Sol. with decomp. in conc.  $\text{HCl} + \text{Aq}$ , hot  $\text{HNO}_3 + \text{Aq}$ , aqua regia, or  $\text{Cl}_2 + \text{Aq}$  (Frobenius.) Insol. in cold dil. acids, but slowly sol. on heating.

The solubility of  $\text{Hg}_2\text{Cl}_2$  in  $\text{HCl} + \text{Aq}$  increases slowly with time, and finally reaches a point where it increases very rapidly, which takes place sooner the more dil. the acid. Presence of  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$  helps the solubility. (Why not oxidation to  $\text{HgCl}_2$ ?) (Varenne, C. R. 92, 1161.)

Solubility of  $\text{Hg}_2\text{Cl}_2$  in  $\text{HCl} + \text{Aq}$  at  $25^\circ$ .  
Solid phase =  $\text{Hg}_2\text{Cl}_2 + 0.1 \text{ g. Hg.}$

G per l		Sp gr of solutions
$\text{HCl}$	$\text{Hg}_2\text{Cl}_2$	
31 69	0 034	
36 46	0 048	
95 43	0.207	1 042
158 4	0.399	1 069
209 2	0 548	1.091
267 3	0 654	1 114
278 7	0 675	1.119
317 3	0 670	1 132
364 6	0 673	1 153

(Richards and Archibald, Z. phys. Ch. 1902, 40, 385.)

Cold conc.  $\text{H}_2\text{SO}_4$  does not dissolve or decomp. Boiling  $\text{H}_2\text{SO}_4$  dissolves with evolution of  $\text{SO}_2$  (Vogel.)

Solubility of  $\text{Hg}_2\text{Cl}_2$  in chlorides +  $\text{Aq}$  at  $25^\circ$ .  
Solid phase =  $\text{Hg}_2\text{Cl}_2 + 0.1 \text{ g. Hg.}$

Salt	G per liter		Sp gr of solutions
	$\text{NaCl}$	$\text{Hg}_2\text{Cl}_2$	
$\text{NaCl}$	5 85	0 0041	
	58 50	0 041	1.040
	119.	0 129	1.078
	148 25	0 194	1.093
	222.3	0.380	1.142
	292.5	0.643	1 188
$\text{BaCl}_2$	104 15	0 044	1.088
	156.22	0 088	1 134
	208.30	0 107	1 174
	312.54	0 231	1 263
$\text{CaCl}_2$	39.96	0.022	..
	55 5	0.033	..
	111	0.081	1.064
	138 75	0.118	1.105
	195.36	0 231	1 151
	267 52	0 322	1 205
	324 67	0 430	1 243
	432 9	0 518	1 315
	499 5	0.510	1 358

(Richards and Archibald, Z. phys. Ch. 1902, 40, 385.)

Sol. in cold  $\text{HCN} + \text{Aq}$  with separation of  $\text{Hg}$ .

Sol. in alkali chlorides +  $\text{Aq}$ .  $\text{NH}_4\text{Cl} + \text{Aq}$  dissolves out  $\text{Hg}_2\text{Cl}_2$  at ord. temp., much more at  $40-50^\circ$ . Dil.  $\text{NH}_4\text{Cl} + \text{Aq}$  decomposes more slowly than conc. Access of air hastens reaction. (Mihle.)

When heated several hours to  $40-50^\circ$ , 100 pts.  $\text{NH}_4\text{Cl} + 833$  pts.  $\text{H}_2\text{O}$  form 0.75 pt.  $\text{Hg}_2\text{Cl}_2$  from 25 pts.  $\text{Hg}_2\text{Cl}_2$ ; 100 pts.  $\text{NaCl} + 833$  pts.  $\text{H}_2\text{O}$  form 0.33 pt.  $\text{Hg}_2\text{Cl}_2$  from 25 pts.  $\text{Hg}_2\text{Cl}_2$ ; 100 pts.  $\text{KCl} + 833$  pts.  $\text{H}_2\text{O}$  form

0.25 pt.  $\text{Hg}_2\text{Cl}_2$  from 25 pts.  $\text{Hg}_2\text{Cl}_2$ ; 100 pts.  $\text{BaCl}_2 + 833$  pts.  $\text{H}_2\text{O}$  form 0.33 pt.  $\text{Hg}_2\text{Cl}_2$  from 25 pts.  $\text{Hg}_2\text{Cl}_2$ . (Mihle, J. Pharm. 26, 108.)

Other chlorides act as  $\text{NH}_4\text{Cl}$ , only less vigorously. (Pettenkofer.)

By boiling 1 pt.  $\text{Hg}_2\text{Cl}_2$  10 times with a solution of 1 pt.  $\text{NaCl}$  each time, the  $\text{Hg}_2\text{Cl}_2$  is finally completely decomp. (Henna.)

Boiling  $\text{BaCl}_2 + \text{Aq}$  or  $\text{CaCl}_2 + \text{Aq}$  dissolve traces.  $\text{K}_2\text{SO}_4 + \text{Aq}$ ,  $\text{KNO}_3 + \text{Aq}$ , or  $\text{KHC}_2\text{H}_3\text{O}_2 + \text{Aq}$  do not dissolve. (Pettenkofer.)

Sol. in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . Insol. in  $\text{NH}_4$  nitrate, or succinate +  $\text{Aq}$ . (Wittstein.)

Sol. in hot  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ , and still more in hot  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ ; on cooling it crystallizes out completely. 25 g.  $\text{Hg}_2\text{Cl}_2$  dissolve in 1.5 l.  $\text{H}_2\text{O}$  containing 60 g.  $\text{Hg}(\text{NO}_3)_2$ . (Debray, C. R. 70, 995.)

Sol. in  $\text{PtCl}_2 + \text{Aq}$ .

Decomp. by  $\text{NH}_4\text{OH} + \text{Aq}$ .

Decomp. by  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ .

Sol. in  $\text{Na}_2\text{S}_2\text{O}_5 + \text{Aq}$ . (Faktor, C. C. 1905, I, 1524.)

Very sl. sol. in  $\text{NH}_4$  succinate. (Wittstein.)

Insol. in  $\text{SbCl}_3$  (Klemensiewicz, C. C. 1908, II, 1850.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 829.)

Insol. in alcohol or ether. More sol. in  $\text{H}_2\text{O}$  containing pepsin and an acid than in  $\text{H}_2\text{O}$ , and is not converted thereby into  $\text{HgCl}_2$ . (Torsellini, Ann. Chim. Ch. farm. (4) 4, 105.)

Small amts. are sol. with decomp. in alcohol, ether and  $\text{CHCl}_3$ . 1 g.  $\text{CHCl}_3$  dissolves 0.0946 g.  $\text{Hg}_2\text{Cl}_2$ . (Madagan, Arch. Pharm. 1884, 222, 788.)

Formic acid (95%) dissolves at  $16.5^\circ$ , 0.02%; at  $18^\circ$ , 0.0003% (Aschan, Ch. Z. 1913, 37, 1117.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate (Hamers, Dissert. 1906; Naumann, B. 1904, 37, 3602.)

Somewhat sol. in hydroxylamine hydrochloride. (Adams, Am. Ch. J. 1902, 28, 1216.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II, 1014.)

Solubility in organic solvents at  $18-20^\circ$ .

100 g. chloroform dissolve traces of  $\text{HgCl}_2$ .

100 g. bromoform dissolve 0.055 g.  $\text{HgCl}_2$ .

100 g. ethyl bromide dissolve traces of  $\text{HgCl}_2$ .

100 g. ethylene dibromide dissolve traces of  $\text{HgCl}_2$ . (Sulo, Z. anorg. 1900, 25, 401.)

**Mercuric chloride,  $\text{HgCl}_2$ .**

Permanent.

Sol. in 18.5 pts.  $\text{H}_2\text{O}$  at  $13.8^\circ$ , and 2-3 pts. at  $100^\circ$ . (J. Davy, 1822.) Sol. in 3 pts. boiling  $\text{H}_2\text{O}$ . (Wenzel.) Sol. in 18.23 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ , and 3 pts. at  $100^\circ$ . (M. R. and P.) Sol. in 18.46 pts. at  $18.75^\circ$ . (Abl.) Sol. in 16 pts. cold, and 3 pts. warm  $\text{H}_2\text{O}$ . (Dumas.)

100 pts.  $H_2O$  dissolve pts.  $HgCl_2$  at  $t^\circ$ :

$t^\circ$	Pts $HgCl_2$	$t^\circ$	Pts $HgCl_2$	$t^\circ$	Pts $HgCl_2$
0	5.73	40	9.62	80	24.30
10	6.57	50	11.34	90	37.05
20	7.39	60	13.86	100	53.96
30	8.43	70	17.29		

(Poggiale, A. ch. (3) 8. 468)

Solubility of  $HgCl_2$  in  $H_2O$ .

$t^\circ$	% $HgCl_2$	$t^\circ$	% $HgCl_2$
+ 1	3.9	80	23.6
4.5	4.8	87	28.2
4.5	4.8	100	39.3
7.5	5.1	121	59.7
13.8	5.2	127	69.7
25.1	7.1	140	77.0
29.5	7.6	150	78.4
38.0	9.9	159	80.2
49	11.3	160	81.7
61	15.1	165	81.8

(Étard, A. ch. 1894, (7) 2. 557.)

71.17 g.  $HgCl_2$  are sol. in 1 l.  $H_2O$  at  $25^\circ$ . (Morse, Z. phys. Ch. 1902, 41. 726)Solubility at  $25^\circ = 0.267$  mol in 1 l.  $H_2O$  (Jander, Z. Elektrochem. 1903, 8. 088)Solubility in  $H_2O$  at  $25^\circ = 0.263$  mol liter (Shearill, Z. phys. Ch. 1903, 43. 735)Sat.  $HgCl_2 + Aq$  at  $25^\circ$  contains 6.9%  $HgCl_2$ . (Foot, Am. Ch. J. 1906, 35. 234.) $HgCl_2 + Aq$  contains 3.95 g.  $HgCl_2$  in 100 g of solution at  $0^\circ$ ; 7.67 g at  $30^\circ$ . (Schreinemakers, Ch. Weekbl. 1910, 7. 202) $HgCl_2 + Aq$  sat. at  $(?)$  contains 6.8%  $HgCl_2$ . (Abe, J. Tok. Chem. Soc. 1912, 33. 1087.) $HgCl_2 + Aq$  sat. at  $35^\circ$  contains 8.51%  $HgCl_2$ . (Schreinemakers and Thonius, Ver. K. Akad. Wet. Amsterdam, 1912, 21. 333.)1 l. aqueous solution sat. at  $25^\circ$  contains 0.265 mol.  $HgCl_2$  (Herz and Paul, Z. anorg. 1913, 82. 431) $H_2O$  dissolves 7.39% at  $20^\circ$  (Aschan, Ch. Z. 1913, 37. 1117.) $HgCl_2 + Aq$  sat at  $8^\circ$  has 1.041 sp. gr. (Anthon, 1837)Sp. gr. of  $HgCl_2 + Aq$  at  $20^\circ$ .

% $HgCl_2$	Sp. gr.	% $HgCl_2$	Sp. gr.
1	1.0072	4	1.0323
2	1.0148	5	1.0411
3	1.0236		

(Schroder, calculated by Gerlach, Z. anal. 27. 306.)

Sp. gr. of  $HgCl_2 + Aq$  at  $15^\circ$ .

% $HgCl_2$	Sp. gr.	% $HgCl_2$	Sp. gr.
8	1.071	11	1.1035
9	1.0815	12	1.115
10	1.095	13	1.127

(Mendelejeff, calculated by Gerlach, Z. anal. 27. 306)

Sp. gr. of  $HgCl_2 + Aq$ .

$HgCl_2$	Sp. gr.			
	at $0^\circ$	at $10^\circ$	at $20^\circ$	at $30^\circ$
4.72	1.04070	1.04033	1.03856	1.03566
3.57	1.03050	1.03022	1.02855	1.02577
2.42	1.02035	1.02018	1.01856	1.01585
1.22	1.01008	1.00990	1.00835	1.00575

(Schröder, B. 19. 161 R.)

Sp. gr. of  $HgCl_2 + Aq$  at room temp containing:

0.226	3.55% $HgCl_2$ .
1.0233	1.0328

(Wagner, W. Ann. 1883, 18. 266.)

Sp. gr. of  $HgCl_2 + Aq$  at  $25^\circ$ .

Concentration of $HgCl_2 + Aq$	Sp. gr.
$1/1$ -normal	1.0275
$1/2$ - " "	1.0138

(Wagner, Z. phys. Ch. 1890, 5. 39)

Sp. gr. at  $16^\circ/4^\circ$  of  $HgCl_2 + Aq$  containing 4.5256%  $HgCl_2 = 1.03806$ .Sp. gr. at  $16^\circ/4^\circ$  of  $HgCl_2 + Aq$  containing 4.2224%  $HgCl_2 = 1.03491$  (Schonrock, Z. phys. Ch. 1893, 11. 768) $HgCl_2 + Aq$  containing 6.04%  $HgCl_2$  has sp. gr.  $20^\circ/20^\circ = 1.0523$ . $HgCl_2 + Aq$  containing 6.08%  $HgCl_2$  has sp. gr.  $20^\circ/20^\circ = 1.0526$ 

(Le Blanc and Rohland, Z. phys. ch. 1896, 19. 282.)

Sat.  $HgCl_2 + Aq$  boils at  $101.1^\circ$ . (Griffiths)B.-pt. of  $HgCl_2 + Aq$ 

% $HgCl_2$	B.-pt.	% $HgCl_2$	B.-pt.
4.8	100.10°	11.04	100.20°
9.0	100.16	15.2	100.275

(Skinner, Chem. Soc. 61. 340.)

Solubility in  $HCl + Aq$  is greater than in  $H_2O$ . (Dumas)Sol. in 0.5 pt.  $HCl + Aq$  of 1.168 sp. gr. at  $23.3^\circ$ , forming a solution of 2.412 sp. gr. (Davy, 1822)

Solubility of  $\text{HgCl}_2$  in  $\text{HCl} + \text{Aq.}$ 

Pts. $\text{HCl}$ in 100 pts. $\text{H}_2\text{O}$	Pts. $\text{HgCl}_2$ dissolved by 100 pts. liquid	Pts. $\text{HCl}$ in 100 pts. $\text{H}_2\text{O}$	Pts. $\text{HgCl}_2$ dissolved by 100 pts. liquid
0 0	6 8	21 6	127 4
5 6	46.8	31 0	141 9
10 1	73.7	50 0	148 0
13 8	87 8	68 0	154 0

(Ditte, A. ch. (5) 22. 551.)

Solubility in  $\text{HCl} + \text{Aq}$  at  $0^\circ$   $\frac{\text{HgCl}_2}{2} = \frac{1}{2}$  mols. $\text{HgCl}_2$  (in mgs.) in 10 ccm. solution,  $\text{HCl}$   
= mols  $\text{HCl}$  ditto,  $\text{H}_2\text{O}$  = grms.  $\text{H}_2\text{O}$   
present.

$\frac{\text{HgCl}_2}{2}$	$\text{HCl}$	Sp. gr.	$\text{H}_2\text{O}$
9 7	4.3	1 117	9 704
19.8	9.9	1 238	9 340
35 5	17 8	1 427	9 816
55 6	26 9	1 665	8 135
68.9	32 25	1 811	7 714
72 37	34 25	1 874	7 679
85 5	41 5	2 023	7 131
88.65	48.1	2 066	6 893
95 675	70 875	2 198	6 431

(Engel, A. ch. (6) 17. 362.)

Not decomp. by  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq.}$ Sol. in 630 pts.  $\text{H}_2\text{SO}_4$ , and in more than 500 pts. hot  
 $\text{HNO}_3 + \text{Aq.}$  of 1.41 sp. gr. without decomp. (J. Davy)Sol. in  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HIO}_3$ , or  $\text{H}_2\text{CrO}_4$   
without decomp. (Millon, A. ch. (3) 18. 373.)Very sl. sol. in  $\text{HNO}_3$ , but not decomp  
thereby (Wurtz)Solubility of  $\text{HgCl}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $30^\circ$ .

Composition of liquid phase			Solid phase
% $\text{HgCl}_2$	% $\text{NH}_4\text{Cl}$	% $\text{H}_2\text{O}$	
0	29 5	70 5	$\text{NH}_4\text{Cl}$
15 68	27 56	56 76	"
22 80	26 91	50 29	"
31 96	26 16	41 88	"
42.45	25 05	32 50	"
50 05	24 79	25 16	{ $\text{NH}_4\text{Cl} + \text{HgCl}_2$ , $2\text{NH}_4\text{Cl}$ , $\text{H}_2\text{O}$
50 60	24 31	25 09	$\text{HgCl}_2$ , $2\text{NH}_4\text{Cl}$ , $\text{H}_2\text{O}$
53 08	22.77	24.15	"
55 97	21 42	22 61	"
58.91	20 06	21 08	$\text{HgCl}_2$ , $2\text{NH}_4\text{Cl}$ , $\text{H}_2\text{O} +$
58.89	19 98	21 13	$\text{HgCl}_2$ , $\text{NH}_4\text{Cl}$ , $\text{H}_2\text{O}$
56 83	18.86	24.61	$\text{HgCl}_2$ , $\text{NH}_4\text{Cl}$ , $\text{H}_2\text{O}$
56.38	18.50	25.12	"
55.83	17.70	26 47	"
55.70	17 13	27 17	"
55.58	16 82	27 60	"

Solubility of  $\text{HgCl}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$   
at  $30^\circ$ —Continued.

Composition of liquid phase			Solid phase
% $\text{HgCl}_2$	% $\text{NH}_4\text{Cl}$	% $\text{H}_2\text{O}$	
55 55	15 94	28 51	$\text{HgCl}_2$ , $\text{NH}_4\text{Cl}$ , $\text{H}_2\text{O}$
55 85	15 35	28 80	"
56 71	14 22	29 07	"
57 04	14 10	28.86	$\text{HgCl}_2$ , $\text{NH}_4\text{Cl}$ , $\text{H}_2\text{O} +$
58 98	14 14	28.88	$3\text{HgCl}_2$ , $2\text{NH}_4\text{Cl}$ , $\text{H}_2\text{O}$
56 83	13 90	29.27	$3\text{HgCl}_2$ , $2\text{NH}_4\text{Cl}$ , $\text{H}_2\text{O}$
56.26	13 04	30 70	"
56 43	11 88	31 69	"
56 70	11 05	32 23	"
57.05	9.92	33 02	"
58 55	9.23	32 22	"
58 65	9 20	32 15	{ $3\text{HgCl}_2$ , $2\text{NH}_4\text{Cl}$ , $\text{H}_2\text{O} +$ $9\text{HgCl}_2$ , $2\text{NH}_4\text{Cl}$
51 83	8 76	39 41	$9\text{HgCl}_2$ , $2\text{NH}_4\text{Cl}$
46.00	7 52	46 48	"
39 02	6 28	54.70	"
35 60	5 26	59 14	"
35 10	5 18	59 72	"
32 90	5.06	62 04	"
29 65	3 62	66 73	$9\text{HgCl}_2$ , $2\text{NH}_4\text{Cl} + \text{HgCl}_2$
40 12	5 13	54 75	$\text{HgCl}_2$
21 00	2 29	76 71	"
7 67	0	92 33	"

(Meerburg, Z. anorg 1908, 59. 139)

1 pt. sat.  $\text{NaCl} + \text{Aq}$  dissolves 1.29 pts.  
 $\text{HgCl}_2$  at  $14^\circ$ . (Voit, A. 104. 354.)Sat.  $\text{NaCl} + \text{Aq}$  (20 grains  $\text{H}_2\text{O} + 7$  grains  $\text{NaCl}$ ) dis-  
solves 32 grains  $\text{HgCl}_2$  at  $15^\circ$ , and 3 grains more on  
warming. Sp. gr. of solution = 2.14 (Davy, 1822)Sat.  $\text{KCl} + \text{Aq}$  (21 grains  $\text{H}_2\text{O} + 7$  grains  $\text{KCl}$ ) dis-  
solves 8 grains  $\text{HgCl}_2$  on being gently heated. (Davy)Sat.  $\text{BaCl}_2 + \text{Aq}$  (20 grains  $\text{H}_2\text{O} + 8$  grains  $\text{BaCl}_2 +$   
 $2\text{H}_2\text{O}$ ) dissolves 16 grains  $\text{HgCl}_2$  at  $15^\circ$ , and 4 grains  
more on heating. Sp. gr. of solution = 1.9 (Davy) $\text{MgCl}_2 + \text{Aq}$  (31 grains  $\text{HCl} + \text{Aq}$  of 1.58 sp. gr.  
neutralised with  $\text{MgO}$ ) dissolves 40 grains  $\text{HgCl}_2$ , and  
25 grains more on gently heating. Sp. gr. of solution =  
2.85 (Davy)Sol. in sat.  $\text{KCl}$ ,  $\text{NaCl} + \text{Aq}$ , and in  $\text{MnCl}_2$ ,  $\text{ZnCl}_2$ ,  
 $\text{CoCl}_2$ ,  $\text{FeCl}_2$ ,  $\text{NiCl}_2$ , and  $\text{CuCl}_2 + \text{Aq}$  (v. Bonsdorff,  
Pogg 17 123)The solubility in  $\text{H}_2\text{O}$  is greatly increased  
by the addition of cupric chloride. 8.5%  
 $\text{HgCl}_2$  is sol. in pure  $\text{H}_2\text{O}$  and 52.8%  $\text{HgCl}_2$   
is sol. in 18.06%  $\text{CuCl}_2 + \text{Aq.}$  (Schreine-  
makers, C. C. 1913, I. 1858.)

Solubility of  $\text{HgCl}_2 + \text{KCl}$  at 25°.

Composition of solution		Composition of undissolved residue		Solid phase
$\text{KCl}$	$\text{HgCl}_2$	$\text{KCl}$	$\text{HgCl}_2$	
26.16	0	100	0	$\text{KCl} + 2\text{KCl}, \text{HgCl}_2, \text{H}_2\text{O}$
26.21	15.04		3.63	
26.24	15.02		26.15	
26.43	15.02		72.01	
26.44	14.02		61.04	$2\text{KCl}, \text{HgCl}_2, \text{H}_2\text{O}$
26.74	18.91	34.61	61.66	
			3.73	
22.36	21.36	34.77	62.02	$2\text{KCl}, \text{HgCl}_2, \text{H}_2\text{O} + \text{KCl}, \text{HgCl}_2, \text{H}_2\text{O}$
21.30	24.88	31.05	61.84	
20.42	27.62		65.24	
20.26	27.38		73.08	$\text{KCl}, \text{HgCl}_2, \text{H}_2\text{O}$
17.95	25.34	21.89	75.10	
			3.01	
9.20	18.45	21.02	74.36	$\text{KCl}, \text{HgCl}_2, \text{H}_2\text{O} + \text{KCl}, 2\text{HgCl}_2, 2\text{H}_2\text{O}$
7.80	19.56	20.76	73.06	
6.84	22.81	20.75	74.54	
6.69	24.32	20.54	73.69	$\text{KCl}, 2\text{HgCl}_2, 2\text{H}_2\text{O} + \text{HgCl}_2$
6.62	25.13		76.46	
6.64	25.16		80.60	$\text{KCl}, 2\text{HgCl}_2, 2\text{H}_2\text{O}$
6.27	25.11	12.09	83.20	
			1.71	
3.77	21.73	11.97	84.18	$\text{KCl}, 2\text{HgCl}_2, 2\text{H}_2\text{O} + \text{HgCl}_2$
4.08	21.75		81.46	
4.06	25.17		63.58	$\text{HgCl}_2$
4.60	24.82		98.50	
0	0.00	0	100	

(Foote and Levy, Am. Ch. J. 1906, 35, 239.)

Solubility of  $\text{HgCl}_2 + \text{KCl}$  at 20°.

G per 100 g $\text{H}_2\text{O}$		Solid phase
$\text{KCl}$	$\text{HgCl}_2$	
0	7.39	$\text{HgCl}_2$
1.12	11.63	"
2.39	15.72	"
4.06	22.17	"
4.84	25.16	$\text{HgCl}_2 + 2\text{HgCl}_2, \text{KCl}$
5.60	25.13	$2\text{HgCl}_2, \text{KCl}$
6.71	25.66	"
7.39	26.41	$2\text{HgCl}_2, \text{KCl} + \text{HgCl}_2, \text{KCl}$
7.46	24.70	$\text{HgCl}_2, \text{KCl}$
8.95	19.93	"
15	22.87	"
17.57	26.12	"
20.36	29	"
26.31	34.83	"
30.32	39.10	"
34.12	42.82	$\text{HgCl}_2, \text{KCl} + \text{HgCl}_2, 2\text{KCl}$
34.18	39.34	$\text{HgCl}_2, 2\text{KCl}$
34.34	35.16	"
34.54	30.63	"
37.72	24.30	"
41.13	19.33	$\text{HgCl}_2, 2\text{KCl} + \text{KCl}$
39.66	15.76	$\text{KCl}$
37.87	10.28	"
35.32	2.1	"

(Tichomiroff, J. russ. Phys. Chem. Soc. 1907 39, 731.)

Solubility of  $\text{HgCl}_2 + \text{RbCl}$  in  $\text{H}_2\text{O}$ . Solubility data are given showing double salts formed at 25°. (Foote and Levy, l. c.)Solubility in  $\text{NaCl} + \text{Aq}$ . 100 pts  $\text{NaCl} + \text{Aq}$  containing given %  $\text{NaCl}$  dissolve g.  $\text{HgCl}_2$ 

% $\text{NaCl}$	g $\text{HgCl}_2$ at 15°	g $\text{HgCl}_2$ at 65°	g $\text{HgCl}_2$ at 100°
26	128	152	208
25	120	142	196
10	58	68	110
5	30	36	64
1	14	18	48
0.5	10	13	44

(Homeyer and Ritsert, Pharm. Ztg. 33, 738.)

Solubility of  $\text{HgCl}_2 + \text{NaCl}$  at 25°.

Composition of solution		Composition of undissolved residue			Solid phase
$\text{NaCl}$	$\text{HgCl}_2$	% $\text{NaCl}$	% $\text{HgCl}_2$	% $\text{H}_2\text{O}$	
26.5	0	100	0		$\text{NaCl} + \text{NaCl}, \text{HgCl}_2, 2\text{H}_2\text{O}$
18.06	51.35		16.39	0	
18.71	51.32		21.98		"
18.64	51.42		68.45		
18.87	51.26		71.25		
14.07	57.74	16.38	74.18	9.44	$\text{NaCl}, \text{HgCl}_2, 2\text{H}_2\text{O}$
14.03	59.00	10.36	74.21	9.43	"
13.25	62.16	10.16	74.70	9.14	"
13.17	62.59	15.06	74.78	0.28	"
12.97	62.50		78.20		$\text{NaCl}, \text{HgCl}_2, 2\text{H}_2\text{O} + \text{HgCl}_2$
13.14	62.48		88.64		"
13.15	62.55		90.83		"

(Foote and Levy, Am. Ch. J. 1906, 35, 239.)

105.0 g.  $\text{HgCl}_2$  are sol. in 1 l of 0.1-N  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  at 25°. (Morse, Z. phys. Ch. 1902, 4, 726.)Solubility in  $\text{MCl} + \text{Aq}$  at 25°.

Salt	In 10 ccm of the solution	
	Millimols $\text{HgCl}_2$	Millimols salt
$\text{LiCl}$	2.65	0
	3.51	4.14
	6.66	8.35
	10.21	12.71
	16.78	17.38
	22.14	22.65
	28.96	30.91
	30.62	35.27
$\text{NaCl}$	2.65	0
	3.72	2.12
	5.08	4.16
	7.48	6.71
	11.92	11.53
	20.22	19.41
	27.54	27.83
	34.34	31.62

Solubility in  $\text{MCl} + \text{Aq}$  at  $25^\circ$ —*Continued.*

Salt	In 10 cc. of the solution	
	Millimols $\text{HgCl}_2$	Millimols salt
$\text{KCl}$	2 65	0
	3 55	1 74
	3 81	2 21
	8 36	6 83
$\text{MgCl}_2$	2 65	0
	3 74	1 68
	7 19	4 15
	11 31	5 70
	18 64	9 97
	25 69	13 20
	32 06	17 28
$\text{CaCl}_2$	2 65	0
	3 64	1 90
	7 66	4 02
	11 08	6 56
	18 11	9 64
	26 45	14 29
	33 04	17 23
$\text{SrCl}_2$	2 65	0
	3 15	1 64
	5 63	3 11
	8 29	5 19
	13 42	7 24
	17 76	10 46
	22 93	13 86
$\text{BaCl}_2$	2 65	0
	6 97	3 85
	11 67	5 72
	16 20	7 76
	26 45	13 36
	53 48	30 30

(Herz and Paul, Z. anorg. 1913, 82. 433.)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of  $\text{I}_2$ . (Herz and Paul, Z. anorg. 1914, 86. 214.)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of hydroxylamine hydrochloride. (Adams, Am. Ch. J. 1902, 28. 213.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

Abundantly sol. in  $\text{H}_2\text{PtCl}_4 + \text{Aq}$ . (Nilson, B. 1876, 9. 1146.)

Sol. in 2.5 pts. solid alcohol (Richter), 3 pts. (Karl), 2.5 pts. alcohol of 0.833 sp. gr. at ordinary temp., and 1.167 pts. on boiling (Berzelius); 2 pts. alcohol of 0.810 sp. gr. at  $15.5^\circ$  (sp. gr. of solution = 1.08) (J. Davy, Phil. Trans. 1822 353).

At  $10^\circ$ , sol. in 2.37 pts. alcohol of  $39^\circ$  (Cartier), in 2.9 pts. alcohol of  $35^\circ$ , in 3.5 pts. alcohol of  $35^\circ$ , in 4.2 pts. alcohol of  $30^\circ$ , in 6.3 pts. alcohol of  $22^\circ$ , in 14.6 pts. alcohol of  $14^\circ$  (N. E. Henry)

Sol. in 25 mols. methyl, 13.1 mols. ethyl, and 20.3 mols. propyl alcohol at  $8.5^\circ$ ; in

16.2 mols. methyl, 12.4 mols. ethyl, and 18 mols. propyl alcohol at  $20^\circ$ , in 6.8 mols. methyl, 10.6 mols. ethyl, and 14.6 mols. propyl alcohol at  $38.2^\circ$ . (Timofejew, C. R., 112. 1224.)

100 pts. absolute methyl alcohol dissolve 66.9 pts.  $\text{HgCl}_2$  at  $25^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 49.5 pts.  $\text{HgCl}_2$  at  $25^\circ$ . (de Buyen, Z. phys. Ch. 10. 783)

At  $15^\circ$ , 1 pt. by weight is sol. in.—

13.53 pts.  $\text{H}_2\text{O}$ .

1.5 " methyl alcohol of sp. gr. 0.7990

2.5 " ethyl " " " 0.8100

6.3 " propyl " " " 0.8180

(Rohland, Z. anorg. 1899, 18. 323.)

100 g.  $\text{HgCl}_2 + \text{CH}_3\text{OH}$  contain 1.2 g.  $\text{HgCl}_2$  at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, 72. 437.)

Solubility of  $\text{HgCl}_2$  in methyl alcohol +  $\text{Aq}$  at  $25^\circ$ .

P = g. alcohol in 100 g. alcohol +  $\text{Aq}$ .

$\text{HgCl}_2$  = millimols  $\text{HgCl}_2$  in 10 cc. of the solution.

P	$\text{HgCl}_2$	Sp. gr.
0	2 67	1 0565
10 60	2 92	1 0441
30 77	4 18	1 0420
37 21	4 96	1 0507
47 06	7 27	1 0809
64 00	14 19	1 2015
78 05	21 11	1 3314
100	17 95	1 2160

(Herz and Anders, Z. anorg. 1907, 52. 165.)

100 cc. 90% ethyl alcohol dissolve 27.5° g.  $\text{HgCl}_2$  at  $15.5^\circ$ . Sp. gr.  $15^\circ$  of sat. solution = 1.065. (Greenish and Smith, Pharm. J. 1903, 71. 881.)

100 g. 99.2% ethyl alcohol dissolve 33.4 g.  $\text{HgCl}_2$  at  $25^\circ$ . (Osaka.)

Solubility of  $\text{HgCl}_2$  in ethyl alcohol +  $\text{Aq}$  at  $25^\circ$ .

P = g. alcohol in 100 g. alcohol +  $\text{Aq}$ .

$\text{HgCl}_2$  = millimols  $\text{HgCl}_2$  in 10 cc. of the solution.

P	$\text{HgCl}_2$	Sp. gr.
0	2.67	1 0565
20 18	2 49	1 0214
40 69	3 94	1 0180
70.01	8 70	1 0616
100	13 61	1 1067

(Herz and Anders, Z. anorg. 1907, 52. 170.)

Solubility of $\text{HgCl}_2$ in ethyl alcohol + Aq at 25°			
$\% \text{ C}_2\text{H}_5\text{OH}$	$\% \text{ HgCl}_2$	$\% \text{ C}_2\text{H}_5\text{OH}$	$\% \text{ HgCl}_2$
0	6.80	45.84	15.36
5.08	6.65	49.86	18.18
14.49	6.41	53.61	21.40
21	6.55	57.26	24.51
26.25	7.31	60.55	27.67
31.53	8.51	63.95	29.86
36.85	10.32	67.39	32.40
41.36	12.69		

(Abe, J. Tok. Chem. Soc. 1912, **33** 1087.)

Solubility in alcohol is increased by presence of hydroxylamine hydrochloride. (Adams, Am. Ch. J. 1902, **28**, 213.)

Solubility of  $\text{HgCl}_2$  in a mixture of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the mixture.  
G = %  $\text{HgCl}_2$  in 10 cem. of the solution.  
S = sp. gr. of the sat. solution.

P	HgCl <sub>2</sub>	S 25°/4°
0	3.686	1.107
4.37	3.943	1.130
10.4	4.261	1.157
41.02	5.837	1.294
80.69	6.167	1.321
84.77	5.782	1.288
91.25	5.385	1.254
100	4.862	1.216

(Herz and Kuhn, Z. anorg. 1908, **58**, 161.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = %  $\text{HgCl}_2$  in 10 cem. of the solution.  
S = sp. gr. of the sat. solution

P	G	S 25°/4°
0	4.862	1.2160
11-11-	5.034	1.2278
23.8	5.714	1.2848
65.2	4.228	1.1568
91.8	2.509	1.0090
93.75	2.323	1.0029
96.6	2.152	0.9851
100	2.003	0.9720

(Herz and Kuhn, Z. anorg. 1908, **60**, 157.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = %  $\text{HgCl}_2$  in 10 cem. of the solution.  
S = sp. gr. of the sat. solution

P	G	S 25°/1°
0	3.686	1.1070
8.1	3.607	1.0988
17.85	3.406	1.0857
56.0	2.711	1.0272
88.6	2.166	0.9854
91.2	2.160	0.9824
95.2	2.087	0.9772
100	2.003	0.9720

(Herz and Kuhn, Z. anorg. 1908, **60**, 160.)

Sp. gr. of  $\text{HgCl}_2$  + alcohol.

$\% \text{ HgCl}_2$	Sp. gr. 25°/20°
0	0.7948
5.44	0.8346
6.52	0.8431

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19**, 283.)

Sp. gr. of alcoholic solution of  $\text{HgCl}_2$

$\% \text{ HgCl}_2$	Sp. gr.			
	at 0°	at 30°	at 20°	at 30°
0.00	0.83135	0.82280	0.81435	0.80594
1.22	0.8307	0.8312	0.8228	0.8141
2.38	0.8484	0.8309	0.8314	0.8227
4.42	0.8635	0.8549	0.8403	0.8375
8.56	0.8966	0.8877	0.8780	0.8689
12.43	0.9306	0.9213	0.9110	0.9024
15.91	0.9620	0.9523	0.9425	0.9329
19.32	0.9951	0.9852	0.9753	0.9652
22.46	1.0285	1.0184	1.0083	0.9982

(Schroder, B. 19, 161 R.)

Sp. gr. at 16°/4° of  $\text{HgCl}_2$  + ethyl alcohol containing 23.5489%  $\text{HgCl}_2$  = 0.90885, containing 11.8801% = 0.88572. (Schoenrock, Z. phys. Ch. 1893, **11**, 768.)

Sp. gr. at 16°/4° of  $\text{HgCl}_2$  + amyl alcohol containing 10.9948%  $\text{HgCl}_2$  = 0.89550 (Schoenrock, Z. phys. Ch. 1893, **11**, 769.)

Sol in 4 pts. ether (Karl); in 4.1 pts. (Henry), in 2.86 pts. ether of 0.745 sp. gr. (sp. gr. of solution = 1.08); the solvent power is not increased by elevating the temp. and b.-pt. of ether is not raised. (J. Davy.) Ether extracts  $\text{HgCl}_2$  from  $\text{HgCl}_2$  + Aq (Orfila); very slightly if  $\text{HgCl}_2$  + Aq is dil. (Lassaigne.)

Very sl. sol. in pure ether. (Polis, B. 20, 717.)

6.35 pts. are sol. in 100 pts. ether at 0°.

6.44 " " " " 100 " " " 18.

6.38 " " " " 100 " " " 35.5.

(Laszczyński, B. 1894, **27**, 2286.)

Sol. in  $7\frac{1}{2}$ -8 pts. ether. (Madsen, Ch. Z. Repert. 1897, 21. 169.)

Solubility in 100 cc. ether at  $17^\circ = 4.1-4.12$  g. (Strömholm, J. pr. 1902, (2), 66. 450.)

The solubility of  $\text{HgCl}_2$  in  $\text{H}_2\text{O}$  is only sl. affected by the presence of ether. An aqueous solution sat. with ether and  $\text{HgCl}_2$  contains about 10% less  $\text{HgCl}_2$  than a pure sat. aqueous solution. Partition coefficient for

$\frac{\text{ether}}{\text{H}_2\text{O}} = 4.9$  at  $0^\circ$ , 3.02 at  $14.6^\circ$ ; 2.80 at  $16.8^\circ$  (Strömholm, Z. phys. Ch. 1903, 44. 70.)

#### Solubility of $\text{HgCl}_2$ in ether+Aq at $25^\circ$ .

% Ether	% $\text{H}_2\text{O}$	% $\text{HgCl}_2$
87 86	5 22	6 92
1 2	93 6	5 2
5 2	90 5	4 3
5 4	91 8	2 8
5 4	93 1	1 5

(Abg, J. Tok Chem. Soc. 1912, 33. 1087.)

#### Solubility of $\text{HgCl}_2$ in ether+ethyl alcohol at $25^\circ$ .

% Alcohol	% $\text{HgCl}_2$	% Alcohol	% $\text{HgCl}_2$
67 57	32 43	27 16	36 29
58 59	32 50	22 48	34 08
51 02	37 39	15 20	28.55
44 79	37 96	8 97	20.67
38 69	38 24	0	5 49
32 84	37.75		

(Abg.)

4 pts ether dissolve 1 pt.  $\text{HgCl}_2$ , but 4 pts. ether+1.33 pts. camphor dissolve 1.33 pts.  $\text{HgCl}_2$ ; 4 pts ether+4 pts. camphor dissolve 2 pts.  $\text{HgCl}_2$ ; 4 pts ether+8 pts. camphor dissolve 4 pts.  $\text{HgCl}_2$ ; 4 pts. ether+16 pts. camphor dissolve 8 pts.  $\text{HgCl}_2$ . (Karis, Pogg. 10. 608.)

3 pts. alcohol dissolve 1 pt.  $\text{HgCl}_2$ , but 3 pts. alcohol+1 pt. camphor dissolve 2 pts.  $\text{HgCl}_2$ ; 3 pts alcohol+3 pts. camphor dissolve 3 pts.  $\text{HgCl}_2$ ; 3 pts alcohol+6 pts camphor dissolve 6 pts.  $\text{HgCl}_2$ . (Karis, l c)

Solution can be obtained containing 25 pts camphor, 16 pts  $\text{HgCl}_2$ , and only 4 pts alcohol. Sp. gr. of solution = 1.326. (Simon, Pogg. 37. 553.)

100 pts. acetone dissolve 60 pts.  $\text{HgCl}_2$  at  $25^\circ$ . (Krug and M'Elroy, J. Anal. Appl. Ch. 184.)

98.35 pts.  $\text{HgCl}_2$  are sol. in 100 pts. acetone at  $0^\circ$

110 95 pts  $\text{HgCl}_2$  are sol. in 100 pts. acetone at  $10^\circ$ .

126.80 pts  $\text{HgCl}_2$  are sol. in 100 pts. acetone at  $18^\circ$ . (Laszcynski, B. 1894, 27. 2287.)

1 g.  $\text{HgCl}_2$  is sol. in 0.70 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 1.956$ . (Naumann, B. 1904, 37. 4334.)

Sat. solution in acetone contains 57.74 g.  $\text{HgCl}_2$  in 100 g. solution at  $25^\circ$ . (Foote and Haigh, J. Am. Chem. Soc. 1911, 33. 461.)

Sp gr. at  $26\ 7^\circ/4^\circ$  of  $\text{HgCl}_2$ +acetone containing 36.25%  $\text{HgCl}_2 = 1.585$ . (Schönrock, Z. phys. Ch. 1893, 11. 769.)

#### Sp. gr of $\text{HgCl}_2$ +acetone.

% $\text{HgCl}_2$	Sp gr $20^\circ/20^\circ$
0	0.8003
10 94	0 8847
21 05	0 9799

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 283.)

100 g. methyl acetate dissolve 46 g. at bpt. ( $56\ 5^\circ$ ). (Schroeder and Steiner, J. pr. 1909, (2) 79. 49.)

1 g.  $\text{HgCl}_2$  is sol. in 2.35 g. methyl acetate at  $18^\circ$ . Sp. gr.  $18^\circ/4^\circ$  of the sat solution = 1.251. (Naumann, B. 1909, 42. 3793.)

#### Solubility in ethyl acetate

Pts sol in 100 pts ethyl acetate	
Pts $\text{HgCl}_2$	$t^\circ$
28 92	0
29 03	13
30 71	35
31 87	48
32.77	60
35 98	83

(Laszcynski, B. 1894, 27. 2286.)

Solubility in ethyl acetate = 1.3466 at  $18^\circ$ . (Alexander, Dissert. 1899.)

#### Solubility of $\text{HgCl}_2$ in ethyl acetate.

Temp.	$0^\circ$	$13^\circ$	$30^\circ$	$40\ 5^\circ$	$50\ 2^\circ$
Mol. $\text{HgCl}_2$ in 100 mols. $\text{C}_4\text{H}_8\text{O}_2$	15 4	15.9	16.0	16.1	16 3

(Linebarger, Am. Ch. J. 1894, 16. 214.)

1 g.  $\text{HgCl}_2$  is sol. in 3.5 g. ethyl acetate at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 1.110$ . (Naumann, B. 1904, 37. 3602.)

Solubility of  $\text{HgCl}_2$  in ethyl acetate and acetone at  $t^\circ$ .

$t^\circ$	Molecules $\text{HgCl}_2$ sol in 100 mol-ecules of ethyl acetate	Molecules $\text{HgCl}_2$ sol in 100 mol-ecules of acetone	Sol. present in acetone
-15	9.10	14.5	$\text{HgCl}_2, \text{CH}_3\text{COCH}_3$
0	9.25	14.3	"
+10		18.7	"
10		23.5	$\text{HgCl}_2$
17		23.2	"
25	9.15	22.8	"

(Aten, Z. phys. Ch. 1906, 54. 121.)

Solubility of  $\text{HgCl}_2$  in ethyl acetate + Aq at  $25^\circ$ .

P = g. ethyl acetate in 100 g. ethyl acetate + Aq.  
 $\text{HgCl}_2$  = millimols.  $\text{HgCl}_2$  in 10 cc. of the solution.

P	$\text{HgCl}_2$	Sp gr
0	2.67	1.0565
4.39	2.72	1.0531
96.76	15.34	1.2371
100	9.75	1.1126

(Herz and Anders, Z. anorg. 1907, 52. 172.)

1 pt. is sol. in 2.05 pts. ethyl acetate at  $18^\circ$  or 100 g. ethyl acetate dissolve 48.7 g.  $\text{HgCl}_2$ . (Naumann, B. 1910, 43. 315.)

Easily sol. in glycerine; sol. in 14 pts glycerine. (Fairley, Monit. Scient. (3) 9. 685.)

100 g. glycerine dissolve 80 g.  $\text{HgCl}_2$  at  $25^\circ$ . (Moles and Maquina, Ann. Soc. Espan. fis. quin. 1914, 12. 383.)

## Solubility in organic solvents

Solvent	$t^\circ$	Sat. solution contains % $\text{HgCl}_2$
Methyl alcohol	-34	7.6
	-20	11.5
	-15	12.8
	-2	18.7
	+4	23.2
	12	27.6
	36	53.1
	51	61.0
	62	63.6
	64	63.7
	74	64.3
	100	68.7
	127	75.2

Solvent	$t^\circ$	Sat. solution contains % $\text{HgCl}_2$
Ethyl alcohol	-60	3.0
	-55	7.8
	-43	8.8
	-40	9.8
	-30	14.3
	-23	18.6
	-21	19.1
	-20	21.9
	-17	22.1
	-11	24.7
	-9	27.0
	-5	29.7
	0	29.0
	+3	30.0
	7	30.9
	10	31.3
	14	31.3
	19	32.0
	31	34.2
N-propyl alcohol	43	36.4
	51	38.9
	62	42.1
	63	42.5
	68	44.7
	75	45.2
	80	48.0
	92	51.0
	93	51.4
	100	53.6
	115	60.6
	127	65.3
	138	67.8
Allyl alcohol	-32	14.7
	-22	15.4
	-14	15.6
	0	16.4
	0	16.5
	+16	18.2
	41	23.8
	53	27.9
	62	29.4
	67	32.7
	78	36.4
Acetone	100	43.8
	127	52.7
Methyl alcohol	-21	20.6
	-1	29.6
	+8	35.2
	22	48.7
Acetone	-23	51.4
	-18	52.9
	-15	56.6
	-10	56.7
	-8	58.4
	-4	59.1
	-1	60.1
	+6	61.9
	12	61.4
	15	61.8
	27	62.0
	36	61.9
Methyl alcohol	54	62.1

Solubility in organic solvents.—*Continued.*

Solvent	t°	Sat. solution contains % HgCl <sub>2</sub>
N-butyl alcohol	-21	12.4
	-6	13.0
	+9	14.3
	21	15.9
	59	25.8
	82	33.1
Isobutyl alcohol	-11	5.5
	-6	6.2
	0	6.7
	+11	7.5
	63	19.3
	98	32.1
	127	42.0
	145	47.2
	155	50.4
Amyl alcohol	-13	8.6
	+26	8.9
	50	14.0
	90	29.8
	106	35.1
Ether	-47	5.6
	-40	5.8
	-35	6.1
	-30	5.9
	-19	5.6
	0	5.8
	+13	5.8
	83	8.4
	100	8.7
	115	9.0
Ethyl formate	-20	29.6
	-3	29.2
	+24	30.0
	+46	31.0
Ethyl acetate	-50	39.6
	-20	40.5
	-14	40.2
	-6	40.0
	0	39.5
	+7	39.9
	19	40.2
	45	41.6
	66	44.0
	100	47.8
Methyl acetate	131	50.1
	150	57.0
	180	59.3
Amyl acetate	-20	42.0
	+24	40.3
	55	41.5
Ethyl butyrate	+22	18.3
	48	18.5
	+20	12.6
	55	13.5
	71	15.1

Solubility in organic solvents.—*Continued.*

Solvent	t°	Sat. solution contains % HgCl <sub>2</sub>
Acetic acid	+21	2.7
	22	3.0
	33	5.0
	43	6.0
	50	6.7
	61	8.0
	87	11.0
	95	12.0
	95	12.5
	115	16.0
	116	17.0
	127	20.0
Formic acid	145	26.3
	182	44.8
	207	55.2
	21	2.0
	50	3.2
	90	7.3

Very sl. sol. in propionic and isobutyric acids.

(Etard, A. ch. 1894, (7) 2. 557 et seq.)

Solubility of HgCl<sub>2</sub> in organic solvents at t°.

Solvent	t°	% HgCl <sub>2</sub>
CHCl <sub>3</sub>	-20.5	0.01
	+44.2	0.12
C <sub>6</sub> H <sub>6</sub>	+6.5	0.26
	18.0	0.53
	34.1	0.64
	54.1	1.02
	69.0	1.39
C <sub>6</sub> H <sub>5</sub> Cl <sub>2</sub>	0	1.33
	12.5	1.55
	20.8	1.68
	25.3	1.73
	30.2	1.92
	33.0	2.05
	45.9	2.42
CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub>	0	22.8
	6.5	22.7
	26.1	22.8
	38.5	23.5
	45.3	26.4

Dukolacki, Z. anorg. 1907, 53. 329.

Solubility of  $\text{HgCl}_2$  in mixed organic solvents at  $t^\circ$ 

Solvent	$t^\circ$	% $\text{HgCl}_2$
$\text{C}_2\text{H}_6 + \text{C}_2\text{H}_5\text{OH}$	-2.5	15.20
	0.0	15.40
	6.0	16.38
	20.5	18.10
	20.65	18.50
	21.5	19.33
	34.5	21.31
	51.4	21.81
	51.5	24.42
$\text{C}_6\text{H}_6 + 2\text{C}_2\text{H}_5\text{OH}$	-5.2	19.45
	0	20.13
	+9.1	21.65
	20.9	23.57
	24.4	24.19
	36.5	26.53
	53.7	31.27
	74.0	38.74
$\text{CHCl}_3 + \text{C}_2\text{H}_5\text{OH}$	-20.5	3.82
	-12.0	4.43
	0.0	4.89
	+8.0	5.37
	23.0	7.12
	38.5	8.51
	44.2	9.51
	45.6	9.98
$\text{CHCl}_3 + 2\text{C}_2\text{H}_5\text{OH}$	-20.5	6.60
	0.0	7.60
	+8.0	8.96
	23.0	10.66
	38.5	12.50
	44.2	14.40
$\text{CHCl}_3 + \text{CH}_3\text{OH}$	-12.0	1.73
	0.0	3.51
	+8.0	5.63
	23.0	10.15
	24.9	10.71
	30.6	11.40
	38.5	12.02
$\text{CHCl}_3 + 2\text{CH}_3\text{OH}$	-12.0	3.33
	0.0	6.73
	+8.0	8.21
	23.0	16.56
	24.9	18.45
	30.6	19.70
$\text{CCl}_4 + 2\text{CH}_3\text{OH}$	0.0	5.20
	7.7	6.69
	24.9	14.06
	30.6	19.40
	35.5	20.50
	36.1	21.80
	48.5	21.90

Solubility of  $\text{HgCl}_2$  in mixed organic solvents at  $t^\circ$ —Continued

Solvent	$t^\circ$	$\text{HgCl}_2$
$\text{C}_2\text{H}_5\text{Cl}_2 + \text{CH}_3\text{OH}$	0.0	13.33
	12.5	21.30
	20.8	29.23
	25.3	34.78
	30.2	36.87
	33.0	37.01
	37.4	37.95
	45.9	39.36
$\text{CH}_3\text{COOC}_2\text{H}_5 + \text{C}_6\text{H}_6$	0.0	9.62
	6.5	9.62
	25.7	9.78
	27.0	9.78
	35.5	10.81
	45.3	13.69
$\text{CH}_3\text{COOC}_2\text{H}_5 + \text{CHCl}_3$	0.0	3.34
	26.1	4.07
	36.1	4.78
	46.0	5.38
	48.5	5.10
$2\text{CH}_3\text{COOC}_2\text{H}_5 + \text{CCl}_4$	0.0	9.24
	10.3	9.05
	25.7	9.32
	27.6	9.50
	38.5	9.89
	45.3	11.70

(Dukelski, Z. anorg. 1907, 53, 335.)

Solubility in organic solvents at  $18^\circ/20^\circ$ .100 g. chloroform dissolve 0.106 g.  $\text{HgCl}_2$ .100 g. tetrachloromethane dissolve 0.002 g.  $\text{HgCl}_2$ .100 g. bromoform dissolve 0.486 g.  $\text{HgCl}_2$ .100 g. ethyl bromide dissolve 2.010 g.  $\text{HgCl}_2$ .100 g. ethylene dibromide dissolve 1.530 g.  $\text{HgCl}_2$ .

(Sule. Z. anorg. 1900, 25, 401.)

Solubility of  $\text{HgCl}_2$  in various organic solvents at  $25^\circ$ .G = g  $\text{HgCl}_2$  dissolved in 1 mol. of solvent.

Solvent	G $\text{HgCl}_2$
Ethylene chloride	1.216
Tetrachlorethane	0.146
Chloroform	0.120
Dichloroethylene	0.110
Pentachlorethylene	0.039
Trichlorethylene	0.036
Perchloroethylene	0.012
Carbon tetrachloride	Trace

(Hofman, et al., B. 1910, 43, 188.)

Very sl sol in nitromethane at ord. temp.  
Very sol on warming. (Bruner, B. 1903, 36, 3298.)

Solubility in  $\text{CS}_2$  at  $t^\circ$ 

$t^\circ$	100 pts sat solution contain pts $\text{HgCl}_2$
-10	0 010
-5	0 014
0	0 018
+5	0 022
10	0 026
15	0 032
20	0 042
25	0 053
30	0 063

(Arcetowski, Z. anorg. 1894, 6, 267.)

0.080 g. is dissolved in 100 g. sat solution in  $\text{CS}_2$  at  $8^\circ$ . (Arcetowski, Z. anorg. 1894, 6, 256.)

Formic acid (95%) dissolves 2.1% at  $19^\circ$ . (Aschan, Ch. Z. 1913, 37, 1117.)

Sol in molten urethane. (Castoro, Z. anorg. 1899, 20, 61.)

Sol in ethyl sulphocyanate (Kallenberg, Z. phys. Ch. 1903, 48, 66.)

Solubility of  $\text{HgCl}_2$  in benzene.

100 pts  $\text{C}_6\text{H}_6$  dissolve at:—

$15^\circ$   $41^\circ$   $55^\circ$   $84^\circ$   
0.54 0.82 0.85 1.80 pts.  $\text{HgCl}_2$ .

(Lasczynski, B. 1894, 27, 2287.)

Solubility in  $\text{C}_6\text{H}_6 = 0.0197$  mol./l. at  $25^\circ$ . (Sherrill, Z. phys. Ch. 1903, 43, 735.)

Sol in  $\text{C}_6\text{H}_6$ , toluene, xylene, and other aromatic hydrocarbons. Insol. or only sl. sol in petroleum ether, hexane, decane and  $\text{CS}_2$  (Gulewitsch, B. 1904, 37, 1563.)

Sol. in p-toluidine. (Werner.)

Sol. in quinoline (Beckmann and Gabel, Z. anorg. 1906, 51, 236.)

Solubility of  $\text{HgCl}_2$  in pyridine.

$t^\circ$  = point of fusion.

Solid Phase =  $\text{HgCl}_2$ ,  $2\text{C}_5\text{H}_5\text{N}$ .

$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$
-32.8	2.76	40.90	29.29	78.0	49.72
-21.9	7.86	50.10	34.94	78.7	50.37
+0.02	13.14	60.03	40.36	80.2	51.52
12.58	17.34	70.15	46.44	82.5	52.40
18.78	19.78	70.8	46.77	89.0	56.45
23.60	21.59	74.6	48.00	90.8	57.01
27.23	22.65	75.2	48.38	94.1	60.09
31.05	24.46	76.4	49.15		

Solubility of  $\text{HgCl}_2$  in pyridine.—Continued

$t^\circ$  = point of fusion

Solid Phase =  $\text{HgCl}_2$ ,  $\text{C}_5\text{H}_5\text{N}$

$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$
74.7	48.38	90.61	53.50	104.1	60.09
83.5	50.53	75.0	50.45	104.2	60.72
86.5	52.37	99.5	56.07	104.7	58.97
87.3	52.02	99.5	57.01	107	63.06
		100.5	57.84		

Solid Phase =  $3\text{HgCl}_2$ ,  $\text{C}_5\text{H}_5\text{N}$

$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$
94.7	60.72	113.6	63.06	124.2	65.00
95.2	60.77	114.0	63.18	129.4	65.63
106.4	61.93	115.7	63.37	145.5	69.66
109.8	62.58	118.2	64.09		

(McBride, Z. phys. Ch. 1910, 14, 196.)

## Solubility in pyridine.

$S$  = temp. of solidification.

Mols per 100	$S$	Mols per 100	$S$	Mols per 100	$S$
5.8	19	27.0	87	38.5	130
5.9	18.5	28.6	(98)	41.0	137
10.2	39.5	30.3	91.5	43.2	142
14.1	52	31.2	92	44.0	143.5
21.4	74.5	33.1	108	47.5	159
25.0	83	35.1	115.5	52.8	173

(Staronka, Anz. Ak. Wiss. Krakau, 1910, 372.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{HgCl}_2$  + pyridine containing 17.53%  $\text{HgCl}_2 = 1.1523$ , containing 6.57%  $\text{HgCl}_2 = 1.0388$ . (Schönrock, Z. phys. Ch. 1893, 11, 768.)

Mol. weight determined in benzonitrile, methyl- and ethyl-sulphide (Werner, Z. anorg. 1897, 15, 31, 26 and 30.)

Sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Easily sol in oil of turpentine and other essential oils; sl. sol in cold benzene, but much more on heating, crystallising on cooling. (Franchimont, B. 16, 387.)

Easily sol. in boiling cresote.

Insol. in olive oil.

Insol. in oils and fats but sol when first dissolved in alcohol, free ether or anhydrous ketones (Glock, Ch. Z. Repert. 36, 315.)

Extracted from  $\text{HgCl}_2$  + Aq by volatile oils

Mercuric hydrogen chloride (Chloromercuric acid),  $\text{HgCl}_2$ ,  $\text{HCl} = \text{HHgCl}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Boullay, A. ch. 34, 243.)

Easily decomposed (Neumann, M. 10, 236.)

HgCl<sub>2</sub>, 2HCl+7H<sub>2</sub>O. Decomp. by H<sub>2</sub>O.  
(Ditte, A. ch. (5) 22. 551.)  
3HgCl<sub>2</sub>, 4HCl+14H<sub>2</sub>O. As above.  
2HgCl<sub>2</sub>, HCl+6H<sub>2</sub>O. As above.  
4HgCl<sub>2</sub>, 2HCl+9H<sub>2</sub>O. As above.  
3HgCl<sub>2</sub>, HCl+5H<sub>2</sub>O. As above.

**Mercuric hydrazine chloride**, HgCl<sub>2</sub>,  
2(N<sub>2</sub>H<sub>4</sub>, HCl).

Very sol in H<sub>2</sub>O. More sol. in hot alcohol  
than in cold; decomp. by HNO<sub>3</sub>. (Curtius,  
J. pr. 1894, (2) 50. 332.)

**Mercuric nickel chloride**, basic, HgCl<sub>2</sub>,  
6NiO, NiCl<sub>2</sub>+20H<sub>2</sub>O, and HgCl<sub>2</sub>, 7NiO,  
NiCl<sub>2</sub>.

(Mailhe, A. ch. 1902, (7) 27. 369.)

**Mercuric nickel chloride.**

Deliquescent. (v. Bonsdorff.)

**Mercuric nitrosyl chloride**, HgCl<sub>2</sub>, NOCl.

Sol. in H<sub>2</sub>O without effervescence. (Sud-  
borough, Chem. Soc. 59. 659.)

**Mercuric phosphoric chloride**, 3HgCl<sub>2</sub>, 2PCl<sub>3</sub>.

Decomp. and dissolved by H<sub>2</sub>O. (Baudri-  
mont, A. ch. (4) 2. 45.)

**Mercuric potassium chloride**, 2HgCl<sub>2</sub>, KCl+  
2H<sub>2</sub>O.

Very easily sol. in warm H<sub>2</sub>O. A clear  
solution at 18° is filled with crystals at 15°.  
Sl. sol. in alcohol. (v. Bonsdorff, Pogg 17.  
122.)

HgCl<sub>2</sub>, KCl+H<sub>2</sub>O. Easily sol in H<sub>2</sub>O; sl  
sol. in alcohol. (v. Bonsdorff, Pogg. 19. 336.)

HgCl<sub>2</sub>, 2KCl+H<sub>2</sub>O. As above.

Solubility determinations show that the  
double salts formed by mercuric and potas-  
sium chlorides at 25° are:

2KCl, HgCl<sub>2</sub>+H<sub>2</sub>O.

KCl, HgCl<sub>2</sub>+H<sub>2</sub>O. Can be recryst. with-  
out decomp.

KCl, 2HgCl<sub>2</sub>+2H<sub>2</sub>O. Gives HgCl<sub>2</sub> on  
recryst. from H<sub>2</sub>O. (Foote and Levy, Am.  
Ch. J. 1906, 35. 237.)

**Mercurous rhodium chloride.**

See Chlororhodite, mercurous.

**Mercuric rubidium chloride**, HgCl<sub>2</sub>, RbCl.

Sol in H<sub>2</sub>O.

HgCl<sub>2</sub>, 2RbCl. Sol. in H<sub>2</sub>O and HCl+Ag.  
(Godeffroy, Arch. Pharm. (3) 12. 47.)

+2H<sub>2</sub>O. Sol in H<sub>2</sub>O. (Godeffroy.)

2HgCl<sub>2</sub>, RbCl. Sol in H<sub>2</sub>O. (Godeffroy.)

Solubility determinations show that at 25°  
there exist five double mercuric rubidium  
chlorides with the following formulas:

RbCl, 5HgCl<sub>2</sub>. Gives HgCl<sub>2</sub> on recryst  
from H<sub>2</sub>O.

3RbCl, 4HgCl<sub>2</sub>+H<sub>2</sub>O. Gives RbCl,

5HgCl<sub>2</sub> on recryst from H<sub>2</sub>O.

RbCl, HgCl<sub>2</sub>+H<sub>2</sub>O. Gives 3RbCl, 4HgCl<sub>2</sub>  
on recryst. from H<sub>2</sub>O.

3RbCl, 2HgCl<sub>2</sub>+2H<sub>2</sub>O. Gives 3RbCl,  
4HgCl<sub>2</sub> on recryst from H<sub>2</sub>O.

2RbCl, HgCl<sub>2</sub>+H<sub>2</sub>O. Gives 3RbCl,

4HgCl<sub>2</sub> on recryst from H<sub>2</sub>O.

(Foote and Levy, Am. Ch. J. 1906, 35. 241.)

**Mercurous silver chloride**, HgCl, AgCl.

(Jones, J. Soc. Chem. Ind. 1893, 12. 983.)

2HgCl, AgCl. Min. *Bardosie*. (Jones,

J. Soc. Chem. Ind. 1893, 12. 983.)

3HgCl, AgCl. (Jones, Chem. Soc. 1910,  
97. 338.)

**Mercuric sodium chloride**, HgCl<sub>2</sub>, NaCl.

Sp. gr. at 16°/4° of aqueous solution con-  
taining 14.937% salt=1.13310; containing  
11.0736%=1.09528. (Schönrock, Z. phys.  
Ch. 1893, 11. 782.)

+H<sub>2</sub>O. (Linebarger, Am. Ch. J. 1893, 15.  
344.)

+1½H<sub>2</sub>O. Sol. in 0.33 pt H<sub>2</sub>O at 15°.  
(Schindler, Repert. 38. 240.)

Extremely easily sol. in alcohol. (Voit.)

Sol. in 275 pts. ether. Ether dissolves the  
undecomposed salt out of H<sub>2</sub>O solution.

(Lassaigne, A. ch. 64. 104.)

HgCl<sub>2</sub>, 2NaCl. Deliquescent. Very sol.  
in H<sub>2</sub>O. (Voit, A. 104. 354.)

2HgCl<sub>2</sub>, NaCl. Decomp. by H<sub>2</sub>O in dil  
solution. Sol. in acetone and acetic ether.  
(Linebarger, Am. Ch. J. 1893, 15. 344.)

Solubility determinations show that the  
only double salt formed by mercuric and  
sodium chlorides between 10.3° and 25° is  
NaCl, HgCl<sub>2</sub>+2H<sub>2</sub>O. Can be recryst from  
H<sub>2</sub>O. (Foote and Levy, Am. Ch. J. 1906, 35.  
237.)

**Mercuric strontium chloride**, basic, SrCl<sub>2</sub>,  
HgO+6H<sub>2</sub>O.

Decomp. by H<sub>2</sub>O. (André, C. R. 104. 431.)

**Mercuric strontium chloride**, 2HgCl<sub>2</sub>, SrCl<sub>2</sub>+  
2H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O. (v. Bonsdorff.)

3HgCl<sub>2</sub>, SrCl<sub>2</sub>+5-6H<sub>2</sub>O. Very sol. in  
H<sub>2</sub>O. (Swan, Am. Ch. J. 1898, 20. 632.)

**Mercurous sulphur chloride.**

See Mercurous sulphochloride.

**Mercuric thallous chloride**, HgCl<sub>2</sub>, TlCl.

Easily sol. in H<sub>2</sub>O. (Jorgensen, J. pr. (2)  
6. 83.)

**Mercurous stannous chloride**, Hg<sub>2</sub>Cl<sub>2</sub>, SnCl<sub>2</sub>.

Decomp. by H<sub>2</sub>O. (Capitaine, J. Pharm.  
25. 549.)

**Mercuric yttrium chloride**, 3HgCl<sub>2</sub>, YCl<sub>3</sub>+  
9H<sub>2</sub>O.

Deliquescent. Very sol in H<sub>2</sub>O. (Popp,  
A. 131. 179.)

**Mercuric zinc chloride,  $\text{HgCl}_2, \text{ZnCl}_2$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Earth, Z anorg 1897, 14. 323.)  
 $2\text{HgCl}_2, \text{ZnCl}_2$  (Varet, C R 1896, 123. 422.)

**Mercuric zinc chloride ammonia,  $\text{HgCl}_2, 4\text{ZnCl}_2, 10\text{NH}_3 + 2\text{H}_2\text{O}$** 

Insol. in boiling  $\text{H}_2\text{O}$ , but decomp thereby (André, C. R. 112. 995.)  
 $\text{HgCl}_2, 2\text{ZnCl}_2, 6\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$ . As above. (André.)

**Mercuric chloride ammonia,  $\text{HgCl}_2, 12\text{NH}_3$** 

Sl. sol. in ammonia. (Franklin, Am Ch. J 1900, 23. 300.)

**Mercuric chloride cadmium oxide,  $\text{HgCl}_2, \text{CdO} + \text{H}_2\text{O}$ .**

(Mailhe, A. ch 1902, (7) 27. 371.)

**Mercuric chloride cobaltous oxide,  $\text{HgCl}_2, 3\text{CoO} + \frac{1}{2}\text{H}_2\text{O}$ .**

(Mailhe, C R. 1901, 132. 1274.)

**Mercuric chloride cupric oxide,  $\text{HgCl}_2, 3\text{CuO} + \text{H}_2\text{O}$ .**

(Mailhe, Bull. Soc 1901, (3) 25. 791.)

**Mercuric chloride hydrazine,  $\text{HgCl}_2, \text{N}_2\text{H}_4$ .**

Very unstable. Decomp. by  $\text{H}_2\text{O}$ . Pptd. from alcohol solution by  $\text{H}_2\text{O}$ ; very sol. in  $\text{H}_2\text{O}$ , decomp. by  $\text{H}_2\text{O}$ .

Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3$ . Decomp. by alkalis. Somewhat sol. in acetic acid. (Hofmann, B. 1897, 30. 2020.)

**Mercuric chloride hydroxylamine,  $\text{HgCl}_2, 2\text{NH}_2\text{OH}$ .**

Completely sol. in methyl and ethyl alcohol; insol. in ether; decomp. by  $\text{H}_2\text{O}$  and  $\text{NaOH} + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH}, \text{HCl} + \text{Aq}$ . (Adams, Am. Ch. J 1902, 28. 210.)

**Mercuric chloride lead oxide,  $\text{HgCl}_2, 2\text{PbO} + 2\text{H}_2\text{O}$ .**

(Mailhe, A. ch. 1902, (7) 27. 372.)

**Mercuric chloride strontium chromate,  $2\text{HgCl}_2, \text{HCl}, \text{SrCrO}_4$ .**

Sol. in  $\text{H}_2\text{O}$  without decomp. (Imbert, Bull. Soc. 1897, (3) 17. 471.)

**Mercuric chloroiodide,  $2\text{HgCl}_2, \text{HgI}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Liebig.)  
 $\text{HgCl}_2, \text{HgI}_2$ . Sl. sol. in hot  $\text{H}_2\text{O}$  with partial decomp. More easily sol. in alcohol. (Köhler, B. 12. 1187.)

**Mercurous fluoride,  $\text{Hg}_2\text{F}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{Hg}_2\text{O}$ .

**Mercuric fluoride,  $\text{HgF}_2 + 2\text{H}_2\text{O}$ .**

Decomp. by cold  $\text{H}_2\text{O}$ , with separation of  $\text{HgO}$ . Sol. in dil  $\text{HNO}_3 + \text{Aq}$ , and  $\text{HF} + \text{Aq}$  (Finkener, Pogg. 110. 628.)

**Mercurous hydrogen fluoride,  $\text{Hg}_2\text{F}_2, 4\text{HF} + 4\text{H}_2\text{O}$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids and dil.  $\text{HF}$ . (Bohm, Z. anorg. 1905, 43. 327.)

**Mercurous silicon fluoride.**

See Fluosilicate, mercurous.

**Mercurous fluoride ammonia,  $\text{Hg}_2\text{F}_2, 2\text{NH}_3$ .**

Stable on air (Finkener, Pogg. 110. 142.)

**Mercurous hydroxide,  $\text{HgOH}$** 

Nearly insol. in cold, sol. in hot  $\text{H}_2\text{O}$ . Sol. in  $\text{NaOH} + \text{Aq}$ . (Bhaduri, Z. anorg 1897, 13. 410.)

**Mercurous iodamide,  $\text{Hg}_2(\text{NH}_2)\text{I}$ .**

(Rammelsberg, Pogg. 43. 184.)

Is a mixture of  $\text{Hg}$  and  $\text{Hg}(\text{NH}_2)\text{I}$ . (Barfoed.)

**Mercurous iodide,  $\text{Hg}_2\text{I}_2$ .**

Sol. in over 2375 pts.  $\text{H}_2\text{O}$ . (Saladin, J. chim. méd. 7. 530.)

Solubility in  $\text{H}_2\text{O} = 2.6 \times 10^{-8}$  g.-equiv. per liter (calculated) (Bodlander, Z. phys. Ch. 1898, 27. 58.)

Solubility in  $\text{H}_2\text{O} = 3 \times 10^{-10}$  mols. per litre at  $25^\circ$ . (Sherrill, Z. phys. Ch. 1903, 43. 735.)

Sol. in  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ . (Stromann, B. 20. 2815.)

Sol. in  $\text{KI} + \text{Aq}$ . Easily sol. in  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$ . Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ , but less than  $\text{HgI}_2$ . Less sol. in  $\text{NH}_4\text{NO}_3$  than in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Brett.)

Partially sol. with separation of  $\text{Hg}$  and formation of  $\text{HgI}_2$ , in cold  $\text{KI} + \text{Aq}$ , hot  $\text{NaI}$ ,  $\text{CaI}_2$ ,  $\text{SrI}_2$ ,  $\text{BaI}_2$ ,  $\text{MgI}_2$ ,  $\text{ZnI}_2$ , and  $\text{NH}_4\text{I} + \text{Aq}$ ; in warm  $\text{NaCl}$ ,  $\text{KCl}$  and  $\text{NH}_4\text{Cl} + \text{Aq}$ , and slowly in hot  $\text{HCl} + \text{Aq}$  (Boullay, A. ch (2) 34. 358.)

Decomp. by alkali chlorides  $+ \text{Aq}$ . (Miahle, A. ch. (3) 5. 177.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1893, 20. 839.)

Not wholly insol. in alcohol, ether, or chloroform. (MacLagan, Rep. anal. Ch. 1884. 378.)

Decomp. by boiling alcohol; 1000 g. boiling alcohol decomp. about 3.15 g.  $\text{Hg}_2\text{I}_2$ . (François, C. R. 1896, 121. 890.)

Boiling alcohol decomp.  $\text{Hg}_2\text{I}_2$  to  $\text{Hg}$  and  $\text{HgI}_2$ , which dissolves until 0.220 g.  $\text{HgI}_2$  are contained in 100 g. alcohol. (François, C. R. 1896, 121. 889.)

Insol. in cold ether. (François, J. Pharm. 1897, (6), 6. 445.)

Insol. in methylene iodide. (Retgers, Z. anorg. 3. 345.)

Difficultly sol. in methyl acetate. (Nau-mann, B. 1900, 42. 3790.)

Phenol at  $180^\circ$  decomp. it into  $\text{Hg}$  and  $\text{HgI}_2$ , until a state of equilibrium is reached with

2.75 g.  $\text{HgI}_2$  to 100 g. phenol, above which point  $\text{HgI}_2$  is sol. (0.05 g in 100 g.) in phenol- $\text{HgI}_2$  mixture. Decomp. by cold aniline more rapidly than by hot. Equilibrium is reached when 26.35 g.  $\text{HgI}_2$  are present to 100 g. aniline at bpt of aniline. Aniline containing more than 26 g.  $\text{HgI}_2$  to 100 g. dissolves  $\text{HgI}_2$  in considerable quantity. (François, C. C. 1896, 1, 470.)

Sl. sol. in benzonitrile (Naumann, B. 1914, 47, 1309.)

Sl. sol. in allyl mustard oil (Mathews, J. phys. Chem. 1905, 9, 647.)

### Mercuric iodide, $\text{HgI}_2$

Sol in 150 (?) pts  $\text{H}_2\text{O}$  (Wärz.)

1 l  $\text{H}_2\text{O}$  at 17.5° dissolves 0.0103 g  $\text{HgI}_2$  (Bourgon, A. ch. (6) 3, 429.)

Sol in about 6500 pts.  $\text{H}_2\text{O}$  (Hagen.)

According to calculation from electrical conductivity of  $\text{HgI}_2 + \text{Aq}$ ,  $\text{HgI}_2$  is much less sol., 1 l  $\text{H}_2\text{O}$  dissolving only 0.5 mg  $\text{HgI}_2$  at 18°. (Kohlrausch and Rose, Z. phys. Ch. 12, 241.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.054 g.  $\text{HgI}_2$  at 22°. (Rohland, Z. anorg. 1898, 15, 412.)

1 l.  $\text{H}_2\text{O}$  at 25° dissolves about 0.06 g (Moise, Z. phys. Ch. 1902, 41, 731.)

1 l.  $\text{H}_2\text{O}$  at 18° dissolves  $4 \times 10^{-4}$  mol (Abegg, Z. Elektrochem. 1903, 9, 553.)

Solubility in  $\text{H}_2\text{O}$  at 25° = 0.00013 mol liter (Sherill, Z. phys. Ch. 1903, 43, 735.)

1 l  $\text{H}_2\text{O}$  dissolves 0.4 mg.  $\text{HgI}_2$  at 18° (Kohlrausch, Z. phys. Ch. 1904, 50, 350.)

1 l  $\text{H}_2\text{O}$  at 18° dissolves 0.2 to 0.4 mg (Kohlrausch, Z. phys. Ch. 1908, 64, 168.)

The yellow modification is always deposited from solution even in the presence of an excess of the red form. (Gerncz, C. R. 1903, 136, 1323.)

Sol. in many acids, especially in  $\text{HCl}$ , and  $\text{HI} + \text{Aq}$ . Insol in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  (Berthelot.) Scarcely sol in dil  $\text{HNO}_3 + \text{Aq}$ .

Not attacked by cold  $\text{H}_2\text{SO}_4$ , decump by hot (Ditte, A. ch. 1879, (5) 17, 124.)

Sat. solution in  $\text{H}_2\text{SO}_4 + \text{Aq}$  contains at critical temp. (158.2°), 0.7%  $\text{HgI}_2$  (Niggh, Z. anorg. 1912, 75, 182.)

Sol. in hot  $(\text{NH}_4)_2\text{CO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , cold  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , or ammonium succinate +  $\text{Aq}$ . (Wittstein.)

Sol. in  $\text{HgCl}_2$ ,  $\text{Hg}(\text{NO}_3)_2$ , or  $\text{Hg}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . Easily sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . Easily sol in soluble iodides +  $\text{Aq}$ . More sol. in hot than in cold  $\text{NaI}$  or  $\text{KI} + \text{Aq}$ . When conc., 1 mol  $\text{KI}$  in hot solution dissolves 3 mols.  $\text{HgI}_2$ , but a portion separates on cooling.  $\text{BaI}_2$ ,  $\text{SrI}_2$ ,  $\text{MgI}_2$ , and  $\text{CaI}_2$  act in the same way. Easily sol. in cold, more sol. in hot  $\text{ZnI}_2 + \text{Aq}$ , 2 mols  $\text{HgI}_2$  being dissolved to 1 mol  $\text{ZnI}_2$ . In  $\text{NH}_4\text{I} + \text{Aq}$ , 3 mols.  $\text{HgI}_2$  are dissolved to 2 mols  $\text{NH}_4\text{I}$ . Abundantly sol in hot  $\text{KCl}$ ,  $\text{NaCl}$ ,  $\text{NH}_4\text{Cl} + \text{Aq}$ , but separates out on cooling, and the trace remaining may be pptd. by  $\text{H}_2\text{O}$ , 2 g.  $\text{KCl}$  in solution dissolves 166 g.  $\text{HgI}_2$ . Sol. in  $\text{HgCl}_2 + \text{Aq}$ , and very easily sol in

alcoholic solution of  $\text{HgCl}_2$ . (Boullay, A. ch. (2) 34, 346.)

### Solubility in $\text{MI} + \text{Aq}$ at 25°.

Salt	In 10 ccm of the solution	
	Millimols $\text{HgI}_2$	Millimols salt
$\text{NaI}$	4.12	7.04
	6.22	13.85
	9.45	22.25
$\text{KI}$	1.27	3.03
	1.80	3.90
	5.10	10.34
	7.00	15.54
	12.24	25.19
$\text{CaI}_2$	0.50	0.53
	2.61	2.52
	4.40	4.68
	4.58	4.84
	17.06	17.99
$\text{SrI}_2$	2.12	2.54
	3.20	3.55
	5.82	5.39
	6.94	6.08
$\text{BaI}_2$	0.59	0.99
	7.42	7.48
	8.98	9.78
	14.62	15.08

(Hers and Paul, Z. anorg. 1913, 82, 434.)

### Solubility of $\text{HgI}_2 + \text{KI}$ in $\text{H}_2\text{O}$

Temp = 20°		
% $\text{KI}$	% $\text{HgI}_2$	Solid phase
50.9	19.3	$\text{KI}$
44.4	32.4	"
39	48	"
37.4	53.6	$\text{KI} + \text{KHgI}_2$
37.8	52.6	$\text{KHgI}_2$
35.1	52.2	"
35.5	51.2	$\text{KHgI}_2, \text{H}_2\text{O}$
26.7	50.3	$\text{KHgI}_2 + \text{HgI}_2$
26.6	49.4	$\text{HgI}_2$
23.7	40.2	"
14.9	22.5	"
Temp = 30°		
60.6	..	$\text{KI}$
40	53	$\text{KI} + \text{KHgI}_2$
39.6	52.7	$\text{KHgI}_2$
40	52.2	"
40.2	51.2	"
39.3	50.3	"
33.7	49.8	"
33	52	"
31.4	51.7	$\text{KHgI}_2, \text{H}_2\text{O}$
29.1	52.2	"

(Dunningham, Chem. Soc. 1914, 105, 368.)

Very sol. in KSCN + Aq. (Philipp, Pogg. 1867, 131. 93.)

Sol. in 109 pts. cryst  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq (Eder and Ulm, M. 1882, 3. 197.)

Very sol. in hot  $\text{CaCl}_2$  + Aq, less sol in  $\text{BaCl}_2$ ,  $\text{KCl}$  and  $\text{NaCl}$  + Aq. (Lea, Z. anorg. 1896, 12. 341.)

Solubility in normal  $\text{Hg}(\text{NO}_3)_2$  + Aq = 48.0 g. per litre. (Morse, Z. phys. Ch. 1902, 41. 731.)

Extremely sol. in cold conc  $\text{NH}_4\text{Br}$  + Aq. (Grossmann, B. 1903, 36. 1602.)

Sol in alkali sulphates + Aq. (Barth, Z. phys. Ch. 1892, 9. 215.)

Sol in  $\text{Ca}(\text{OCl})_2$  + Aq; sol. in  $\text{KOH}$  + Aq (Melsens, A. ch. (3) 26, 222.)

Sol. in liquid  $\text{SO}_2$ . (Walden and Centnerszwer, C. C. 1902, I. 344.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sol. in  $\text{SOCl}_2$ ,  $\text{S}_2\text{Cl}_2$ ,  $\text{SO}_2\text{Cl}_2$ , warm  $\text{AsCl}_3$ ,  $\text{PBr}_3$ , warm  $\text{POCl}_3$  (Walden, Z. anorg. 1900, 26. 212.)

Easily sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 374.)

More sol. in alcohol than in  $\text{H}_2\text{O}$ . 1 l  $\text{H}_2\text{O}$  containing 10% of 90% alcohol dissolves 0.08 g  $\text{HgI}_2$ . 1 l. of alcohol of 80° B. dissolves 2.851 g.  $\text{HgI}_2$ . 1 l absolute alcohol dissolves 11.86 g  $\text{HgI}_2$  (Bourgoon, A. ch. (6) 3. 429.)

Sol. in 130 pts. cold, and 15 pts. hot 90% alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 3.16 pts. at 19.5°; 100 pts. absolute ethyl alcohol dissolve 2.09 pts. at 19.5° (de Bruyn, Z. phys. Ch. 10. 783.)

0.00842 pt is sol in 1 pt. alcohol at 15° (Gautier and Charpy, C. R. 1890, 111. 847.)

100 g methyl alcohol dissolve 3.7 g.  $\text{HgI}_2$  at 19°; ethyl alcohol, 1.86 g., propyl alcohol, 1.25 g.; isobutyl alcohol, at 22.5°, 0.51 g. (Timofeev, Dissert. 1894.)

At 15-20°, 100 g methyl alcohol dissolve 3.24 g.  $\text{HgI}_2$ , ethyl alcohol, 1.42 g.; propyl alcohol, 0.826 g. (Rohland, Z. anorg. 1898, 15. 412.)

Solubility of  $\text{HgI}_2$  in ethyl alcohol + Aq at 25°

A = g. alcohol in 100 g. alcohol + Aq.

$\text{HgI}_2$  = millimols  $\text{HgI}_2$  in 100 cc. of the solution.

A	$\text{HgI}_2$	Sp. gr.
100	3.86	0.80325
95.82	2.56	0.80950
92.44	1.92	0.81536
86.74	1.38	0.82996
78.75	0.935	0.84654
67.63	0.45	0.87214

(Herz and Knoch, Z. anorg. 1905, 45. 266.)

Solubility of  $\text{HgI}_2$  in methyl alcohol + Aq at 25°

P = g. alcohol in 100 g. alcohol + Aq

$\text{HgI}_2$  = millimols.  $\text{HgI}_2$  in 10 cc. of the solution.

P	$\text{HgI}_2$	Sp. gr.
0	0.0013	
47.06	0.0098	0.9187
64.00	0.0347	0.8834
78.05	0.0981	0.8519
100	0.571	0.8155

(Herz and Anders, Z. anorg. 1907, 52. 165.)

Solubility of  $\text{HgI}_2$  in ethyl alcohol + Aq at 25°.

P = g. alcohol in 100 g. alcohol + Aq.

$\text{HgI}_2$  = millimols.  $\text{HgI}_2$  in 10 cc. of the solution.

P	$\text{HgI}_2$	Sp. gr.
70.01	0.061	0.8636
100	0.386	0.8032

(Herz and Anders, Z. anorg. 1907, 52. 170.)

At 15°, 1 pt. by weight is sol. in:—

24813 pts.  $\text{H}_2\text{O}$

30.8 pts. methyl alcohol of sp. gr. at 0.7990.

70.3 " ethyl " " " " " 0.8100.

121.0 " propyl " " " " " 0.8160.

(Rohland, Z. anorg. 1899, 18. 328.)

Solubility of  $\text{HgI}_2$  in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the mixtures.

$\text{HgI}_2$  = g.  $\text{HgI}_2$  in 10 ccm. of the solution.

S 25°/4° = Sp. gr. of the sat. solution.

P	$\text{HgI}_2$	S 25°/4°
0	0.180	0.8038
4.37	0.193	0.8039
10.4	0.208	0.8046
41.02	0.232	0.8077
80.69	0.289	0.8131
84.77	0.296	0.8140
91.25	0.298	0.8146
100	0.316	0.8156

(Herz and Kuhn, Z. anorg. 1908, 58. 164.)

## Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = g.  $\text{HgI}_2$  in 10 ccm. of the solution.  
S = Sp. gr. of the sat. solution.

P	G	S 25°/1°
0	0.316	0.8156
23.8	0.301	0.8155
91.8	0.169	0.8101
93.75	0.167	0.8110
96.6	0.153	0.8108
100	0.142	0.8116

(Herz and Kuhn, Z. anorg. 1908, 60. 158.)

## Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = g.  $\text{HgI}_2$  in 10 ccm. of the solution.  
S = Sp. gr. of the sat. solution.

P	G	S 25°/1°
0	0.180	0.8038
8.1	0.173	0.8036(?)
17.85	0.165	0.8043
56.6	0.155	0.8075
91.2	0.152	0.8099
95.2	0.144	0.8108
100	0.142	0.8116

(Herz and Kuhn, Z. anorg. 1908, 60. 161.)

## Solubility in 100 pts. amyl alcohol equals:

0.66 pts at 13°.
3.66 " " 71°.
5.30 " " 100°.
9.57 " " 133.5°.

(Laszcynski, B. 1894, 27. 2287.)

Sp. gr. at 16°/4° of  $\text{HgI}_2$  + alcohol containing 1.8358%  $\text{HgI}_2$  = 0.80718; containing 1.7119% = 0.80597. (Schönrock, Z. phys. Ch. 1893, 11. 770.)

Somewhat sol in ether. Sol in 77 pts ether (Saladin) Sol in 60 pts. ether (Hager)

Sol. in cold ether. (François, J. Pharm. 1897, (6) 6. 445.)

Very al sol. in anhydrous ether. (Hampe)

0.62 pt. is sol. in 100 pts. ether at 0°.

0.97 pt. is sol. in 100 pts. ether at 36°.

(Laszcynski, B. 1894, 27. 2286.)

Solubility in ether = 0.3% at ord. temp (Marsh, Chem. Soc. 1910, 97. 2299.)

Nearly insol in ether. (Dunningham, Chem. Soc. 1914, 105. 368.)

Data are given on the system  $\text{HgI}_2 + \text{KI} + \text{ether}$ . (Dunningham.)

Solubility at 23° in chloroform = 0.071%; in ether = 0.551%; in acetone = 2.005%; in ethyl alcohol = 2%, in methyl alcohol = 3.975%; in benzene = 0.247%. (Beckmann and Stock, Z. phys. Ch. 1895, 17. 130.)

## Solubility in organic solvents at t°.

Solvent	t°	100 g. of the solvent dissolve g. $\text{HgI}_2$
Chloroform	61	0.163
Tetrachloromethane	75	0.094
Ethylene dichloride	85.5	1.200
Isobutyl chloride	69	0.328
Ethyl bromide	38	0.773
Methyl alcohol	66	6.512
Ethyl alcohol	78	4.325
Isopropyl alcohol	81	2.266
Isobutyl alcohol	ca. 100	2.433
Methyl formate	36-38	1.166
Ethyl formate	52-55	2.150
Methyl acetate	56-59	2.500
Ether	35	0.470
Acetone	56	3.249
Acetal	ca. 100	2.000
Chloral	96	
Epichlorohydrin	ca. 100	6.113
Hexane	67	0.072
Benzene	80	0.825
Ethyl acetate	74-78	4.200

(Sulc, Z. anorg. 1900, 25. 402.)

## Solubility in organic solvents at 18-20°.

100 g. chloroform dissolve 0.040 g.  $\text{HgI}_2$ .  
100 g. tetrachloromethane dissolve 0.006 g.  $\text{HgI}_2$ .

100 g. bromoform dissolve 0.486 g.  $\text{HgI}_2$ .  
100 g. ethyl bromide dissolve 0.643 g.  $\text{HgI}_2$ .

100 g. ethyl iodide dissolve 2.041 g.  $\text{HgI}_2$ .  
100 g. ethylene dibromide dissolve 0.748 g.  $\text{HgI}_2$ .

(Sulc, Z. anorg. 1900, 25. 401.)

1 pt. ethylene bromide dissolves 0.00553 pts  $\text{HgI}_2$  at 15°. (Gautier and Charpy, C. R. 1890, 111. 647.)

100 pts. methylene iodide  $\text{CH}_2\text{I}_2$  dissolve 2.5 pts  $\text{HgI}_2$  at 15°, 16.6 pts at 100°, and 58 pts. at 180°. (Retgers, Z. anorg. 3. 252.)

1 l. sat. solution in  $\text{CCl}_4$  at 15° contains 0.170 g.  $\text{HgI}_2$ . (Dawson, Chem. Soc. 1909, 96. 874.)

Sol in 340 pts. glycerine (Fairley, Monit. Scient. (3) 9. 685.)

100 pts. acetone dissolve 2.09 pts  $\text{HgI}_2$  at 25° (Krug and M'Elroy, J. Anal. Ch. 6. 84.)

Sol in acetone and in methylal. (Eidmann, C. C. 1899, II, 1014.)

Solubility in 100 pts. acetone equals:

2.83 pts. $\text{HgI}_2$ at — 1°.
3.36 " " " 18°.
4.73 " " " 40°.
6.07 " " " 58°.

(Laszcynski, B. 1894, 27. 2287.)

100 g. methyl acetate solution, sat. at 18°, contain 1.10 g.  $\text{HgI}_2$ . (Bezold, Dissert. 1906.)

100 g boiling methyl acetate slowly dissolve 2.3 g  $\text{HgI}_2$  (Schroeder and Steiner, J. pr. 1909, (2) 79. 49.)

### Solubility in ethyl acetate at t°.

Pts sol in 100 pts ethyl acetate	t°
1 49	- 2
1 56	+17 5
1 64	21
2 53	40
3 19	55
4 31	76

(Laszczyński, B. 1894, 27. 2286)

100 g. ethyl acetate anhydrous, or sat. with  $\text{H}_2\text{O}$  at 18°, dissolve at 18°, 14.70 g  $\text{HgI}_2$ . Solubility increases somewhat with temp. (Hammers, Dissert. 1906.)

### Solubility of $\text{HgI}_2$ in ethyl acetate + Aq at 25°

P = g. ethyl acetate in 100 g. ethyl acetate + Aq  
 $\text{HgI}_2$  = millimols.  $\text{HgI}_2$  in 10 cc. of the solution.

P	$\text{HgI}_2$	Sp gr
4 39	0.0028	0 9973
96 76	0.412	0 9063
100	0 241	0 9011

(Hers and Anders, Z. anorg. 1907, 52. 172.)

1 pt. is sol in 68.03 pts. ethyl acetate at 18°. (Naumann, B. 1910, 43. 316.)

Solubility in diethyl oxalate is 12.5% at bpt. and 2.5% at 100°. (Reinders, Z. phys. Ch. 1900, 32. 507.)

### Solubility in $\text{CS}_2$ at t°.

t°	100 pts sat solution contain pts $\text{HgI}_2$
-10	0.107
- 5	0 141
0	0.173
+ 5	0 207
10	0 239
15	0.271
20	0 320
25	0 382
30	0.445

(Arcowski, Z. anorg. 1894, 6. 267.)

### Solubility in $\text{CS}_2$ .

100 g. of the sat. solution contain at

-86.5°	-93°	-116°
0.024	0.023	0.017 g. $\text{HgI}_2$

(Arcowski, Z. anorg. 1896, 11. 274.)

0.0028 pt. is sol. in 1 pt.  $\text{CS}_2$  at 15°. (Gautier and Charpy, C. R. 1890, 111. 647.)

1 l. sat solution in  $\text{CS}_2$  at 15° contains 3.127 g.  $\text{HgI}_2$ . (Dawson, Chem. Soc. 1909, 96. 874.)

Very sol. in liquid methylamine (Gibbs, J. Am. Chem. Soc. 1906, 28. 1419.)

Abundantly sol. in methylamine. (Fitzgerald, J. phys. Chem. 1912, 16. 633.)

Somewhat sol. in allyl mustard oil. (Mathews, J. phys. Chem. 1905, 9. 647.)

Sol. in  $\text{Sb}(\text{CH}_3)_3 + \text{Aq}$ .

Very sl. sol. in Na citrate + Aq. (Spiller.)

1 pt.  $\text{C}_6\text{H}_6$  dissolves 0.00217 pts.  $\text{HgI}_2$  at 15°. (Gautier and Charpy, C. R. 1890, 111. 647.)

### Solubility in 100 pts. benzene equals:

0.22 pts at 15°
0 88 " " 60°
0 95 " " 65°
1.24 " " 84°

(Laszczyński, B. 1894, 27. 2284.)

1 l.  $\text{C}_6\text{H}_6$  dissolves 0.00493 mol.  $\text{HgI}_2$  at 25°. (Sherrill, Z. phys. Ch. 1903, 43. 735.)

100 g. boiling phenol dissolve 10 g.  $\text{HgI}_2$ . (François, C. R. 1895, 121. 769.)

Sl. sol. in phenol with 20%  $\text{H}_2\text{O}$ . Not very sol. in acetic acid at 119°, in amyl acetate at 133°, in amyl bromide at 119°. Rather sol. in diethyl oxalate at 180°, in ethylene bromide at 131°, in amyl alcohol at 137°, in amyl iodide at 150°, in  $\text{CHBr}_3$  at 151°, in iodo-benzol at 190°, in oil of turpentine at 160°. Very sol. in benzaldehyde at 179°, in methylene iodide at 182°. (Reinders, Z. phys. Ch. 1900, 32. 506.)

1000 pts. oil of bitter almonds dissolve 4 pts.  $\text{HgI}_2$  at ord. temp.; 1000 pts. olive oil, 4 pts; 1000 pts. poppy oil, 10 pts; 1000 pts. nut oil, 15 pts; 1000 pts. castor oil, 20 pts; 1000 pts. lard oil, 4. 5 pts; 1000 pts. vaseline, 2.5 pts; 1000 pts. benzene, 4 pts. Sol. in phenol. (Mehn, Pharm J. 3. 327; B. 19. 8 R.)

### Solubility in aniline.

S = Temp of solidification.

Mols per 100	S	Mols per 100	S	Mols per 100	S
5.9	12°	19.9	48 5°	33 0	128°
8 2	22.5	25.8	53 5	35 6	140
10 3	29	29.3	105	37 5	147
14.9	41.5	31 7	122	39.2	156
16 6	45	32.4	(55)		

(Staronka, Anz. Ak. Wiss. Krakau, 1910. 372.)

Solubility of  $\text{HgI}_2$  in aniline at  $t^\circ$ .

$t^\circ$	g $\text{HgI}_2$ per 100 g aniline	Solid phase
-6.5	23.35	$\text{HgI}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$
+0.4	28.69	"
17.8	42.85	"
21.1	47.55	"
26.9	55.47	"
30.1	62.05	"
36.2	75.80	"
42.9	96.49	"
46.8*	.	" + $\text{HgI}_2(\text{red})$
48.8	128.1	$\text{HgI}_2(\text{red})$
63.6	163.8	"
70.82	184.1	"
76.2	201.6	"
95.9	246.7	"
108.*	.	$\text{HgI}_2(\text{red}) + \text{HgI}_2(\text{yellow})$
115.7	281.8	$\text{HgI}_2(\text{yellow})$
137.2	295.2	"
181.1	279	"
199.1	863.2	"

\* Transition point.

(Pearce and Fry, J. phys. Ch. 1914, 18. 667)

Very sol. in boiling alcoholic solution of aniline. (Vohl, Dissert 1871.)

Abundantly sol. in hot benzonitrile and other aromatic nitriles. (Werner, Z. anorg. 1897, 15. 7.)

Sol. in benzonitrile (0.98 g. in 100 g. at  $18^\circ$ ). 20 times more sol. by addition of 5 g. KI to 100 cc. benzonitrile. (Naumann, B. 1914, 47. 1375.)

Sol. in pyridine (Naumann, B. 1904, 37. 4609.)

Solubility of  $\text{HgI}_2$  in pyridine.

S = temp. of solidification.

Mols. per 100	S	Mols. per 100	S	Mols. per 100	S
5	$10^\circ$	34.6	$107^\circ$	51.3	$93.5^\circ$
9.8	42.5	38.0	103	51.6	96
15.14	66.5	43.0	97	52.7	108
19.3	83	46.7	88.5	53.2	109
25.3	102.5	48.5	89	55.4	122
29.6	107	50.6	89	57.9	135

(Staronka, Anz. Ak. Wiss. Krakau, 1910. 372.)

Sp. gr. at  $16\frac{1}{4}^\circ$  of  $\text{HgI}_2$  + pyridine containing 10.43%  $\text{HgI}_2 = 1.1482$ ; containing 7.99% = 1.1053. (Schdnrock, Z. phys. Ch. 1893, 11. 770.)

Solubility of  $\text{HgI}_2$  in quinoline.

S = temp. of solidification.

Mols. per 100	S	Mols. per 100	S	Mols. per 100	S
4.7	$100^\circ$	29.8	$151^\circ$	43.0	$165^\circ$
9.1	115.5	31.4	153	46.1	167
13.2	133.5	35.4	156	48.8	170
23.1	138	37.7	160	49.5	169.5
26.7	145	41.6	165	54.4	166.5

(Staronka, Anz. Ak. Wiss. Krakau, 1910. 372)

Mol. weight determined in pyridine, methyl- and ethyl-sulphide (Werner, Z. anorg. 1897, 15. 20)

More or less sol. at high temp in petroleum (bpt.  $160-230^\circ$ ), bromnaphthalene, pyridine, toluene and amyl alcohol. (Reinders, Z. phys. Ch. 1900, 32. 503.)

Yellow modification.

100 g. of sat. solution in acetone at  $25^\circ$  contain 3.0 g.  $\text{HgI}_2$ . (Reinders, Z. phys. Ch. 1900, 32. 514)

Red modification

Solubility in alcohol equals:

0.717-0.724 g. in 100 g. solution at  $0^\circ$ 1.044-1.084 g. " " "  $25^\circ$ 2.10-2.20 g. " " "  $50^\circ$ .

(Reinders, Z. phys. Ch. 1900, 32. 522.)

100 g. of sat. solution in acetone at  $25^\circ$  contain 1.95 g.  $\text{HgI}_2$ . (Reinders, Z. phys. Ch. 1900, 32. 514.)

$\text{HgI}_2$  is moderately sol. in abs. alcohol at its h.-pt. The solution has a deced yellow color. On cooling, yellow crystals separate out. They soon change to the red modification.

Readily sol. in hot amyl alcohol. Yellow crystals separate from the solution when cooled.

Readily sol. in allyl alcohol, forming a yellow solution, from which yellow crystals separate on cooling.

Sl. sol. in acetone, giving a yellow solution. On cooling yellow plates separate from the solution and rapidly turn red.

Sol. in phenol at  $150^\circ \text{C}$ . Solution has yellow color and yellow crystals separate out on cooling.

Readily sol. in boiling benzene. Saturated solution is yellow. The yellow iodide separates out on cooling, and changes rapidly to the red.

Sol. in toluene giving yellow solution, from which yellow crystals separate on cooling. They rapidly change to red.

Readily sol. in naphthalene at temperatures above its transition point. Solution is yellow and on cooling yellow crystals separate out.

Readily sol. in hot pseudo-cumene giving a yellow solution. On cooling gives yellow crystals.

Readily sol. in ethyl iodide giving very

yellow solution, from which yellow crystals separate on cooling, which change to red rapidly.

Only sl sol in ethyl bromide, giving yellow solution from which yellow crystals separate on cooling, which change rather slowly to the red.

Sparingly sol. in isopropyl bromide.

Moderately sol in isobutyl bromide, giving a pink solution from which yellow crystals separate on cooling, which change slowly to red.

Sl. sol in ethyldene chloride. On sudden cooling at 18° the iodide crystallizes out in yellow plates, which quickly change to red.

Sparingly sol in propyl chloride, giving a pink solution, from which yellow crystals separate on cooling.

Readily sol in ethyl cyanide, giving a yellow solution. On cooling yellow crystals separate and rapidly change to red.

Moderately sol in benzene cyanide, giving a deep yellow solution. On sudden cooling the solution deposits yellow crystals, which rapidly turn red.

Rapidly sol in benzoic acid at high temperatures.

Sparingly sol. in ethyl acetate, giving yellow solution.

Sol. in ethyl propionate.

Very sol in ethyl butyrate, giving a yellow solution. On cooling the iodide crystallized from the solution.

Sl. sol. in ethyl isobutyrate.

Readily sol. in methyl salicylate, giving a yellow solution.

Sparingly sol. in phenyl salicylate, giving yellow solution. On cooling yellow crystals separate out, which gradually change to red. (Kastle, *Am. Ch. J.* 1899, 22, 474.)

**Mercuriomercuric iodide,  $Hg_2I_4 = Hg_2I_2 \cdot 2HgI_2$ .**

Insol. in  $H_2O$  or alcohol. Partially sol. in  $KI + Ag$ , in hot  $NaCl$  and  $NH_4Cl + Ag$ , and in hot  $HCl + Ag$ , though very slowly (Boullay, *A. ch.* (2) 34, 346).

**Mercury periodide,  $HgI_4$ .**

Sol in  $KI + Ag$ . Decomp. by cold  $H_2O$  or alcohol. (Jørgensen, *J. pr.* (2) 2, 347.)

**Mercuric hydrogen iodide (Iodomeric acid),  $HI$ ,  $HgI_2 = HHgI_2$ .**

Crystallizes from  $HI + Ag$ . (Boullay.)

Easily decomp. (Neumann, *M.* 10, 236.)

$3HgI_2 \cdot 2HI + H_2O$ . (François, *Dissert.* 1901.)

**Mercuric nickel iodide,  $HgI_2 \cdot NiI_2 + 6H_2O$ .**

Sol. in alcohol, ether, and acetone; not decomp. by  $H_2O$ . (Dobroserdoff, *C. C.* 1901, II, 332.)

$2HgI_2 \cdot NiI_2 + 6H_2O$ . Hygroscopic; decomp. by  $H_2O$ ; sol. in acetone and ether. (Dobroserdoff, *C. C.* 1901, II, 332.)

**Mercuric potassium iodide,  $HgI_2 \cdot KI + 1\frac{1}{2}H_2O$ .**

Deliquescent (v. Bonsdorff). Permanent, decomp. by  $H_2O$  into  $2KI$ ,  $HgI_2$ , and  $HgI$ ; (Boullay); sol. in alcohol, ether, and conc.  $HC_2H_3O_2$ , but decomp. by other acids (Berthelot, *J. Pharm.* 14, 186). Sp. gr. of sat. solution in  $H_2O = 2.4$  to 3.1.

+  $H_2O$ . Sol. in  $H_2O$  with decomp. Can be cryst. from alcohol. Very sl sol. in dry ether. Very sol. in wet ether. (Marsh, *Chem. Soc.* 1910, 97, 2297.)

$HgI_2 \cdot 2KI$ . Sol. in  $H_2O$ . (Thomson and Bloxam, *Chem. Soc.* 41, 379.)

Sat. solution of  $KI + HgI_2$  in  $H_2O$  at 22.9° contains 8.66%  $K$ , 22.49%  $Hg$  and 52.48%  $I$ , corresponding to 0.23 mol  $K$ , 0.11 mol  $Hg$  and 0.45 mol  $I$ . (Duboin, *C. R.* 1905, 141, 385.)

Sp. gr. at 16°/4° of aqueous solution containing 12.2875% salt = 1.10148; containing 12.2371% = 1.1038, containing 7.9843% = 1.06481 (Schönrock, *Z. phys. Ch.* 1893, 11, 782.)

Sol. in methyl acetate. (Bezold, *Dissert.* 1906.)

Sol. in ethyl acetate. (Alexander, *Dissert.* 1899; Hamers, *Dussert.* 1906.)

Sol. in acetone. (Eidmann, *C. C.* 1899, II, 1014; Naumann, *B.* 1904, 37, 4328.)

Sol. in methyl acetate (Naumann, *B.* 1909, 42, 3790), ethyl acetate (Naumann, *B.* 1904, 37, 3601.)

+  $2H_2O$ . Sol. in alcohol, ether and acetone; decomp. by  $H_2O$ . (Pawlow, *C. C.* 1901, I, 363.)

Solubility determinations show that  $KHgI_2$  and  $KHgI_2 + H_2O$  are the only double salts formed at 20°-30°. See  $HgI_2 + KI$  under  $HgI_2$ . (Dunningham, *Chem. Soc.* 1914, 106, 368.)

**Mercuric rubidium iodide,  $HgI_2 \cdot RbI$ .**

Sol. in alcohol; decomp. by  $H_2O$ .

$HgI_2 \cdot 2RbI$ . Very easily sol. in  $H_2O$ . (Grossmann, *B.* 1904, 37, 1258.)

Very sol. in acetic acid and alcohol; decomp. by  $H_2O$ . Stable in aq. solution in the presence of an excess of  $RbI$ . (Erdmann, *Arch. Pharm.* 1894, 232, 30.)

**Mercuric silver iodide,  $HgI_2 \cdot 2AgI$ .**

(Wegelin and Kilpi, *Z. anorg.* 1909, 61, 416.)

**Mercuric sodium iodide,  $HgI_2 \cdot NaI$ .**

Deliquescent, and decomp. by much  $H_2O$ . (v. Bonsdorff, *Pogg.* 17, 266.)

Sol. in alcohol; decomp. by  $H_2O$ .

$HgI_2 \cdot 2NaI$ . Deliquescent; sol. in  $H_2O$  and alcohol. (Boullay.)

Sat. solution of  $NaI + HgI_2$  in  $H_2O$  at 24.75° contains 4.59%  $Na$ , 25%  $Hg$ , and 58.25%  $I$ , corresponding to 0.20 mol.  $Na$ ,

0.12 mol.  $\text{Hg}_2$  and 0.45 mol. I. (Duboin, C. R. 1905, **141**, 385.)  
 +4H<sub>2</sub>O Extremely deliquescent. (Duboin, C. R. 1906, **143**, 314.)

**Mercuric strontium iodide**,  $\text{HgI}_2$ ,  $\text{SrI}_2$  (?).

Sol. in H<sub>2</sub>O without decomp. (Boullay.)  
 +N<sub>2</sub>O As Ca salt (Duboin, C. R. 1906, **142**, 573.)  
 2 $\text{HgI}_2$ ,  $\text{SrI}_2$  (?). Decomp. by much H<sub>2</sub>O into sol.  $\text{HgI}_2$ ,  $\text{SrI}_2$  and insol.  $\text{HgI}_2$ . (Boullay.)

**Mercuric thorium iodide**,  $5\text{HgI}_2$ ,  $\text{ThI}_4 + 18\text{H}_2\text{O}$

Very deliquescent. Easily decomp. by H<sub>2</sub>O. (Duboin, A. ch. 1909, (8) **18**, 282.)  
 $5\text{HgI}_2$ ,  $2\text{ThI}_4 + 21\text{H}_2\text{O}$ . (Duboin)  
 $2\text{HgI}_2$ ,  $\text{ThI}_4 + 12\text{H}_2\text{O}$  (Duboin)

**Mercuric zinc iodide**.

Deliquescent. Decomp. by H<sub>2</sub>O. (v. Bunsen.)

**Mercuric iodide ammonia**,  $\text{HgI}_2$ ,  $2\text{NH}_3$ .

Decomp. by  $\text{NH}_3$  giving  $\text{NH}_4\text{I}$  and  $\text{NH}_4\text{I}$  (François, C. R. 1900, **130**, 333.)  
 Stable only in the presence of excess of ammonia. Gives off  $\text{NH}_3$  in the air. (François, J. Pharm. 1897, (6) **5**, 388; C. C. 1897, I. 1088.)

**Mercuric iodide hydrazine**,  $\text{HgI}_2$ ,  $\text{N}_2\text{H}_4$

Decomp. by H<sub>2</sub>O (Hofmann and Marburg, A. 1899, **305**, 215.)

**Mercuric iodide rubidium bromide**,  
 $\text{HgI}_2$ ,  $2\text{RbBr}$ .

Decomp. by H<sub>2</sub>O.  
 Sol. in alcohol without decomp. (Grosman, B. 1903, **36**, 1603.)

**Mercuric iodide silver chloride**,  $\text{HgI}_2$ ,  $2\text{AgCl}$ .

Insol. in H<sub>2</sub>O. (Lea, Sill. Am. J. (3) **7**, 31.)

**Mercury iodoantimonide**,  $\text{Hg}_2\text{Sb}_2\text{HgI}_2$ .

Sol. in  $\text{HNO}_3$ , aqua regia and hot  $\text{H}_2\text{SO}_4$ ; insol. in HCl. (Granger, C. R. 1901, **132**, 1116.)

**Mercury nitride**,  $\text{Hg}_2\text{N}_2$ .

Gradually decomp. by H<sub>2</sub>O. Decomp. by conc.  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$  (Hirzel, J. B. 1852, 419.)

Not attacked by cold, but decomp. by hot dil.  $\text{H}_2\text{SO}_4$ .

Sol. in acids + Aq.  
 Sol. in ammoniacal solutions of ammonium salts

Insol. in excess of  $\text{KNH}_4$ . (Franklin, Z. anorg. 1905, **46**, 18.)

Sol. in ammonia solutions of ammonium salts and in aq. acid solutions.

Very explosive. (Franklin, J. Am. Chem. Soc. 1905, **27**, 835.)

$\text{HgN}_2$

See Mercurous azoimide.

$\text{HgN}_2$

See Mercuric azoimide.

**Mercurous oxide**,  $\text{Hg}_2\text{O}$ .

Insol. in H<sub>2</sub>O. Insol. in dil. HCl or  $\text{HNO}_3$ , +Aq. Sol. in warm conc.  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$  + Aq.  
 Sol. in 150,000 pts. H<sub>2</sub>O (Bhaduri, Z. anorg. 1897, **13**, 410.)

Decomp. by H<sub>2</sub>O or weak bases (Rose),  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Wittstein),  $\text{KNO}_3 + \text{Aq}$  (Rose),  $\text{KI} + \text{Aq}$  (Berthelot), or conc.  $\text{NH}_4\text{Cl} + \text{Aq}$  (Pagenstecher) into HgO and Hg, or  $\text{HgCl}_2$ , etc.

Sl. decomp. by alkali chlorides + Aq with formation of  $\text{HgCl}_2$ , which dissolves. (Mihale.)

Sl. sol. in alkali cyanides + Aq. (Jahn.)

Insol. in KOH, and NaOH + Aq.

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, **20**, 829.)

Insol. in alcohol and ether.

**Mercuric oxide**, HgO.

Sol. in 20,000 to 30,000 pts. H<sub>2</sub>O (Bineau, C. R. **41**, 509.)

Sol. in 200,000 pts. H<sub>2</sub>O. (Wallace, Ch. Gaz. 1858, 345.)

Ordinary coarse HgO is sol. in H<sub>2</sub>O to the extent of 50 mg. per l. at 25°, but when finely powdered the solubility increases to 150 mg. per l. (Hulett, Z. phys. Ch. 1901, **37**, 406.)

Red modification is—

Sol. in 19,500 pts. H<sub>2</sub>O at 25°, in 2,600 pts. H<sub>2</sub>O at 100°. (Schick, Z. phys. Ch. 1903, **42**, 172.)

1 l. H<sub>2</sub>O dissolves 50 mg. red modification of HgO at 25°. (Hulett, Z. phys. Ch. 1901, **37**, 406.)

Yellow modification is—

Sol. in 19,300 pts. H<sub>2</sub>O at 25°, in 2400 pts. at 100° (Schick, Z. phys. Ch. 1903, **42**, 172.)

Sol. in acids. Insol. in  $\text{H}_3\text{PO}_4$  or  $\text{H}_3\text{AsO}_4$  + Aq. (Haack, A. 262, 190.)

Scarcely attacked by  $\text{H}_2\text{C}_2\text{O}_4$  + Aq (Mihale, A. ch. (3) **18**, 352.)

Solubility of HgO in HF at 25°.

Hg = g.-atoms Hg in 1 l. of the solution.

HF normal	Hg
0.12	0.01258
0.24	0.0247
0.57	0.0629
1.11	0.1168
2.17	0.2586

(Jaeger, Z. anorg. 1901, **27**, 26.)

Solubility of  $\text{HgO}$  in  $\text{HF}$  is decreased by the addition of  $\text{KF}$ , which proves the non-existence of complex fluorides. (Jaeger.)

Insol. in  $\text{H}_3\text{AsO}_4$ ,  $\text{H}_3\text{PO}_4$ , and in primary and secondary alkali salts of these acids. (Haack, A. 1891, 262, 190.)

Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq.}$ , less in  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Brett.)

Insol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq.}$

Decomp. by alkali chlorides +  $\text{Aq}$  into  $\text{HgCl}_2$ , which dissolves (Miahle, A. ch. (3) 5, 177.)

Sol. in  $\text{Fe}(\text{NO}_3)_3$ , and  $\text{Bi}(\text{NO}_3)_3 + \text{Aq}$  with pptn of oxides Sol. in  $\text{KI} + \text{Aq}$  (Persoz.)

Very sol in acid sulphates +  $\text{Aq}$  (Barth, Z. phys. Ch. 1892, 9, 192.)

Completely sol in conc.  $\text{CaCl}_2$ ,  $\text{BaCl}_2$ ,  $\text{MgCl}_2$ , and  $\text{SrCl}_2 + \text{Aq.}$  (André, C. R. 1887, 104, 431.)

Solubility in  $\text{Ag}$  salts +  $\text{Aq.}$  100 g.  $\text{Ag}_2\text{SO}_4$  in aqueous solution dissolve 13 g.  $\text{HgO}$ . Solubility in  $\text{AgNO}_3 + \text{Aq}$  is 15.6. 100; in  $\text{Ag}$  acetate +  $\text{Aq}$  is 1.137. 100. (Finci, Gazz. ch. it 1911, 41, (2) 545.)

Much less sol. in  $\text{KCl}$  and  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Schoch.)

Sol. in  $\text{U}(\text{NO}_3)_6$ ,  $\text{Al}(\text{NO}_3)_3$  and  $\text{Fe}(\text{NO}_3)_3 + \text{Aq.}$  (Mailhe, A. ch. 1902, (7) 27, 373.)

Very sl. sol in cold  $\text{Hg}(\text{CN})_2 + \text{Aq}$ , abundantly sol at  $75^\circ$  with evolution of  $\text{HCN}$  (Barthe, J. Pharm. 1896, (6) 3, 183.)

Sol. in cold or hot alcoholic  $\text{NH}_4\text{SCN}$  in large amounts (Flousser, A. 1875, 179, 225.)

Completely sol in  $\text{KI} + \text{Aq.}$  (Jehn, Arch. Pharm. 1873, 201, 97.)

Solubility of red or yellow modification in  $\text{N}/50$   $\text{KCl} + \text{Aq}$  is about 25% greater than in pure  $\text{H}_2\text{O}$ . (Schick, Z. phys. Ch. 1903, 42, 168.)

Insol. in liquid  $\text{HF}$ . (Franklin, Z. anorg. 1905, 48, 2.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 829.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 829.)

Sol. in alcoholic solution of hydroxylamine hydrobromide below  $0^\circ$  (Adams, Am. Ch. J. 1902, 28, 216.)

Insol. in alcohol.

Sol. in trichloroacetic acid +  $\text{Aq}$  (Brand, J. pr. 1913, (2) 88, 342.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II, 1014.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

When freshly pptd., is insol. in acetone +  $\text{Aq.}$  even on warming, but easily sol. if liquid is made alkaline by  $\text{NaOH}$ . Insol. in acetophenone even after long warming at  $100^\circ$ . Sol. in acetaldehyde and much  $\text{H}_2\text{O}$  and a little  $\text{NaOH}$ . (Auld and Hantzsch, B. 1905, 38, 2680.)

Sol. in formamide. (Fischer, Arch. Pharm. 1894, 232, 329.)

Very sol. in ethylene diamine. For 1 mol.

$\text{HgO}$ , 7-10 mols. ethylene diamine are necessary. (Traube and Lowe, B. 1914, 47, 1910.)

Easily sol in benzamide. (Dessaigues, A. ch. 1852, (3) 34, 146.)

When freshly pptd., is sol in picric acid +  $\text{Aq.}$  (Varet, C. R. 1894, 119, 560.)

Sol. in alkaline solution of phenol disulphonic acid. (Lumière and Chevroliet, C. R. 1901, 132, 145.)

Sol. in nucleic acid +  $\text{Aq}$  when freshly pptd. (Schweckerath, Pat. 1899.)

Sol. in gum arabic +  $\text{Aq.}$  (Peschier, J. Pharm. 1896, (6) 3, 509.)

**Mercuric oxybromide,  $\text{HgBr}_2$ ,  $\text{HgO}$ .**

(André, A. ch. (6) 3, 123.)

$\text{HgBr}_2$ ,  $2\text{HgO}$  (André.)

$\text{HgBr}_2$ ,  $3\text{HgO}$ . (a) Yellow Insol in cold, sl. sol in hot  $\text{H}_2\text{O}$ . Easily sol in alcohol (Löwig.)

(b) Brown. Insol in alcohol (Rammelsberg, Pogg. 55, 248.)

$\text{HgBr}_2$ ,  $4\text{HgO}$ . (André.)

Insol in ord. solvents. Decomp. by alkalis and acids. (Fischer and von Wartenburg, Ch. Z. 1902, 26, 894.)

$2\text{HgBr}_2$ ,  $7\text{HgO}$ . Readily decomp. by acids and alkalis. (Fischer and von Wartenburg.)

**Mercurous oxychloride,  $\text{Hg}_2\text{O}$ ,  $2\text{HgCl}$ .**

Min. *Eglestonite*.

Decomp. by hot  $\text{HCl}$  and by  $\text{HNO}_3$ . (Moses, Am. J. Sci. 1903, (4) 16, 253.)

**Mercuric oxychloride,**

$\text{HgO}$ ,  $\text{HgCl}_2$ . Less sol. than  $\text{HgCl}_2$ , but not isolated. (Thümmel.) Decomp. by cold  $\text{H}_2\text{O}$ . (André, A. ch. (6) 3, 118.)

$\text{HgO}$ ,  $2\text{HgCl}_2$ . Decomp. by warm  $\text{H}_2\text{O}$  or cold alcohol into  $2\text{HgO}$ ,  $\text{HgCl}_2$ . (Thümmel, Arch. Pharm. (3) 27, 589.)

Decomp. by  $\text{H}_2\text{O}$ . Not decomp. by alcohol. (Arctowski, Z. anorg. 1895, 9, 178.)

$2\text{HgO}$ ,  $\text{HgCl}_2$ . Two modifications.

A. Red. Insol in  $\text{H}_2\text{O}$ ; decomp. by alkali carbonates, or chlorides +  $\text{Aq}$  into  $4\text{HgO}$ ,  $\text{HgCl}_2$ .

Acted upon by cold alkali carbonates and alkali chlorides +  $\text{Aq.}$  (Schoch, Am. Ch. J. 1903, 29, 335.)

Not decomp. by  $\text{H}_2\text{O}$  at ord. temp. (Thümmel.)

Very sl. sol. in cold, completely sol in hot  $\text{H}_2\text{O}$ . (Haack, A. 1891, 262, 189.)

A small amt. of  $\text{HNO}_3$  converts it into a white powder; more  $\text{HNO}_3$  dissolves it. (Haack, A. 1891, 262, 189.)

B. Black. Not decomp. by alkali chlorides, or carbonates +  $\text{Aq.}$  (Thümmel.)

Not affected by boiling alkali carbonates or alkali chlorides +  $\text{Aq.}$  (Schoch, Am. Ch. J. 1901, 29, 335.)

Insol. in cold and hot  $\text{H}_2\text{O}$  and alcohol.

Sol. in acid. (Van Nest, Dissert. 1909.)

Not changed by  $\text{H}_2\text{O}$ . (Blaas, Miner. Mitt. (2) 2, 177.)

Sol. in  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq.}$  (Blaas.)  
 Not changed by alcohol. (Blaas.)  
 $+1\frac{1}{2}\text{H}_2\text{O}$ . (Räy, A. 1901, 316. 255.)  
 $3\text{HgO}$ ,  $\text{HgCl}_2$  Decomp. by warm  $\text{H}_2\text{O}$  (Thümmel.)

Not attacked by cold  $\text{H}_2\text{O}$ . (André.)  
 Ppt. (Tarugi, Gazz. ch. it. 1901, 31. 313.)  
 Decomp. by  $\text{H}_2\text{O}$  Not decomp. by alcohol. (Aretowski, Z. anorg. 1895, 9. 178.)

Three modifications.

a. Prisms Decomp. by boiling  $\text{H}_2\text{O}$ .

b. Brick-red, amorphous

c. Yellow plates

(Schoch, Am. Ch. J. 1903, 29. 337.)

Yellow plates.

Decomp. by hot  $\text{H}_2\text{O}$ ,  $\text{Na}_2\text{CO}_3$  or  $\text{NaOH} + \text{Aq.}$  Sol. in  $\text{KHCO}_3 + \text{Aq.}$  Insol. in cold dil.  $\text{HNO}_3$  (Tarugi)

$4\text{HgO}$ ,  $\text{HgCl}_2$  Decomp. by  $\text{H}_2\text{O}$ . Not decomp. by alcohol (Aretowski, Z. anorg. 1895, 9. 178.)

Two modifications

A. Yellow plates.

Easily sol. in acids. Insol. in alcohol and ether. Decomp. by  $\text{KOH}$ . (Dukelski, Z. anorg. 1900, 49. 336.)

B. Brown, amorphous.

Easily sol. in acids Decomp. by  $\text{KOH}$ . Insol. in alcohol and ether. (Dukelski, Z. anorg. 1900, 49. 336.)

$5\text{HgO}$ ,  $\text{HgCl}_2$ . (Milon.)

Does not exist (Thümmel)

$6\text{HgO}$ ,  $\text{HgCl}_2$ . Does not exist. (T.)

$+ \text{H}_2\text{O}$  Insol. in cold  $\text{H}_2\text{O}$ . (Roucher, A. ch. (3) 27. 353.)

Does not exist (T.)

$7\text{HgO}$ ,  $4\text{HgCl}_2$  (Roucher.)

Does not exist. (T.)

**Mercuriomercuric oxychloride,  $\text{Hg}_2\text{OCl}$**

Min. *Tertinguite*.

Decomp. by  $\text{HCl}$  and  $\text{HNO}_3$ .

Slowly decomp. by cold acetic acid when powdered. (Hillebrand and Schaller, J. Am. Chem. Soc. 1907, 29. 1190.)

**Mercuric strontium oxychloride,  $\text{HgO}$ ,  $\text{SrCl}_2$   $+ 6\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (André, C. R. 104. 431.)

**Mercuric oxyfluoride,  $\text{HgO}$ ,  $\text{HgF}_2 + \text{H}_2\text{O}$**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil  $\text{HNO}_3 + \text{Aq.}$  (Finkener)

**Mercuric oxyiodide,  $3\text{HgO}$ ,  $\text{HgI}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HI} + \text{Aq.}$  (Weyl, Pogg. 131. 524.)

**Mercuric oxyphosphide,  $\text{Hg}_2\text{P}_2\text{O}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Patheil and van Haaren, Arch. Pharm. 1900, 238. 35.)

**Mercuric oxytelluride,  $2\text{HgSe}$ ,  $\text{HgO}$ .**

Easily sol. in aqua regia. (Uelsmann, A. 116. 122.)

**Mercury phosphide,  $\text{Hg}_3\text{P}_2$ .**

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq.}$  Easily sol. in aqua regia. (Granger, C. R. 115. 229.)  
 $\text{Hg}_3\text{P}_4$ . (Granger, C. N. 1898, 77. 229.)

**Mercury phosphochloride,  $\text{P}_2\text{Hg}_3$ ,  $3\text{HgCl}_2 + 3\text{H}_2\text{O}$ .**

See Dimercuriphosphonium mercuric chloride.

**Mercury phosphosulphide,  $2\text{HgS}$ ,  $\text{P}_2\text{S}_5$ .**

$\text{HgS}$ ,  $\text{P}_2\text{S}_5$ .

$2\text{HgS}$ ,  $\text{P}_2\text{S}_5$ . (Berzelius)

$3\text{HgS}$ ,  $\text{P}_2\text{S}_5$ . (Baudrimont, C. R. 55. 323.)

$2\text{HgS}$ ,  $\text{P}_2\text{S}_5$ . (Berzelius, A. 47. 256.)

**Mercuric selenide,  $\text{HgSe}$ .**

Sol. in cold aqua regia when crystalline When precipitated shows the same properties towards solvents as mercuric sulphide (Reeb J. Pharm. (4) 9. 173.)

Min. *Tilmannite*. Sol. only in aqua regia.

**Mercuric selenochloride,  $2\text{HgSe}$ ,  $\text{HgCl}_2$**

Insol. in boiling  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Easily sol. in aqua regia and a mixture of  $\text{H}_2\text{SO}_4$  and conc.  $\text{HNO}_3 + \text{Aq.}$  (Uelsmann, J. B. 1860. 92.)

**Mercurous sulphide,  $\text{Hg}_2\text{S}$ .**

Insol. in  $\text{H}_2\text{O}$ , dil.  $\text{HNO}_3$ , hot  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{S} + \text{Aq.}$  Sol. in  $\text{KOH} + \text{Aq.}$  with separation of  $\text{Hg}$ . (Rose.)

Does not exist; only mixtures of  $\text{Hg}$  and  $\text{HgS}$  are formed. (Barfoed, J. pr. 93. 230.)

See also Baskerville, J. Am. Chem. Soc. 1903, 25. 799.)

Not attacked by  $\text{HNO}_3$  below  $0^\circ$ , but attacked by dil  $\text{HNO}_3$  and  $\text{HCl} + \text{Aq.}$  when temp. is increased Sol. in  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S}$  but  $\text{Hg}$  soon ppts (Antony and Sestini, Gazz. ch. it. 1894, 24. (1) 194.)

**Mercuric sulphide,  $\text{HgS}$ .**

Insol. in  $\text{H}_2\text{O}$ .

Pptd. as a brown coloration in presence of 20,000 pts  $\text{H}_2\text{O}$ , and as a green coloration in presence of 40,000 pts  $\text{H}_2\text{O}$  (Lassaigne.)

Much less sol. in  $\text{H}_2\text{O}$  than  $\text{Ag}_2\text{S}$  or  $\text{Cu}_2\text{S}$ . (Bodlander, Z. phys. Ch. 1898, 27. 84.)

1 l.  $\text{H}_2\text{O}$  dissolves  $0.05 \times 10^{-4}$  mols  $\text{HgS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 53. 294.)

Sol. in cold conc., and in hot dil  $\text{HI} + \text{Aq.}$  or  $\text{HBr} + \text{Aq.}$  (Kekulé, A. Suppl. 2. 101.) Very sl. decomp. by hot conc  $\text{HCl} + \text{Aq.}$  Not attacked by hot  $\text{HNO}_3 + \text{Aq.}$  Sol. in cold aqua regia.

Not attacked by 4-N  $\text{HNO}_3$  or 4-N  $\text{HNO}_3 + 4\text{-N H}_2\text{SO}_4$  at ord. temp. even after many days. By action of a mixture of equal volumes of 4-N  $\text{HNO}_3$  and conc.  $\text{H}_2\text{SO}_4$ , there was slight action on pptd.  $\text{HgS}$  after 14, more action after 62 days. If  $\text{HgS}$  is boiled with the 4-N acids, oxidation takes place most rapidly with 4-N  $\text{HNO}_3$ , then the mixture 66.7% 4-N  $\text{H}_2\text{SO}_4 + 33.3\%$  4-N  $\text{HNO}_3$ , then

33.3% 4-N  $\text{H}_2\text{SO}_4$  + 66.7% 4-N  $\text{HNO}_3$ , and lastly 4-N  $\text{H}_2\text{SO}_4$  alone. (Moore, J. Am. Chem. Soc. 1911, 33, 1094.)

Cold conc.  $\text{H}_2\text{SO}_4$  does not attack red or black  $\text{HgS}$ , but they are attacked by hot acid. (Berthelot, A. ch. 1898, (7) 14, 198.)

Freshly pptd  $\text{HgS}$  is insol. in dil  $\text{KCN}$  +  $\text{Aq}$ . (Berthelot.)

Sol. in  $\text{K}_2\text{S}$  +  $\text{Aq}$ , but readily only in presence of free alkali. (Brunner, Pogg. 15, 596.) Insol. in boiling  $\text{KOH}$  +  $\text{Aq}$ .

Sol. in  $\text{KSH}$  or  $\text{NaSH}$  +  $\text{Aq}$ . Very sl. sol. in cold yellow  $(\text{NH}_4)_2\text{S}$  +  $\text{Aq}$ . Insol. in  $\text{KCN}$  or  $\text{Na}_2\text{S}_2\text{O}_3$  +  $\text{Aq}$ . (Fresenius.)

Easily sol. in conc.  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S}$  +  $\text{Aq}$ , even in absence of  $\text{KOH}$  or  $\text{NaOH}$ . Insol. in  $(\text{NH}_4)_2\text{S}$  +  $\text{Aq}$ . Sol. in  $\text{CaS}$ ,  $\text{BaS}$ , or  $\text{SrS}$  +  $\text{Aq}$ . Insol. in  $\text{NaSH}$  or  $\text{KSH}$  +  $\text{Aq}$ . (de Koninck, Z. angew. Ch. 1891, 51.)

Solubility in  $\text{NaSH}$  is very small in comparison with that in  $\text{Na}_2\text{S}$  +  $\text{Aq}$ . (Knox, Trans. Faraday. Soc. 1908, 4, 30.)

Solubility in  $\text{BaS}$  is practically equal to that in  $\text{Na}_2\text{S}$ . (Knox.)

All cryst. modifications are sol. in conc.  $\text{K}_2\text{S}$  and in conc.  $\text{Na}_2\text{S}$  +  $\text{Aq}$ . (Allen and Crenshaw, Am. J. Sci. 1912, (4) 34, 368.)

Sol. in potassium thiocarbonate +  $\text{Aq}$ . (Rosenblatt, Z. anal. 26, 15.)

Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, and -stannates. (Storch, B. 18, 2015.)

1 l.  $\text{BaS}_2\text{H}_2$  +  $\text{Aq}$  containing 50 g.  $\text{Ba}$  dissolves no  $\text{HgS}$  in the cold, but 50-60 g. at 40-50°.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 829.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014.)

Insol. in pyridine. (Schroeder, Dissert. 1901.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

Exists in a colloidal state, sol. in  $\text{H}_2\text{O}$ . (Winninger, Bull. Soc. (2) 49, 452.)

Min. *Cinnabar*. Insol. in  $\text{H}_2\text{O}$ , alcohol, dil. acids, or alkaline solutions.

Decomp. by hot dil.  $\text{HNO}_3$  +  $\text{Aq}$ . Not decomp. by  $\text{HCl}$  +  $\text{Aq}$ , but easily by hot  $\text{H}_2\text{SO}_4$  or aqua regia. Easily sol. in  $\text{CuCl}_2$  +  $\text{Aq}$ . (Karsten.)

Sol. in a mixture of  $\text{Na}_2\text{S}$  and  $\text{NaOH}$  when present in the proportion of  $\text{HgS} : 2\text{Na}_2\text{S}$ .

Sol. in pure  $\text{Na}_2\text{S}$  +  $\text{Aq}$  or in mixtures of  $\text{Na}_2\text{S}$  and  $\text{NaSH}$  +  $\text{Aq}$ . Insol. in cold  $\text{NaSH}$  +  $\text{Aq}$ , but sol. on warming with evolution of  $\text{H}_2\text{S}$ . (Becker, Sill. Am. J. (3) 33, 199.)

Insol. in acetone. (Krug and M'Elroy.)

*Cinnabar* is easily sol. in 20%  $\text{HBr}$  +  $\text{Aq}$ . (Rising and Lenher, J. Am. Chem. Soc. 1896, 18, 96.)

Sol. in  $\text{S}_2\text{Cl}_2$ . (Smith, J. Am. Chem. Soc. 1898, 20, 291.)

**Mercuric platinum sulphide.**

See Sulphoplatinate, mercuric.

**Mercuric potassium sulphide,  $\text{K}_2\text{S}$ ,  $2\text{HgS}$ .**

Decomp. into its constituents by  $\text{H}_2\text{O}$ ; decomp. by  $\text{HCl}$ , and  $\text{HNO}_3$  +  $\text{Aq}$ , and by hot  $\text{KOH}$ , and  $\text{NH}_4\text{OH}$  +  $\text{Aq}$ . (Schneider, Pogg. 127, 488.)

$\text{K}_2\text{S}$ ,  $\text{HgS}$  +  $5\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  or alkalis. (Weber, Pogg. 87, 76.)

+  $\text{H}_2\text{O}$ . (Ditte.)

+  $7\text{H}_2\text{O}$ . Sol. in  $\text{K}_2\text{S}$  +  $\text{Aq}$ . (Ditte, C. R. 98, 1271.)

$\text{K}_2\text{S}$ ,  $5\text{HgS}$  +  $6\text{H}_2\text{O}$ . Easily decomp. by  $\text{H}_2\text{O}$ . (Ditte.)

**Mercuric sodium sulphide,  $\text{HgS}$ ,  $\text{Na}_2\text{S}$  +  $8\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  or alkalis.

$5\text{HgS}$ ,  $2\text{Na}_2\text{S}$  +  $3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Knox, Trans. Faraday. Soc. 1908, 4, 38.)

**Mercuric sulphobromide,  $2\text{HgS}$ ,  $\text{HgBr}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Not attacked by boiling  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . (Rose.)

**Mercuric sulphochloride,  $2\text{HgS}$ ,  $\text{HgCl}_2$ .**

Insol. in  $\text{H}_2\text{O}$ , cold or hot, dil. or conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl}$  +  $\text{Aq}$ . (Rose, Pogg. 13, 59.)

Decomp. by hot aqua regia.

By boiling with dil.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HCl}$ ,  $\text{Hg}$  and  $\text{Cl}$  go into solution. (Hamers, Dissert. 1906.)

Insol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ . Partly sol. in  $\text{HCl}$  and  $\text{HNO}_3$ ; easily sol. in aqua regia. (Alexander, Dissert. 1899.)

Sol. in aqua regia. (Denigès, Bull. Soc. 1915, (4) 17, 356.)

$3\text{HgS}$ ,  $\text{HgCl}_2$ . Properties as the above comp. (Poleck and Goerckl, B. 21, 2415.)

$4\text{HgS}$ ,  $\text{HgCl}_2$ . As above. (P. and G.)

$5\text{HgS}$ ,  $\text{HgCl}_2$ . As above. (P. and G.)

Insol. in alkali sulphides and in fuming  $\text{HNO}_3$ ; decomp. by  $\text{NaOBr}$  +  $\text{Aq}$  and by  $\text{KOH}$ . (Bodroux, C. R. 1900, 130, 1399.)

Sl. sol. in solutions of alkali sulphides unless heated. (Berzelius.)

Easily sol. in alkali sulphides +  $\text{Aq}$ ; slowly sol. in alkalis or alkali hydrosulphides +  $\text{Aq}$ . (Atterberg, J. B. 1873, 253.)

**Mercurous sulphotetrachloride,  $\text{Hg}_2\text{SCl}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{S}$ ,  $\text{HgCl}_2$  going into solution. (Capitaine, J. Pharm. 25, 525.)

**Mercuric sulphofluoride,  $2\text{HgS}$ ,  $\text{HgF}_2$ .**

Decomp. by boiling  $\text{H}_2\text{O}$ . Not decomp. by hot  $\text{HCl}$  or  $\text{HNO}_3$  +  $\text{Aq}$ , but gives  $\text{HF}$  with hot  $\text{H}_2\text{SO}_4$  +  $\text{Aq}$ . (Rose, Pogg. 13, 66.)

**Mercury sulphodimide,  $\text{Hg}_2\text{N}_2\text{S}$ ,  $\text{NH}_3$ .**

Ppt. (Ruff, B. 1904, 37, 1585.)

**Mercuric sulphiodide,  $\text{HgS}$ ,  $\text{HgI}_2$ .**

Ppt. (Rammelsberg, Pogg. 48, 175.)

$2\text{HgS}$ ,  $\text{HgI}_2$ . (Palm, C. C. 1863, 121.)

Insol. in min. acids with exception of aqua regia. (Hamets, Dissert. 1906.)

**Mercuric sulphiodide ammonia**,  $2\text{HgS}$ ,  $\text{HgI}_2$ ,  $\text{NH}_3$ .  
(Poerster, Ch. Z. 1895, 19. 1895.)

**Mercuric telluride**,  $\text{HgTe}$ .

Min. *Coloradoite*. Sol in boiling  $\text{HNO}_3$  + Aq with separation of  $\text{H}_2\text{TeO}_3$ .

**Metastannic acid**.

See Stannic acid.

**Molybdatoiodic acid**.

See Molybdoiodic acid.

**Molybdenum**, Mo

Not attacked by HCl, HF, or dil.  $\text{H}_2\text{SO}_4$  + Aq. Sol. in conc.  $\text{H}_2\text{SO}_4$ . Very easily sol. in aqua regia. Oxidised by  $\text{HNO}_3$  + Aq either to molybdenum oxide, which dissolves in  $\text{HNO}_3$ , or, if  $\text{HNO}_3$  is in excess, to molybdic acid, which remains undissolved.

Attacked by  $\text{HNO}_3$  + Aq containing 3-70%  $\text{HNO}_3$ , but only slowly by 70% acid, with formation of insol. white powder; much more vigorously by 50% acid, in which case a clear solution is formed. (Montemartini, Gazz. ch. it. 22. 384.)

Not attacked by alkalis + Aq. (Bucholz, Scheer, J. 9. 485.)

With a sp. gr. 9.01, the metal is malleable and sol. in a mixture of HF and  $\text{HNO}_3$ , sol. in fused  $\text{KClO}_3$ . (Moissan, Bull. Soc. 1895, (3) 13. 966.)

Ductile Mo is moderately quickly attacked by  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and HCl (Fink, Met. Chem. Eng. 1910, 8. 341.)

Not immediately attacked by cold dil.  $\text{HNO}_3$ . Not attacked by dil and conc.  $\text{H}_2\text{SO}_4$ . Boiling dil. HCl + Aq does not attack; conc. dissolves traces by long heating. Sol. in aqua regia. (Lederer, Dissert. 1911.)

Dil. HCl dissolves 20.3% Mo at  $110^\circ$  in 18 hrs. More slowly sol. in HCl (sp. gr. 1.15).

Insol. in dil.  $\text{H}_2\text{SO}_4$  at  $110^\circ$ . Slowly sol. in conc.  $\text{H}_2\text{SO}_4$  (sp. gr. 1.82) at  $110^\circ$ , rapidly sol. at  $200^\circ$ - $250^\circ$ .

Slowly sol. in conc.  $\text{HNO}_3$  (sp. gr. 1.40), rapidly sol. in dil.  $\text{HNO}_3$  (sp. gr. 1.15).

Rapidly sol. in hot aqua regia. Insol. in hot or cold HF. (Ruder, J. Am. Chem. Soc. 1912, 34. 388.)

Insol. in KOH + Aq. Sol. in fused KOH. (Ruder, J. Am. Chem. Soc. 1912, 34. 389.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

**Molybdenum acichloride**.

See Molybdenyl chloride.

**Molybdenum amide**,  $\text{OH} \cdot \text{MoO}_2 \cdot \text{NH}_3$ .

Very unstable. Insol. in abs. alcohol. (Fleck, Z. anorg. 1894, 7. 353.)

**Molybdenum amide nitride**,  $\text{Mo}_2\text{N}_3\text{H}_4 = 4\text{MoN}_2, \text{Mo}(\text{NH}_2)_2$ .

Not attacked by HCl, or dil.  $\text{HNO}_3$  + Aq (Uhrlaub.)

**Molybdenum amidochloride**,  $\text{Mo}_2(\text{NH}_2)_2\text{Cl}_2$ .

Insol. in  $\text{H}_2\text{O}$  and dil. acids. (Rosenheim, Z. anorg. 1905, 46. 317.)

**Molybdenum amidochloride ammonia**,  $\text{Mo}_2(\text{NH}_2)_2\text{Cl}_2, 10\text{NH}_3$ .

Unstable in the air. (Rosenheim, Z. anorg. 1905, 46. 319.)

**Molybdenum boride**,  $\text{Mo}_3\text{B}_4$ .

Moderately attacked by hot conc. acids and vigorously by hot aqua regia. (Tucker and Moody, Chem. Soc. 1902, 81. 17.)

**Molybdenum dibromide**,  $\text{MoBr}_2 = \text{Mo}_2\text{Br}_4\text{Br}_2$ .

See Bromomolybdenum bromide.

**Molybdenum tribromide**,  $\text{MoBr}_3$ .

Not decomp. by  $\text{H}_2\text{O}$ . Boiling conc. HCl, and cold dil.  $\text{HNO}_3$  + Aq do not attack appreciably. Dil. alkalis act slowly, but decomp. with separation of  $\text{Mo}_2\text{O}_3$  on boiling. (Blomstrand, J. pr. 82. 435.)

**Molybdenum tetrabromide**,  $\text{MoBr}_4$ .

Rapidly deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . (Blomstrand, J. pr. 82. 433.)

**Molybdenum bromochloride**, etc.

See Bromomolybdenum chloride, etc.

**Molybdenum bronze**.

See Molybdate molybdenum oxide, sodium.

**Molybdenum carbide**,  $\text{Mo}_2\text{C}$ .

Insol. in  $\text{HNO}_3$ . (Moissan, Bull. Soc. 1895, (3) 13. 967.)

MoC. Does not decomp.  $\text{H}_2\text{O}$  even at  $500$ - $600^\circ$ . Slowly attacked by hot HCl, HF and hot conc.  $\text{H}_2\text{SO}_4$ . Easily decomp. by  $\text{HNO}_3$ . Not attacked by NaOH + Aq or KOH + Aq. (Moissan and Hoffmann, C. R. 1904, 138. 1559.)

**Molybdenum carbonyl**,  $\text{Mo}(\text{CO})_6$ .

Quickly attacked by bromine. Sol. in ether or benzene. (Mond, Hirtz and Cowap, Chem. Soc. 1910, 97. 808.)

**Molybdenum dichloride**,  $\text{MoCl}_2 = \text{Mo}_2\text{Cl}_4\text{Cl}_2$ .

See Chloromolybdenum chloride.

**Molybdenum trichloride,  $\text{MoCl}_3$ .**

Insol. in  $\text{H}_2\text{O}$  or boiling conc.  $\text{HCl} + \text{Aq}$ . Easily sol., especially when heated, in  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{H}_2\text{SO}_4$ . Decomp. by  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ .

Sl. sol. in alcohol. (Leicht and Kempe.)  
Practically insol. in alcohol and ether (Hampe, Ch. Z. 1888, 12. 5)

**Molybdenum tetrachloride,  $\text{MoCl}_4$ .**

Deliquescent. Sol. with little  $\text{H}_2\text{O}$ , but only partly sol. in more  $\text{H}_2\text{O}$ . Only sl. sol. in conc.  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$ . Partly sol. in alcohol and ether. (Liechti and Kempe.)

**Molybdenum pentachloride,  $\text{MoCl}_5$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  with extreme evolution of heat. Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

When freshly prepared, is incompletely sol. in  $\text{H}_2\text{O}$ , but after standing is easily sol. with hissing (Kalscher, Dissert 1902.)

Sol. in a small amt. of conc.  $\text{HCl}$ . (Hampe, Ch. Z. 1888, 12. 5)

Sol. in absolute alcohol or ether (Liechti and Kempe.)

Sol. in  $\text{CHCl}_3$  and in  $\text{CCl}_4$ . Sol. with hissing in many organic solvents (ethers, alcohols, ketones, aldehydes, acids, acid esters, acid anhydrides, amines). Sol. in cinnamic aldehyde (Kalscher, Dissert 1902.)

**Molybdenum hydroxyl chloride,  $\text{Mo}(\text{OH})_2\text{Cl}_2$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Debray, C. R. 46. 1101.)

**Molybdenum tetrachloride phosphorus pentachloride,  $\text{MoCl}_4 \cdot \text{PCl}_5$ .**

Sol. in  $\text{H}_2\text{O}$ .  
 $\text{MoCl}_4 \cdot 2\text{PCl}_5$ . Sol. in  $\text{H}_2\text{O}$ . (Cronander, Bull. Soc. (2) 19. 500.)

**Molybdenum phosphorus pentachloride,  $\text{MoCl}_5 \cdot \text{PCl}_5$ .**

Easily decomp. (Smith and Sargent, Z. anorg. 1894, 6. 385.)

**Molybdenum phosphoryl chloride,  $\text{MoCl}_5 \cdot \text{POCl}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ ; insol. in  $\text{CS}_2$ ; sol. in  $\text{C}_2\text{H}_6$  and  $\text{CHCl}_3$ .

**Molybdenum trichloride potassium chloride.**

Efflorescent. Decomp. with  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{MoCl}_3 \cdot 3\text{KCl}$ . Very sol. in  $\text{H}_2\text{O}$ . Nearly insol. in alcohol and ether. (Chilesotti, C. C. 1903, II. 652.)

$+2\text{H}_2\text{O}$ . Fairly easily sol. in cold  $\text{H}_2\text{O}$  without any apparent decomp. Decomp. in aqueous solution, slowly in the cold but rapidly on boiling. This decomp. is prevented by the presence of  $\text{HCl}$ .

Sl. sol. in conc.  $\text{HCl}$ . (Henderson, Proc. Chem. Soc. 1903, 19. 245.)

**Molybdenum rubidium chloride,  $\text{Rb}_2\text{MoCl}_6 + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . Nearly insol. in alcohol and ether. (Chilesotti, C. C. 1903, II. 652.)

**Molybdenum pentachloride nitrogen sulphide,  $\text{MoCl}_5 \cdot \text{N}_2\text{S}_4$ .**

Decomp. in moist air (Davis, Chem. Soc. 1906, 89, (2) 1575.)

**Molybdenum heptafluoride,  $\text{MoF}_7$ .**

Decomp. by a little  $\text{H}_2\text{O}$  with separation of blue oxide. Sol. in large amount of  $\text{H}_2\text{O}$  forming a colorless solution.

Absorbed by alkalis and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Ruff, B. 1907, 40. 2930.)

**Molybdenum fluoride with  $\text{MF}$ .**

See Fluomolybdate, M.

**Molybdenum potassium trifluoride (?).**

Precipitate. Sol. in  $\text{HCl} + \text{Aq}$ .

**Molybdenum potassium tetrafluoride (?).**

Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Molybdenum sesquihydroxide,  $\text{Mo}_2\text{O}_5\text{H}_5$ .**

Difficultly sol. in acids. Insol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$ . Somewhat sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , but pptd. on boiling. (Berzelius.)

**Molybdenum hydroxide,  $\text{Mo}_2\text{O}_5 \cdot 5\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{CaCl}_2$ ,  $\text{NH}_4\text{Cl}$ , or  $\text{NaCl} + \text{Aq}$ . Sl. sol. in alcohol. (Berzelius.)

**Molybdenum dihydroxide,  $\text{MoO}_3 \cdot x\text{H}_2\text{O}$ .**

Slowly and not abundantly sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by  $\text{NH}_4\text{Cl}$  and other salts. Gelatinizes by standing in closed vessels or by evaporating on the air. Sol. in the ordinary acids. Insol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ . Sol. in alkali carbonates  $+ \text{Aq}$ .

**Molybdenum dioxide,  $\text{MoO}_3$ .**

Insol. in  $\text{H}_2\text{O}$  and alcohol. Sl. attacked by cold  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ . (Guichard, A. ch. 1901, (7) 23. 567.)

Sl. decomp.  $\text{H}_2\text{O}$  at ordinary temp. Slowly sol. in  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ . (Guichard, C. R. 1896, 123. 822.)

**Molybdenum tetraiodide (?).**

Completely sol. in water. (Berzelius.)

**Molybdenum nitride,  $\text{Mo}_2\text{N}_3$ , and  $\text{Mo}_2\text{N}_4$ .**

(Uhrlaub.)

See Molybdenum amide.

$\text{Mo}_2\text{N}_2$ . (Rosenheim, Z. anorg. 1905, 46. 317.)

**Molybdenum monoxide, MoO.**

Known only as hydroxide (Blomstrand, J. pr. 77. 90.)

**Molybdenum sesquioxide, Mo<sub>2</sub>O<sub>3</sub>**

Insol. in acids or alkalis

See **Molybdenum sesquihydroxide.**

**Molybdenum dioxide, MoO<sub>2</sub>**

Insol. in HCl or HF + Aq. Sl sol in conc. H<sub>2</sub>SO<sub>4</sub>. HNO<sub>3</sub> oxidises to MoO<sub>3</sub>. Not attacked by KOH + Aq. (Ullik, A. 144. 227.)

Sl sol in KHC<sub>4</sub>H<sub>4</sub>O<sub>6</sub> + Aq.

**Molybdenum trioxide, MoO<sub>3</sub>**

Sol in 500 pts. cold, and much less hot H<sub>2</sub>O. (Bucholz)

Sol. in 960 pts. hot H<sub>2</sub>O (Hatchett)

Sol. in 570 pts. cold, and much less hot H<sub>2</sub>O. (Dumas.)

Sol. in acids before ignition. Insol. in acids, but sl. sol. in acid potassium tartarate + Aq after ignition. Sol. in alkalis or alkali carbonates + Aq

Sol. in NH<sub>4</sub>OH + Aq

See also **Molybdic acid.**

Min. *Molybde*. Sol. in HCl + Aq

**Molybdenum oxide, Mo<sub>2</sub>O<sub>3</sub>.**

Sol. in H<sub>2</sub>SO<sub>4</sub> and HCl, only sl. sol. in H<sub>2</sub>SO<sub>4</sub>. (Klasen, B. 1901, 34. 151.)

+ 3H<sub>2</sub>O. Sl sol. in H<sub>2</sub>O (2 g in 1 l.). Insol. in NH<sub>4</sub>Cl + Aq. Insol. in caustic alkalis, somewhat sol. in NH<sub>4</sub>OH. Much more sol. in M<sub>2</sub>CO<sub>3</sub> + Aq and in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq. (Klasen, B. 1901, 34. 150.)

Mo<sub>2</sub>O<sub>3</sub> + 3H<sub>2</sub>O. (Smith and Oberholtzer, Z. anorg. 1893, 4. 243.)

Mo<sub>2</sub>O<sub>3</sub> + 6H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Bailhache, C. R. 1901, 133. 1212.)

Mo<sub>2</sub>O<sub>3</sub> + 6H<sub>2</sub>O. Very sol. in H<sub>2</sub>O (Guichard, C. R. 1900, 131. 419.)

Mo<sub>2</sub>O<sub>3</sub>. Sol. in H<sub>2</sub>O. (Junius, Z. anorg. 1905, 46. 447.)

Mo<sub>2</sub>O<sub>3</sub> + 21H<sub>2</sub>O = Mo<sub>2</sub>O<sub>3</sub>, 18MoO<sub>3</sub> + 21H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O. Insol. in NH<sub>4</sub>Cl + Aq. (Klasen, B. 1901, 34. 160.)

Mo<sub>2</sub>O<sub>3</sub> + 24H<sub>2</sub>O = Mo<sub>2</sub>O<sub>3</sub>, 24MoO<sub>3</sub> + 24H<sub>2</sub>O. (Klasen, B. 1901, 34. 159.)

3Mo<sub>2</sub>O<sub>3</sub>, 2Mo<sub>2</sub>O<sub>3</sub> + 18H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (B.)

It is probable that the five blue oxides of molybdenum described by Klasen (B. 34, 148, 158) and Bailhache are either the blue oxide Mo<sub>2</sub>O<sub>3</sub>, prepared by the author or mixtures of this compd. with molybdenum trioxide. (Guichard, C. R. 1902, 134. 173.)

Mo<sub>2</sub>O<sub>3</sub>. Not attacked by ammonia, easily oxidised by HNO<sub>3</sub> + Aq. Not attacked by HCl or H<sub>2</sub>SO<sub>4</sub> + Aq. (Wöhler, A. 110. 275.)

Formula is Mo<sub>2</sub>O<sub>3</sub>, according to Wöhler, but Muthmann (A. 238. 108) has shown that correct formula is Mo<sub>2</sub>O<sub>3</sub>.

Not attacked by boiling alkalis, HCl, or dil. H<sub>2</sub>SO<sub>4</sub> + Aq. Sol. in conc. H<sub>2</sub>SO<sub>4</sub> with

subsequent decomp. Sol. in aqua regia, and Cl<sub>2</sub> + Aq. (Muthmann)

Mo<sub>2</sub>O<sub>3</sub>. Sol. in H<sub>2</sub>O. (Muthmann, A. 238. 108.)

Min. *Isaemannite* (?).

+ 5H<sub>2</sub>O. Moderately sol. in H<sub>2</sub>O. (Marchetti, Z. anorg. 1899, 19. 303.)

Mo<sub>2</sub>O<sub>3</sub>. (v. d. Pfordten, B. 15. 1925.)

**Molybdenum trioxide ammonia, MoO<sub>3</sub>, 3NH<sub>3</sub>.**

Unstable in air. Very sol. in H<sub>2</sub>O with evolution of ammonia. (Rosenheim, Z. anorg. 1906, 50. 303.)

3MoO<sub>3</sub>, NH<sub>3</sub> + 1/2 H<sub>2</sub>O. True composition of commercial molybdic acid. (Klasen, B. 1901, 34. 156.)

NH<sub>4</sub>H<sub>2</sub>MoO<sub>4</sub>. Very sl. sol. in cold, easily sol. in hot H<sub>2</sub>O with partial decomp. (Klasen, B. 1901, 34. 156.)

3MoO<sub>3</sub>, 3NH<sub>3</sub> + 7H<sub>2</sub>O = (NH<sub>4</sub>)<sub>3</sub>Mo<sub>3</sub>O<sub>12</sub> + 4H<sub>2</sub>O. True composition of Rammelsberg's 3(NH<sub>4</sub>)<sub>2</sub>MoO<sub>4</sub>, 7MoO<sub>3</sub> + 12H<sub>2</sub>O. (Klasen, B. 1901, 34. 155.)

4MoO<sub>3</sub>, NH<sub>3</sub> + 6H<sub>2</sub>O. Very sl. sol. in cold, very easily sol. in hot H<sub>2</sub>O. An insol. modification with less H<sub>2</sub>O gradually cryst. out. (Mylius, B. 1903, 36. 639.)

4MoO<sub>3</sub>, 2NH<sub>3</sub> + 3H<sub>2</sub>O. (Klasen, B. 1901, 34. 156.)

6MoO<sub>3</sub>, 3NH<sub>3</sub> + 5H<sub>2</sub>O. Very sl. sol. in cold, more easily sol. in hot H<sub>2</sub>O, with partial decomp. (Klasen, B. 1901, 34. 156.)

12MoO<sub>3</sub>, 3NH<sub>3</sub> + 12H<sub>2</sub>O. (Klasen, B. 1901, 34. 158.)

12MoO<sub>3</sub>, 3NH<sub>3</sub>, 12H<sub>2</sub>O + 3MoO<sub>3</sub>, 8H<sub>2</sub>O. Moderately sol. in boiling H<sub>2</sub>O. (Klasen)

15MoO<sub>3</sub>, 3NH<sub>3</sub> + 6H<sub>2</sub>O. Insol. in H<sub>2</sub>O (Klasen)

4MoO<sub>3</sub>, MoO<sub>3</sub>, 2NH<sub>3</sub> + 7H<sub>2</sub>O. Slowly sol. in H<sub>2</sub>O; fairly stable, gradually decomp. by dil. acids (Hofmann, Z. anorg. 1896, 12. 280.)

**Molybdenum trioxide ammonia hydrogen peroxide, 18MoO<sub>3</sub>, 14NH<sub>3</sub>, 3H<sub>2</sub>O<sub>2</sub> + 18H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. Sp. gr. of sat. solution = 1.486 at 17°. (Baerwald, B. 1884, 17. 1206.)

**Molybdenum oxybromide.**

See **Molybdenyl bromide.**

**Molybdenum oxychloride.**

See **Molybdenyl chloride.**

**Molybdenum oxyfluoride.**

See **Molybdenyl fluoride.**

**Molybdenum oxyfluoride with MF.**

See **Fluoxymolybdate, M, and Fluoxyhypomolybdate, M.**

**Molybdenum phosphide, Mo<sub>2</sub>P<sub>2</sub>.**

Gradually sol. in hot HNO<sub>3</sub> + Aq. (Wöhler and Rautenberz, A. 109. 374.)

**Molybdenum selenide, MoSe<sub>3</sub>.**

Not obtained pure. (Uelsmann, A. 116. 125)

**Molybdenum silicide.**

Sol in HF; only very sl sol in other acids (Warren, C. N. 1898, 78. 319)

MoSi<sub>2</sub> Insol in all min acids; sol. in a warm mixture of HF+HNO<sub>3</sub>. (Defacqz, C. R. 1907, 144. 1425)

Insol in min. acids, sol. in HF+HNO<sub>3</sub>. Unattacked by 10-20% KOH+Aq. Decomp. by fused NaOH. (Honigschmid, M 1907, 28. 1020.)

Not attacked by boiling HNO<sub>3</sub>, aqua regia or HF. (Watts, Trans. Am. Electrochem. Soc. 1906, 9. 106)

Mo<sub>2</sub>Si<sub>3</sub>. (Vigouroux, C. R. 129. 1238.)

**Molybdenum disulphide, MoS<sub>2</sub>.**

Insol in H<sub>2</sub>O. Easily sol in aqua regia Easily oxidised by HNO<sub>3</sub>. Sol in boiling H<sub>2</sub>SO<sub>4</sub>. Sl. attacked by KOH+Aq (Berzelius.)

Min. *Molybdenite*. Sol. in HNO<sub>3</sub>+Aq, with separation of MoO<sub>3</sub>; sol. in aqua regia, very sl sol. in H<sub>2</sub>SO<sub>4</sub>.

**Molybdenum trisulphide, MoS<sub>3</sub>.**

Somewhat sol in H<sub>2</sub>O, especially if hot, but pptd by an acid. Difficultly sol except when boiled with KOH+Aq. Sl. sol. in solutions of alkali sulphides unless heated. (Berzelius.)

Easily sol. in alkali sulphides+Aq; slowly sol. in alkalis or alkali hydrosulphides+Aq (Atterberg, J. B. 1873. 258)

**Molybdenum tetrasulphide, MoS<sub>4</sub>.**

Not decomp. by hot H<sub>2</sub>O or acids

Sl. sol. in cold alkali sulphides+Aq, but easily by boiling. (Berzelius.)

Insol in liquid NH<sub>3</sub>. (Gore, Am Ch J 1898, 20. 828.)

**Molybdenum sesquisulphide, Mo<sub>2</sub>S<sub>3</sub>.**

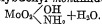
Insol. in HCl and H<sub>2</sub>SO<sub>4</sub>; sol. in hot conc. HNO<sub>3</sub> and aqua regia (Guschard, C. R. 1900, 130. 138.)

**Molybdenum sulphide with MS.**

See Sulphomolybdate, M.

**Molybdenum sulphochloride, Mo<sub>2</sub>S<sub>2</sub>Cl<sub>2</sub>.**

Insol. in H<sub>2</sub>O and alkalis. Slowly sol. in conc. HNO<sub>3</sub>. (Smith and Oberholtzer, Z anorg. 1894, 5. 67.)

**Molybdenyl monamide, NH<sub>4</sub>MoO<sub>4</sub> or**

(Rosenheim, Z anorg. 1905, 46. 318.)

**Molybdenyl bromide, MoO<sub>2</sub>Br<sub>2</sub>.**

Deliquescent, and sol. in H<sub>2</sub>O with slight evolution of heat.

Mo<sub>2</sub>O<sub>4</sub>Br<sub>2</sub>. Unstable in air (Smith and Oberholtzer, Z anorg. 4. 236)

**Molybdenyl potassium bromide, MoOBr<sub>3</sub>, 2KBr.**

(Weinland, Z anorg 1905, 44. 109.)

MoOBr<sub>3</sub>, KBr+2H<sub>2</sub>O; (Weinland, Z anorg 1905, 44. 110)

**Molybdenyl rubidium bromide, MoOBr<sub>3</sub>, 2RbBr.**

(Weinland, Z. anorg 1905, 44. 108.)

**Molybdenyl chloride, MoO<sub>2</sub>Cl<sub>2</sub>.**

Sol. in H<sub>2</sub>O and alcohol

Abundantly sol. in abs. alcohol. Not very sol. in abs ether (Hampe, Ch. Z. 1888, 12. 23.)

+H<sub>2</sub>O Composition settled by mol. wt. determinations. Dissociates in alcohol and in H<sub>2</sub>O. (Vaudenberghe, Z. anorg. 1895, 10. 52)

Very hygroscopic. Sol. in acetone, ether and alcohol. (Vaudenberghe, l c.)

MoOCl<sub>4</sub>. Deliquescent. Sol in little H<sub>2</sub>O with violent action. More H<sub>2</sub>O decomposes (Puttbach, A. 201. 123.)

Formula is Mo<sub>2</sub>O<sub>3</sub>Cl<sub>3</sub>, according to Blomstrand (J pr. 71. 460)

Mo<sub>2</sub>O<sub>3</sub>Cl<sub>3</sub>. (Puttbach, l c.)

Mo<sub>2</sub>O<sub>3</sub>Cl<sub>3</sub>. Deliquescent. Sol. in H<sub>2</sub>O with very slight evolution of heat and subsequent formation of precipitate. (Blomstrand)

Sol. in acids (Puttbach, A. 201. 129.)

Mo<sub>2</sub>O<sub>3</sub>Cl<sub>3</sub>. Deliquescent, and sol. in H<sub>2</sub>O. (Blomstrand.)

Mo<sub>2</sub>O<sub>3</sub>Cl<sub>3</sub>. Insol. in HCl and cold H<sub>2</sub>SO<sub>4</sub>.

Sol. in hot H<sub>2</sub>SO<sub>4</sub> and HNO<sub>3</sub>. (Puttbach, A. 201. 123.)

Mo<sub>2</sub>O<sub>3</sub>Cl<sub>3</sub>. Difficultly sol. in HCl. Easily sol. in HNO<sub>3</sub> and alkalis+Aq. (Puttbach)

**Molybdenyl potassium chloride, MoO<sub>2</sub>Cl<sub>2</sub>, KCl+H<sub>2</sub>O.**

(Weinland, Z. anorg 1905, 44. 97)

+2H<sub>2</sub>O. (Weinland, Z anorg 1905, 44. 96)

6MoO<sub>2</sub>Cl<sub>2</sub>, 2KCl+6H<sub>2</sub>O. (Weinland, Z. anorg. 1905, 44. 97.)

MoOCl<sub>3</sub>, 2KCl+2H<sub>2</sub>O. Sol. in H<sub>2</sub>O (Nordenskjöld, B. 1901, 34. 1573)

Ppt (Henderson, Proc. Chem Soc. 1908, 19. 245.)

**Molybdenyl rubidium chloride, MoO<sub>2</sub>Cl<sub>2</sub>, RbCl+H<sub>2</sub>O.**

MoO<sub>2</sub>Cl<sub>2</sub>, 2RbCl. (Weinland, Z. anorg. 1905, 44. 95.)

MoOCl<sub>3</sub>, 2RbCl. Sl. sol. in H<sub>2</sub>O. Less sol. than K salt (Nordenskjöld, B. 1901, 34. 1573.)

**Molybdenyl fluoride,  $\text{MoO}_2\text{F}_2$ .**

Decomp. rapidly in moist air. (Schulze, J. pr. (2) 21. 442.)

Very hygroscopic. Sol. in a little  $\text{H}_2\text{O}$  giving a blue solution, in more  $\text{H}_2\text{O}$  giving a colorless solution.

Sol. in  $\text{AsCl}_3$ ,  $\text{SiCl}_4$ ,  $\text{SO}_2\text{Cl}_2$  and  $\text{PCl}_3$ . On warming these solutions, gas is evolved.

Insol. in toluene. Nearly insol. in ether,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , and  $\text{CS}_2$ . Sol. in warm pyridine and in ethyl and methyl alcohol (Ruff, B 1907, 40. 2934.)

$\text{MoOF}_4$ . Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$  and conc.  $\text{H}_2\text{SO}_4$ . Decomp. by alcohol. Sol. in ether and  $\text{CHCl}_3$  with evolution of gas. Insol. in toluene. Very sl. sol. in benzene and  $\text{CS}_2$  (Ruff, B 1907, 40. 2932.)

$\text{Mo}_2\text{O}_3\text{F}_4$ . Deliquescent. Easily sol. in  $\text{HF}$  + Aq, not in  $\text{H}_2\text{O}$ . (Smith and Oberholtzer)

**Molybdenyl fluoride with MF.**

See Fluoxymolybdate, M, and Fluoxyhypomolybdate, M.

**Molybdenyl hydroxide,  $\text{MoO}(\text{OH})_2$** 

2 g. are sol. in 1000 cc.  $\text{H}_2\text{O}$ ; insol. in  $\text{H}_2\text{O}$  +  $\text{NH}_4\text{Cl}$ ; only sl. sol. in  $\text{NH}_4\text{OH}$  and alkali carbonates + Aq. (Klason, B 1901, 34. 151.)

**Molybdic acid,  $\text{H}_2\text{MoO}_4$ .**

(Ullik, A. 144. 217.)

Nearly insol. in  $\text{H}_2\text{O}$ . (Vivier, C. R. 106. 601.)

Very sparingly sol. in cold  $\text{H}_2\text{O}$ , more sol. in hot  $\text{H}_2\text{O}$ . (Rosenheim and Berthelm, Z anorg. 1903, 34. 435.)

 **$\alpha$ -modification**

Solubility of  $\text{MoO}_3$ ,  $\text{H}_2\text{O}$  ( $\alpha$ -modification) in  $\text{H}_2\text{O}$  at  $t^\circ$ .

1000 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{MoO}_3$ .

$t^\circ$	G. $\text{MoO}_3$	$t^\circ$	G. $\text{MoO}_3$
14.8	2.117	42.0	3.446
15.2	2.131	45.0	3.661
24.6	2.619	52.0	4.184
25.6	2.689	60.0	4.685
30.3	2.973	70.0	4.231
36.0	3.085	80.0	5.212
36.8	3.295		..

(Rosenheim and Davidsohn, Z anorg. 1903, 37. 318.)

( $\beta$  modification),  $\text{MoO}_3$ ,  $\text{H}_2\text{O}$ . From  $\text{MoO}_3$ ,  $2\text{H}_2\text{O}$  at  $60^\circ$ – $70^\circ$ . (Rosenheim and Davidsohn.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Easily sol. in  $\text{H}_2\text{SO}_4$ . (Ruegenberg and Smith, J. Am. Chem. Soc. 1900, 22. 772.)

$\text{H}_2\text{MoO}_4$ . Sol. in  $\text{H}_2\text{O}$  and acids. (Millingk.)

Very sol. in  $\text{H}_2\text{O}$ . (Mylus, B 1903, 36. 638.)

Solubility of  $\text{MoO}_3$ ,  $2\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$ .

1000 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{MoO}_3$  at  $t^\circ$ .

$t^\circ$	G. $\text{MoO}_3$	$t^\circ$	G. $\text{MoO}_3$
18	1.066	59	11.258
23	1.856	60	12.057
30	2.638	66	17.274
40	4.761	70	20.550
48	6.360	74.4	20.904
50.2	6.873	75	20.920
54	7.855	79	21.064

(Rosenheim and Berthelm, Z. anorg. 1903, 34. 430.)

Solubility of  $\text{MoO}_3$ ,  $2\text{H}_2\text{O}$  in ammonium salts + Aq at  $t^\circ$ .

1000 g. of the solvent dissolve g.  $\text{MoO}_3$ .

Solvent	$t^\circ$	G. $\text{MoO}_3$
10% $(\text{NH}_4)_2\text{SO}_4$	29.6	19.27
10% $\text{NH}_4\text{HSO}_4$	31.5	27.53
"	41.8	34.36
"	49.7	37.69

(Rosenheim and Davidsohn, Z. anorg. 1903, 37. 315.)

$\text{H}_2\text{MoO}_4$  (?). Known only in solution.

$\text{H}_2\text{MoO}_7$ . Easily sol. in  $\text{H}_2\text{O}$ . (Ullik.)

$\text{H}_2\text{MoO}_{13}$ . Easily sol. in  $\text{H}_2\text{O}$ . (U)

$\text{H}_2\text{MoO}_{16}$ . Easily sol. in  $\text{H}_2\text{O}$ . (U)

Molybdic acid also exists in a colloidal modification, sol. in  $\text{H}_2\text{O}$ . (Graham, C. R. 59. 174.)

**Molybdates.**

The normal molybdates of the alkali metals are easily sol. in  $\text{H}_2\text{O}$ , while the others are sl. sol or insol. therein.

The trimolybdates are sl. sol. in cold, but very easily sol. in hot  $\text{H}_2\text{O}$ .

The tetramolybdates are easily sol. in  $\text{H}_2\text{O}$ .

**Aluminum molybdate,  $\text{Al}_3(\text{MoO}_4)_3$ .**

Precipitate. (Gentile, J. pr. 81. 414.)

Contains aluminum hydroxide and sulphate. (Struve, J. pr. 61. 441.)

**Aluminum ammonium molybdate.**

See Aluminicomolybdate, ammonium.

**Aluminum barium molybdate.**

See Aluminicomolybdate, barium.

**Ammonium molybdate,  $(\text{NH}_4)_2\text{MoO}_4$ .**

Efflorescent through loss of  $\text{NH}_3$ ; decomp. by  $\text{H}_2\text{O}$  into acid salt. (Svanberg and Struve.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

$(\text{NH}_4)_2\text{Mo}_2\text{O}_7$ . Sol. in  $\text{H}_2\text{O}$   
 $+\text{H}_2\text{O}=\text{NH}_4\text{HMoO}_4$ . Sol. in  $\text{H}_2\text{O}$ . Sol.  
 in 2-3 pts  $\text{H}_2\text{O}$  (Brandes, Mauro, Gazz  
 ch. it. 18. 120)

$(\text{NH}_4)_3\text{Mo}_2\text{O}_7+4\text{H}_2\text{O}$ . (Commercial ammonium molybdate)  
 Not efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Delafontaine, N. Arch. Sc. ph. nat. 23. 17.)

According to Struve and Berlin=  
 $(\text{NH}_4)_4\text{Mo}_2\text{O}_{17}+3\text{H}_2\text{O}$   
 According to Margnac and Delfs=  
 $(\text{NH}_4)_4\text{HMoO}_4$ . The true composition of  
 commercial ammonium molybdate is  
 $(\text{NH}_4)_{10}\text{Mo}_{12}\text{O}_{41}$ . (Junius, Z. anorg 1905,  
 46. 428)

$+12\text{H}_2\text{O}$ . More sol. than the above.  
 (Rammelsberg, Pogg. 127. 298)  
 Insol in acetone. (Krug and M'Elroy, J  
 Anal. Appl. Ch. 6. 184)

$(\text{NH}_4)_{10}\text{Mo}_{12}\text{O}_{41}$ . True formula for commercial ammonium molybdate (Sand and  
 Eisenlohr, Z. anorg 1907, 52. 68)

$+7\text{H}_2\text{O}$  (Junius, Z. anorg. 1905, 46. 428.)  
 $(\text{NH}_4)_3\text{Mo}_2\text{O}_{11}+\text{H}_2\text{O}$  (Jean, C. R. 78.  
 436.)

$(\text{NH}_4)_3\text{Mo}_2\text{O}_{11}+\text{H}_2\text{O}$  Very difficultly sol.  
 in cold, easily sol in hot  $\text{H}_2\text{O}$  (Berlin, J. pr.  
 49. 445.)

Easily sol in  $\text{NH}_4\text{OH}+\text{Aq.}$  (Kammerer,  
 J. pr. (2) 8. 358.)

$(\text{NH}_4)_2\text{O}$ ,  $4\text{MoO}_3$ . Practically insol. in  
 cold, sl sol in hot  $\text{H}_2\text{O}$ . (Westphal, Dissert.  
 1895.)

$+2\text{H}_2\text{O}$ . Very difficultly sol in cold,  
 rather easily sol. in hot  $\text{H}_2\text{O}$ . (Berlin)  
 100 cc.  $\text{H}_2\text{O}$  dissolve 3.5200 g. at  $15^\circ$ ; sp  
 gr.=1.03, 3.6711 g. at  $18^\circ$ , sp gr=1.04;  
 4.5961 g at  $32^\circ$ ; sp gr.=1.05 (Wempe, Z.  
 anorg. 1912, 78. 258.)

$+2\frac{1}{2}\text{H}_2\text{O}$ . (Junius, Z. anorg. 1905, 46.  
 440.)

$(\text{NH}_4)_2\text{O}$ ,  $8\text{MoO}_3+13\text{H}_2\text{O}$ . (Rosenheim,  
 Z. anorg. 1897, 15. 188.)

$(\text{NH}_4)_2\text{O}$ ,  $9\text{MoO}_3+17\text{H}_2\text{O}$ . (Westphal,  
 Dissert. 1895.)

See also Molybdenum trioxide ammonia.

**Ammonium barium molybdate,**  
 $3(\text{NH}_4)_2\text{O}$ ,  $3\text{BaO}$ ,  $14\text{MoO}_3+12\text{H}_2\text{O}$ .  
 (Westphal, Dissert. 1895.)

**Ammonium bismuth molybdate,**  
 $\text{NH}_4\text{Bi}(\text{MoO}_4)_3$ .  
 (Riederer, J. Am. Chem. Soc. 1903, 25.  
 914.)

**Ammonium cadmium molybdate ammonia,**  
 $(\text{NH}_4)_2\text{Cd}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ .  
 Sol. in dil  $\text{NH}_4\text{OH}+\text{Aq.}$  (Briggs, Chem.  
 Soc. 1904, 85. 674)

**Ammonium cerium molybdate,**  
 $(\text{NH}_4)_4\text{CeMo}_{14}\text{O}_{46}+24\text{H}_2\text{O}$   
 Sol. in  $\text{H}_2\text{O}$ . (Barbieri, C. A. 1909. 293)

**Ammonium chromic molybdate.**

See Chromomolybdate, ammonium.

**Ammonium cobaltous molybdate,**  
 $3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3$ ,  $3\text{CoO}$ ,  $7\text{MoO}_3+1\text{H}_2\text{O}$   
 $5[3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3]$ ,  $7[3\text{CoO}$ ,  $7\text{MoO}_3]+$   
 $x\text{H}_2\text{O}$   
 $2[3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3]$ ,  $3[3\text{CoO}$ ,  $7\text{MoO}_3]+$   
 $x\text{H}_2\text{O}$   
 $3[3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3]$ ,  $5[3\text{CoO}$ ,  $7\text{MoO}_3]+$   
 $x\text{H}_2\text{O}$ .  
 $3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3$ ,  $5[3\text{CoO}$ ,  $7\text{MoO}_3]+$   
 $x\text{H}_2\text{O}$ .  
 $9[2(\text{NH}_4)_2\text{O}$ ,  $5\text{MoO}_3]$ ,  $5[2\text{CoO}$ ,  $5\text{MoO}_3]+$   
 $118\text{H}_2\text{O}$   
 $4(\text{NH}_4)_2\text{O}$ ,  $2\text{CoO}$ ,  $15\text{MoO}_3+20\text{H}_2\text{O}$ .  
 (Marckwald, Dissert 1895.)

**Ammonium cobaltous molybdate ammonia,**  
 $(\text{NH}_4)_2\text{Co}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$   
 Sol. in dil  $\text{NH}_4\text{OH}+\text{Aq.}$  (Briggs, Chem.  
 Soc. 1904, 85. 674.)

**Ammonium cobaltic molybdate.**

See Cobaltimolybdate, ammonium.

**Ammonium cupric molybdate,**  $(\text{NH}_4)_2\text{O}$ ,  $\text{CuO}$ ,  
 $5\text{MoO}_3+9\text{H}_2\text{O}$

Sl. sol. in cold, sol. in boiling  $\text{H}_2\text{O}$  without  
 decomp (Struve.)

**Ammonium cupric molybdate ammonia,**

$(\text{NH}_4)_2\text{Cu}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$   
 Sol in dil  $\text{NH}_4\text{OH}+\text{Aq.}$   
 Decomp. by  $\text{H}_2\text{O}$ . (Briggs, Chem. Soc.  
 1904, 85. 673.)

**Ammonium ferric molybdate,**  $3(\text{NH}_4)_2\text{Mo}_2\text{O}_7$ ,  
 $\text{Fe}_2(\text{MoO}_4)_3+20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Struve.)  
 See also Ferricomolybdate, ammonium.

**Ammonium lanthanum molybdate,**  
 $(\text{NH}_4)_2\text{La}_2\text{Mo}_{14}\text{O}_{48}+24\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Barbieri, C. A. 1909. 293.)

**Ammonium lithium molybdate,**  $\text{NH}_4\text{LiMoO}_4$ ,  
 $+\text{H}_2\text{O}$ .  
 (Traube, N. Jahrb Miner 1894, I. 194.)

**Ammonium magnesium molybdate,**  $(\text{NH}_4)_2\text{O}$ ,  
 $\text{MgO}$ ,  $2\text{MoO}_3+2\text{H}_2\text{O}=(\text{NH}_4)_2\text{MgO}_4$ ,  
 $\text{MgMoO}_4+2\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$  (Ullik, A. 144. 344.)

**Ammonium manganous molybdate,**  
 $2(\text{NH}_4)_2\text{O}$ ,  $\text{MnO}$ ,  $3\text{MoO}_3+5\text{H}_2\text{O}$ .  
 Decomp. by boiling  $\text{H}_2\text{O}$ . (Marckwald,  
 Dissert. 1895.)

$(\text{NH}_4)_2\text{O}$ ,  $2\text{MnO}$ ,  $6\text{MoO}_3+16\text{H}_2\text{O}$ .  
 Decomp by boiling  $\text{H}_2\text{O}$ . (Marckwald, Dissert.  
 1895.)

$(\text{NH}_4)_2\text{O}$ ,  $3\text{MnO}$ ,  $6\text{MoO}_3 + 16\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Marckwald, Dissert. 1896.)

$3(\text{NH}_4)_2\text{O}$ ,  $2\text{MnO}$ ,  $12\text{MoO}_3 + 22\text{H}_2\text{O}$ . (Marckwald, Dissert. 1896.)

**Ammonium manganic molybdate.**

See Permanganomolybdate ammonium.

**Ammonium mercuric molybdate.**

Sol. in  $\text{HCl} + \text{Aq}$ . Sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ , separating out on cooling. Sol. in hot  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Hürzel.)

**Ammonium molybdenum molybdate,**

$(\text{NH}_4)_2\text{O}$ ,  $2\text{MoO}_3$ ,  $4\text{MoO}_3 + 9\text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$ , but the solution soon becomes cloudy (Rammelsberg, Pogg. 127. 291.)

**Ammonium neodymium molybdate,**

$(\text{NH}_4)_2\text{NdMoO}_4 + 12\text{H}_2\text{O}$ .

Ppt. (Barbieri, C. C. 1911, I. 1043.)

**Ammonium nickel molybdate,**

$(\text{NH}_4)_2\text{O}$ ,  $3\text{NiO}$ ,  $9\text{MoO}_3 + 25\text{H}_2\text{O}$ .

Very sl. sol. in cold, sol. in hot  $\text{H}_2\text{O}$  without decomp. (Marckwald, Dissert. 1895.)

$3(\text{NH}_4)_2\text{O}$ ,  $2\text{NiO}$ ,  $10\text{MoO}_3 + 14\text{H}_2\text{O}$ . Very

sl. sol. in cold, sol. in hot  $\text{H}_2\text{O}$  without decomp. (Marckwald, Dissert. 1895.)

$5(\text{NH}_4)_2\text{O}$ ,  $3\text{NiO}$ ,  $16\text{MoO}_3 + 16\text{H}_2\text{O}$ . (Hall,

J. Am. Chem. Soc. 1907, 29, 702.)

$6(\text{NH}_4)_2\text{O}$ ,  $3\text{NiO}$ ,  $16\text{MoO}_3 + 29\text{H}_2\text{O}$ . Very

sl. sol. in cold, sol. in hot  $\text{H}_2\text{O}$  without decomp. (Marckwald, Dissert. 1895.)

$8(\text{NH}_4)_2\text{O}$ ,  $6\text{NiO}$ ,  $31\text{MoO}_3 + 63\text{H}_2\text{O}$ . Very

sl. sol. in cold, sol. in hot  $\text{H}_2\text{O}$  without decomp. (Marckwald, Dissert. 1895.)

$3(\text{NH}_4)_2\text{O}$ ,  $9\text{NiO}$ ,  $34\text{MoO}_3 + 120\text{H}_2\text{O}$ . Very

sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$  without decomp. (Marckwald, Dissert. 1895.)

**Ammonium nickelic molybdate.**

See Nickelmolybdate, ammonium.

**Ammonium nickel hydrogen molybdate,**

$(\text{NH}_4)_4\text{H}_2(\text{Ni}(\text{MoO}_4)_2) + 5\text{H}_2\text{O}$

See Nickelmolybdate, ammonium hydrogen.

**Ammonium praseodymium molybdate,**

$(\text{NH}_4)_2\text{PrMoO}_4 + 12\text{H}_2\text{O}$

Ppt. (Barbieri, C. A. 1911. 1884.)

**Ammonium samarium molybdate,**

$(\text{NH}_4)_2\text{SmMoO}_4 + 12\text{H}_2\text{O}$ .

Ppt. (Barbieri, C. A. 1911. 1884.)

**Ammonium sodium molybdate,**  $7(\text{NH}_4)_2\text{O}$ ,

$2\text{Na}_2\text{O}$ ,  $21\text{MoO}_3 + 15\text{H}_2\text{O}$  (?).

Easily sol. in  $\text{H}_2\text{O}$ . (Delafontaine, J. pr. 95. 136.)

$7(\text{NH}_4)_2\text{O}$ ,  $3\text{Na}_2\text{O}$ ,  $25\text{MoO}_3 + 30\text{H}_2\text{O}$  (?).

(Delafontaine.)

$(\text{NH}_4, \text{Na})_2\text{O}$ ,  $3\text{MoO}_3 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Mauno, Gazz. ch. it. 11. 214.)

**Ammonium thorium molybdate.**

See Thoromolybdate, ammonium.

**Ammonium titanium molybdate.**

See Titanomolybdate, ammonium.

**Ammonium vanadium molybdate.**

See Vanadiomolybdate, ammonium.

**Ammonium zinc molybdate.**

Sol. in  $\text{H}_2\text{O}$ . (Bezelius.)

**Ammonium zirconium molybdate.**

See Zirconomolybdate, ammonium.

**Ammonium molybdate hydrogen dioxide,**

$18\text{MoO}_3$ ,  $7(\text{NH}_4)_2\text{O}$ ,  $3\text{H}_2\text{O}_2 + 11\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Barwald, B. 17. 1206.)

**Barium molybdate, basic,**  $2\text{BaO}$ ,  $\text{MoO}_3 + \text{H}_2\text{O}$  (?).

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{Aq}$  or  $\text{HNO}_3 + \text{Aq}$ . (Heine, J. pr. 9. 204.)

**Barium molybdate,  $\text{BaMoO}_4$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ . (Svanberg and Struve.)

Sol. in 17,200 pts  $\text{H}_2\text{O}$  at  $23^\circ$ . More sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Smith and Bradbury, B. 24. 2930.)

$+ 3\text{H}_2\text{O}$  (Westphal, Dissert. 1895.)

$\text{BaMo}_2\text{O}_{10} + 3\text{H}_2\text{O}$ . Sl sol. in  $\text{H}_2\text{O}$ .

$\text{Ba}_2\text{MoO}_4 + 9\text{H}_2\text{O}$ . Appreciably sol. in  $\text{H}_2\text{O}$ . (Jorgensen.)

According to Svanberg and Struve =  $\text{Ba}_2\text{Mo}_2\text{O}_7 + 6\text{H}_2\text{O}$ .

$+ 12\text{H}_2\text{O}$  or  $5\text{BaO}$ ,  $12\text{MoO}_3 + 20\text{H}_2\text{O}$ .

(Junius, Z. anorg. 1905, 46. 433.)

$+ 22\text{H}_2\text{O}$  Ppt. (Westphal, Dissert.

1895.)

$\text{BaO}$ ,  $4\text{MoO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ . Ppt. (Wempe, Z. anorg. 1912, 78. 320.)

$+ 12\text{H}_2\text{O}$ . Ppt. (Rosenheim, Z. anorg. 1913, 79. 299.)

$\text{BaMo}_2\text{O}_{10} + 4\text{H}_2\text{O}$ . Insol. in cold or hot  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . Extremely slightly decomp. by  $\text{H}_2\text{SO}_4$  or  $\text{H}_2\text{SO}_4 + \text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ . (Svanberg and Struve.)

**Barium paramolybdate,**  $5\text{BaO}$ ,  $12\text{MoO}_3 + 10\text{H}_2\text{O}$

Ppt. Sol. in excess of  $\text{BaCl}_2 + \text{Aq}$ . (Junius, Z. anorg. 1905, 46. 433.)

**Barium tetramolybdate,**  $\text{BaH}_2(\text{Mo}_4\text{O}_{12})_2 + 17\text{H}_2\text{O}$ .

Insol. in cold, apparently decomp. by hot  $\text{H}_2\text{O}$ , a small part dissolving, and the rest forming an insol. residuc. (Ullik, A. 144. 336.)

+14H<sub>2</sub>O. Insol. in cold and hot H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 320.)  
BaO, 8MoO<sub>3</sub>+17H<sub>2</sub>O. (Felix, Dissert 1912.)

Barium chromic molybdate.

See Chromicomolybdate, barium.

Barium cobaltic molybdate.

See Cobaltimolybdate, barium.

Barium manganic molybdate.

See Permanganomolybdate, barium.

Barium nickelic molybdate.

See Nickelimolybdate, barium.

Barium nickel hydrogen molybdate,

Ba<sub>2</sub>H<sub>4</sub>Ni(MoO<sub>4</sub>)<sub>3</sub>+10H<sub>2</sub>O.

See Nickelomolybdate, barium hydrogen.

Barium vanadium molybdate.

See Vanadiomolybdate, barium.

Barium molybdate hydrogen dioxide, 8BaO,  
19MoO<sub>3</sub>, 2H<sub>2</sub>O<sub>2</sub>+13H<sub>2</sub>O.

Precipitate. (Barwald.)

Bismuth molybdate, Bi<sub>2</sub>O<sub>3</sub>, 3MoO<sub>3</sub>.

Somewhat sol. in H<sub>2</sub>O. Sol in 500 pts. H<sub>2</sub>O and in the stronger acids (Richter.)

Bromomolybdenum molybdate.

See under Bromomolybdenum comps.

Cadmium molybdate, CdMoO<sub>4</sub>.

Insol. in H<sub>2</sub>O; sol. in NH<sub>4</sub>OH+Aq, KCN+Aq, or acids (Smith and Bradbury, B. 24. 2380.)

CdO, H<sub>2</sub>O, 8MoO<sub>3</sub>+6H<sub>2</sub>O. Decomp. by boiling with H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 323.)

Cæsium molybdate, Cs<sub>2</sub>O, 3MoO<sub>3</sub>+H<sub>2</sub>O.

(Ephraim and Herschfinkel, Z. anorg 1909, 64. 270.)

Cs<sub>2</sub>O, 5MoO<sub>3</sub>+3H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 270.)

+3½H<sub>2</sub>O. Very sl. sol. in cold, easily sol. in hot H<sub>2</sub>O. (Wempe, Dissert 1911.)

2Cs<sub>2</sub>O, 5MoO<sub>3</sub>+5H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 271.)

3Cs<sub>2</sub>O, 10MoO<sub>3</sub>+3H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg 1909, 64. 271.)

Cs<sub>2</sub>O, 16MoO<sub>3</sub>+8H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 271.)

3Cs<sub>2</sub>O, 10MoO<sub>3</sub>+3H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 271.)

Cæsium tetramolybdate, Cs<sub>2</sub>O, 4MoO<sub>3</sub>.

Only sl. sol. in H<sub>2</sub>O. (Muthmann, B. 1898, 31. 1841.)

+2H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O. (Muthmann, B. 1898, 31. 1841.)

+3H<sub>2</sub>O. Easily sol. in cold or hot H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 317.)

+5H<sub>2</sub>O. Very sol. in cold and hot H<sub>2</sub>O. (Wempe, Dissert 1911.)

Cs<sub>2</sub>O, MoO<sub>3</sub>, Cs<sub>2</sub>O, 3MoO<sub>3</sub>+4.5H<sub>2</sub>O. Sol in H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 317.)

Cæsium paramolybdate, 5Cs<sub>2</sub>O, 12MoO<sub>3</sub>+11H<sub>2</sub>O.

Efflorescent. Easily sol. in H<sub>2</sub>O (Wempe, Z. anorg. 1912, 78. 317.)

Calcium molybdate, CaMoO<sub>4</sub>.

Insol precipitate (Ullik.)

Sl. sol. in H<sub>2</sub>O; insol in alcohol. (Smith and Bradbury, B. 24. 2930.)

+H<sub>2</sub>O. (Westphal, Dissert. 1895.)

+2H<sub>2</sub>O. (Westphal, Dissert. 1895.)

+6H<sub>2</sub>O. Difficultly sol. in cold, easily in hot H<sub>2</sub>O. (Ullik, A. 144. 231.)

CaMo<sub>4</sub>O<sub>12</sub>+9H<sub>2</sub>O. Easily sol. in cold H<sub>2</sub>O.

CaO, 2H<sub>2</sub>O, 12MoO<sub>3</sub>+21H<sub>2</sub>O. Efflorescent. Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O. (Wempe.)

Calcium hydrogen tetramolybdate,

CaH<sub>2</sub>(Mo<sub>4</sub>O<sub>12</sub>)<sub>2</sub>+17H<sub>2</sub>O.

Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O with decomp (Ullik.)

+16H<sub>2</sub>O. Insol. in cold, difficultly sol. in hot H<sub>2</sub>O (Wempe, Z. anorg. 1912, 78. 318.)

Cerium molybdate, Ce<sub>2</sub>(MoO<sub>4</sub>)<sub>3</sub>.

Precipitate. Insol. in H<sub>2</sub>O, sol. in acids. (Cossa, B. 19. 536 R.)

Chromic molybdate.

Insol. in H<sub>2</sub>O, but sol. in acids. Sol in NH<sub>4</sub> molybdate+Aq (Berzelius.)

See also Chromicomolybdic acid.

Chromic molybdate, with M. molybdate.

See Chromicomolybdate. M.

Cobaltous molybdate, CoMoO<sub>4</sub>.

Decomp by alkalis and strong acids. (Berzelius.)

+H<sub>2</sub>O. Sl. sol. in pure, easily sol. in acidified H<sub>2</sub>O. (Coloriano, Bull. Soc. (2) 50. 451.)

CoO, 2MoO<sub>3</sub>+2H<sub>2</sub>O. (Marekwald, Dissert. 1895.)

6½H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O. (Marekwald.)

CoMo<sub>2</sub>O<sub>10</sub>+10H<sub>2</sub>O. Very sl. sol. in cold, but very easily sol. in hot H<sub>2</sub>O. (Ullik, W. A. B. 56, 2. 767.)

Cobaltic potassium molybdate.

See Cobaltimolybdate, potassium.

Cobaltous sodium molybdate,

Na<sub>2</sub>O, 2CoO, 6MoO<sub>3</sub>+18H<sub>2</sub>O.

(Marekwald, Dissert. 1895.)

2Na<sub>2</sub>O, CoO, 7MoO<sub>3</sub>+20H<sub>2</sub>O. Sol. in cold H<sub>2</sub>O without decomp. Decomp. on heating. (Marekwald.)

$3\text{Na}_2\text{O}$ ,  $2\text{CuO}$ ,  $12\text{MoO}_3 + 27\text{H}_2\text{O}$ . (Marek-wald.)

$3\text{Na}_2\text{O}$ ,  $3\text{CuO}$ ,  $14\text{MoO}_3 + 50\text{H}_2\text{O}$ . Sol in much cold  $\text{H}_2\text{O}$ . (Marek-wald.)

$4\text{Na}_2\text{O}$ ,  $6\text{CuO}$ ,  $25\text{MoO}_3 + 68\text{H}_2\text{O}$ . (Marek-wald.)

**Cobaltous molybdate ammonia**,  $\text{CoMoO}_4 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Sonnenschein, J. pr. 53. 340.)

**Cupric molybdate, basic**,  $4\text{CuO}$ ,  $3\text{MoO}_3 + 5\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Struve, J. B. 1854. 350.)

**Cupric molybdate**,  $\text{CuMoO}_4$

Sl. sol. in  $\text{H}_2\text{O}$ ; decomp. by acids and alkaline solutions.

$\text{CuMoO}_3 \cdot 6\frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ . (Ullik, A. 144. 233.)

$+5\text{H}_2\text{O}$ . Very sl. sol. in cold, and extraordinarily easily sol. in hot  $\text{H}_2\text{O}$  (Ullik)

**Cupric molybdate ammonia**,

$\text{CuMoO}_4 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$ .

Gives off  $\text{NH}_3$  at ord temp. Decomp. by  $\text{H}_2\text{O}$ .

Sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$  from which it can be cryst. (Briggs, Chem. Soc. 1904, 85. 674.)

$\text{CuMoO}_4 \cdot 4\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$  (Jorgensen, Ch. Z. Repeat. 1890, 20. 225.)

**Didymium molybdate**,  $\text{Dy}_2(\text{MoO}_4)_3$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . (Cossa, B. 19. 536R.)

$\text{Dy}_2\text{O}_3$ ,  $6\text{MoO}_3 + 3\text{H}_2\text{O}$  (?) Precipitate. (Smith)

**Glucinum molybdate, basic**,  $2\text{GfO}$ ,  $\text{MoO}_3 + 3\text{H}_2\text{O}$

Nearly insol. in  $\text{H}_2\text{O}$ . (Atterberg, J. B. 1873. 258.)

**Glucinum molybdate**,  $\text{GfO}$ ,  $\text{MoO}_3 + 2\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  with decomp. (Rosenheim, Z. anorg. 1897, 15. 307.)

$\text{GfMoO}_4$ ,  $\text{MoO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Atterberg.)

**Gold (auric) molybdate** (?).

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ . (Richter.)

**Hydroxylamine potassium molybdate**.

$\text{MoO}_3 \cdot \text{H}_2(\text{NH}_2\text{O})_2(\text{NH}_2\text{OK})$ .

Easily sol. in  $\text{H}_2\text{O}$ ; pptd. by alcohol. (Hofmann, A. 1899, 309. 324.)

**Indium molybdate**,  $\text{In}_2(\text{MoO}_4)_3 + 2\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ .

Easily sol. in  $\text{HCl}$ . (Renz, B. 1901, 34. 2765.)

**Iron (ferrous) molybdate**,  $\text{FeMoO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Schulze, A. 126. 55.)

**Iron (ferric) molybdate**,  $\text{Fe}_2\text{O}_3$ ,  $4\text{MoO}_3 + 7\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . Slowly sol. in cold, easily in hot  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . Dil. acids gradually dissolve out  $\text{Fe}_2\text{O}_3$  in the cold. When ignited, difficultly sol. in all solvents. (Stenacker.)

$\text{Fe}_2\text{O}_3$ ,  $5\text{MoO}_3 + 16\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Struve, J. B. 1854. 346.)

$2\text{Fe}_2\text{O}_3$ ,  $7\text{MoO}_3 + 34\text{H}_2\text{O}$ . Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 704.)

**Ferric potassium molybdate**,  $\text{Fe}_2\text{O}_3$ ,  $3\text{K}_2\text{O}$ ,  $12\text{MoO}_3 + 20\text{H}_2\text{O} = 3\text{K}_2\text{Mo}_2\text{O}_7$ ,

$\text{Fe}_2(\text{Mo}_2\text{O}_7)_3 + 20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Struve)

**Lanthanum molybdate**,  $\text{La}_2\text{H}_3(\text{MoO}_4)_3 = \text{La}_2\text{O}_3$ ,  $\text{MoO}_3 + 3\text{H}_2\text{O}$ . (?)

Precipitate. (Smith)

**Lead molybdate**,  $\text{PbMoO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in warm  $\text{HNO}_3 + \text{Aq}$ ; decomp. by  $\text{H}_2\text{SO}_4$ ; sol. in conc.  $\text{HCl} + \text{Aq}$ , or  $\text{KOH} + \text{Aq}$ .

Min. *Wulfenite*. As above.

**Lithium molybdate**,  $\text{Li}_2\text{MoO}_4$ .

Moderately sol. in cold, and only sl. more sol. in hot  $\text{H}_2\text{O}$  (Ephraim, Z. anorg. 1909, 64. 250.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ .

$5\text{Li}_2\text{O}$ ,  $5\text{MoO}_3 + 2\text{H}_2\text{O}$ . 46.13 g. are present in 100 ccm. of the aqueous solution at  $20^\circ$ , and sp. gr. of the solution = 1.44. (Wempe, Z. anorg. 1912, 78. 309.)

$\text{Li}_2\text{O}$ ,  $2\text{MoO}_3 + 5\text{H}_2\text{O}$ . Sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 258.)

$\text{Li}_2\text{O}$ ,  $3\text{MoO}_3 + \text{H}_2\text{O}$ . Easily sol. in warm  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

$+4\text{H}_2\text{O}$ . (Wempe.)

$+4\frac{1}{2}\text{H}_2\text{O}$ . (Wempe.)

$+7\text{H}_2\text{O}$ . Nearly insol. in cold, sol. in hot  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 258.)

$3\text{Li}_2\text{O}$ ,  $3\text{MoO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 258.)

**Lithium paramolybdate**,  $3\text{Li}_2\text{O}$ ,  $7\text{MoO}_3 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1897, 15. 181.)

$+28\text{H}_2\text{O}$ . Easily sol. in cold and hot  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 258.)

**Lithium tetramolybdate**,  $\text{Li}_2\text{O}$ ,  $4\text{MoO}_3 + 7\text{H}_2\text{O}$ .

Sol. in cold  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 258.)

$\text{Li}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $8\text{MoO}_3 + 10\text{H}_2\text{O}$ . Easily sol.

in hot  $H_2O$ . (Wempe, Z. anorg. 1912, 78. 308.)

$Li_2O$ ,  $3H_2O$ ,  $16MoO_3 + 6\frac{1}{2}H_2O$ . Easily sol. in warm  $H_2O$ . (Wempe, Z. anorg. 1912, 78. 308.)

Lithium potassium molybdate,  $KLiMoO_4 + H_2O$ .

(Traube, N. Jahrb. Miner, 1894, I. 194.)

Magnesium molybdate,  $MgMoO_4$ .

Min. *Belonesia*.

Insol. in  $HCl + Aq$ . (Scacchi, Zert. Kryst. 1888, 14. 523.)

+  $5H_2O$ . Easily sol. in cold, but still more sol. in hot  $H_2O$ . (Delafontaine.)

Sol. in 12-15 pts. cold  $H_2O$ . (Brandes.)

+  $7H_2O$ . Easily sol. in hot or cold  $H_2O$  (Ullik.)

$MgMo_2O_7 + 10H_2O$ . Difficultly sol. in cold, very easily in hot  $H_2O$ . (Ullik.)

Magnesium paramolybdate,  $Mg_3Mo_2O_{14} + 20H_2O$ .

Quite sol. in cold, more easily in hot  $H_2O$  (Ullik.)

Magnesium tetramolybdate,  $MgO$ ,  $H_2O$ ,  $8MoO_3 + 19H_2O$ .

Magnesium hydrogen tetramolybdate,  $MgH_2(Mo_4O_{13})_2 + 19H_2O$

Easily sol. in cold  $H_2O$ . (Ullik, A. 144. 335.)

Sl. sol. in cold, easily sol. in hot  $H_2O$ . (Wempe, Dissert. 1911.)

+  $20H_2O$ . Ppt. (Wempe, Z. anorg. 1912, 78. 323.)

Magnesium hydrogen octamolybdate,  $MgH_2(Mo_8O_{21})_2 + 29H_2O$ .

Very difficultly sol. in cold, very easily sol. in hot  $H_2O$  (Ullik, W. A. B. 60, 2. 314.)

Magnesium potassium molybdate,  $MgMoO_4$ ,  $K_2MoO_4 + 2H_2O$ .

Slowly sol. in cold, easily in hot  $H_2O$ . (Ullik, A. 144. 343.)

Manganous molybdate,  $MnMoO_4 + H_2O$ .

Insol. in  $H_2O$ . Sl. sol. in pure, easily sol. in acidified  $H_2O$ . Decomp. by alkalis or alkali carbonates +  $Aq$ . (Coloriano, Bull. Soc. (2) 50. 451.)

+  $\frac{1}{2}H_2O$ . (Marckwald, Dissert. 1895.)

+  $10H_2O$ . (Marckwald.)

Manganic potassium molybdate.

See Permanganomolybdate, potassium.

Manganic silver molybdate.

See Permanganomolybdate, silver.

Mercurous molybdate,  $Hg_2Mo_2O_7$ .

Decomp. by  $H_2O$ . (Struve, J. B. 1754. 350.)

Sol in 500-600 pts.  $H_2O$ ; decomp. by  $HNO_3 + Aq$  (Hatchett.)

Molybdenum molybdate.

See Molybdenum oxides,  $Mo_2O_7$ ,  $Mo_4O_6$ , etc.

Neodymium molybdate,  $Nd_2(MoO_4)_3$ .

Very sl. sol. in  $H_2O$

1 pt. is sol. in 53790 pts.  $H_2O$  at  $28^\circ$ .

1 " " " " 32466 "  $H_2O$ . "  $75^\circ$ .

(Hitchcock, J. Am. Chem. Soc. 1895, 17. 532.)

Nickel molybdate,  $NiMoO_4 + \frac{1}{2}H_2O$ , +  $\frac{1}{2}H_2O$  and +  $5H_2O$ .

(Marckwald, Dissert. 1895.)

$NiO$ ,  $3MoO_3 + 18H_2O$ . Sl. sol. in cold; easily sol. in hot  $H_2O$ . (Marckwald.)

$5NiO$ ,  $14MoO_3 + 57H_2O$ , and +  $70H_2O$ . Sl. sol. in cold; easily sol. in hot  $H_2O$ . (Marckwald.)

Nickel potassium molybdate,  $3NiO$ ,  $5K_2O$ ,  $16MoO_3 + 21H_2O$

Can be cryst. from  $H_2O$  (Hall, J. Am. Chem. Soc. 1907, 29. 701.)

Nickelic potassium molybdate.

See Nickelomolybdate, potassium.

Nickel potassium hydrogen molybdate,

$K_2H_4[Ni(MoO_4)_4] + 5H_2O$ .

See Nickelomolybdate, potassium hydrogen.

Nickel sodium molybdate,  $2NiO$ ,  $Na_2O$ ,  $6MoO_3 + 17H_2O$ .

Sol in cold  $H_2O$  without decomp. but decomp. on warming. (Marckwald, Dissert. 1895.)

Nickel molybdate ammonia,  $NiMoO_4$ ,  $2NH_3$ , +  $H_2O$

Decomp. by  $H_2O$ . (Sonnenschein, J. pr. 53. 341.)

Potassium molybdate,  $K_2MoO_4$ .

Deliquescent in moist air. Very sol. in  $H_2O$ . Insol. in alcohol. (Svanberg and Struve, J. pr. 44. 265.)

184.6 grams are sol. in 100 grams  $H_2O$  at  $25^\circ$  (Amadori, C. A. 1912. 2878.)

Solubility of  $K_2MoO_4 + K_2SO_4$  at  $25^\circ$ .

G. per 100 g. $H_2O$		G. per 100 g. $H_2O$	
$K_2SO_4$	$K_2MoO_4$	$K_2SO_4$	$K_2MoO_4$
0	184.6	1.50	99.49
0.46	180.7	2.13	45.89
0.72	177.	3.95	17.48
0.98	127.2	8.55	4.73
1.27	107.5	12.10	0

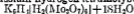
(Amadori, Att. acc. Linc. 1912, 21, I. 467, 667.)

+ $\frac{1}{2}$ H<sub>2</sub>O Easily sol. in H<sub>2</sub>O (Wempe, Dissert. 1911.)  
 K<sub>2</sub>O, 8MoO<sub>3</sub>+13H<sub>2</sub>O Easily sol in warm H<sub>2</sub>O (Wempe, Dissert. 1911.)  
 K<sub>2</sub>O, 10MoO<sub>3</sub>+9H<sub>2</sub>O Nearly insol in hot and cold H<sub>2</sub>O. 100 g. H<sub>2</sub>O dissolve 0.682 g. at 100° (Felix, Dissert. 1912.)  
 +15H<sub>2</sub>O Sol in H<sub>2</sub>O. (Felix)  
 5K<sub>2</sub>O, 12MoO<sub>3</sub>+8H<sub>2</sub>O Sl sol in cold H<sub>2</sub>O (Junius, Z anorg 1905, 46. 439)

**Potassium trimolybdate, K<sub>3</sub>Mo<sub>3</sub>O<sub>10</sub>**

Difficultly sol in cold, but much more easily in hot H<sub>2</sub>O. When ignited is absolutely insol in H<sub>2</sub>O. (Svanberg and Struve)  
 +2H<sub>2</sub>O. (Junius, Z anorg 1905, 46. 439.)  
 Sl. sol. in cold, easily sol in hot H<sub>2</sub>O (Wempe, Dissert. 1911.)  
 +2 $\frac{1}{2}$ H<sub>2</sub>O. Easily sol in H<sub>2</sub>O (Wempe, Dissert. 1911.)  
 +3H<sub>2</sub>O. Very sl. sol. in cold, more easily sol. in hot H<sub>2</sub>O. (Wempe, Dissert. 1911.)  
 +11H<sub>2</sub>O. Practically insol. in H<sub>2</sub>O. (Westphal, Dissert. 1895.)

**Potassium hydrogen tetramolybdate,**



Sl. sol. in cold H<sub>2</sub>O Decomp by boiling H<sub>2</sub>O (Rosenheim, Z anorg. 1913, 79. 298)  
 KHM<sub>4</sub>O<sub>19</sub>+6H<sub>2</sub>O. Decomp by H<sub>2</sub>O (Ullik.)

**Potassium paramolybdate, K<sub>4</sub>Mo<sub>7</sub>O<sub>24</sub>+4H<sub>2</sub>O.**

Decomp even by cold H<sub>2</sub>O (Delafontaine)  
 Formula is K<sub>4</sub>Mo<sub>7</sub>O<sub>24</sub>+6H<sub>2</sub>O, according to Svanberg and Struve (?)

**Potassium selenium molybdate.**

See Selenomolybdate, potassium.

**Potassium sodium molybdate, K<sub>2</sub>MoO<sub>4</sub>, 2Na<sub>2</sub>MoO<sub>4</sub>+14H<sub>2</sub>O**

Very easily sol. in cold, still more easily in hot H<sub>2</sub>O (Delafontaine.)

**Potassium vanadium molybdate.**

See Vanadiomolybdate, potassium.

**Potassium zinc molybdate.**

Sol. in H<sub>2</sub>O. (Beizelius.)

**Potassium molybdate hydrogen dioxide,**



Sol in H<sub>2</sub>O. (Bärwald, C. C. 1885. 424)

**Potassium molybdate sulphocyanide, KSCN, K<sub>2</sub>Mo<sub>2</sub>O<sub>12</sub>+4H<sub>2</sub>O.**

Decomp. by H<sub>2</sub>O. Sol. in dil HCl+Aq (Péchar, C. R. 1894, 118. 806.)

**Praseodymium molybdate, Pr<sub>2</sub>(MoO<sub>4</sub>)<sub>3</sub>**

Very sl sol in H<sub>2</sub>O.

1 pt is sol in 65820 pts H<sub>2</sub>O at 23°

1 " " " 69800 " " 75°.

(Hitchcock, J. Am. Chem. Soc. 1895, 17. 530.)

**Rubidium molybdate, Rb<sub>2</sub>O, MoO<sub>3</sub>.**

Ilygrosopic (Ephraim, Z anorg 1909, 64. 263)

Rb<sub>2</sub>O, 2MoO<sub>3</sub>+2H<sub>2</sub>O Easily sol in H<sub>2</sub>O. (Ephraim, Z anorg 1909, 64. 263.)

Rb<sub>2</sub>Mo<sub>7</sub>O<sub>21</sub>+4H<sub>2</sub>O Very sl. sol. in cold, much more easily sol in hot H<sub>2</sub>O (Delafontaine, N Arch Sc phys. nat. 30. 233)

(Ephraim, Z anorg 1909, 64. 263)

+4 $\frac{1}{2}$ H<sub>2</sub>O (Wempe, Dissert. 1911.)

2Rb<sub>2</sub>O, 7MoO<sub>3</sub>+5H<sub>2</sub>O. Very sl. sol. in cold, very easily sol. in hot H<sub>2</sub>O. (Wempe.)

5Rb<sub>2</sub>O, 7MoO<sub>3</sub>+14H<sub>2</sub>O. (Ephraim and

Herschfinkel, Z. anorg. 1909, 64. 268.)

3Rb<sub>2</sub>O, 8MoO<sub>3</sub>+6H<sub>2</sub>O (Ephraim and

Herschfinkel, Z. anorg 1909, 64. 269)

5Rb<sub>2</sub>O, 12MoO<sub>3</sub>+H<sub>2</sub>O, 100 cc H<sub>2</sub>O dissolve 1.941 g. at 21°. (Wempe, Z anorg. 1912, 78. 258)

Rb<sub>2</sub>O, 3MoO<sub>3</sub>. Insol. in H<sub>2</sub>O (Muthmann, B. 1898, 31. 1839.)

+H<sub>2</sub>O (Muthmann, B. 1898, 31. 1839)

+3H<sub>2</sub>O Sl sol in cold, easily sol. in hot H<sub>2</sub>O (Wempe, Dissert. 1911.)

6 $\frac{1}{2}$ H<sub>2</sub>O (Ephraim and Henschfinkel, Z. anorg 1909, 64. 269.)

2Rb<sub>2</sub>O, 3MoO<sub>3</sub>+4H<sub>2</sub>O. Sl. sol in cold, easily in hot H<sub>2</sub>O. (Wempe, Dissert. 1911.)

Rb<sub>2</sub>O, 4MoO<sub>3</sub>. Difficultly sol in cold, easily in hot H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 312)

+ $\frac{1}{2}$ H<sub>2</sub>O Practically insol in H<sub>2</sub>O. Very sol by addition of NH<sub>3</sub>. (Ephraim and Henschfinkel, Z anorg 1909, 64. 266)

+2.5H<sub>2</sub>O Insol. in H<sub>2</sub>O (Ephraim, Z anorg. 1909, 64. 263)

+4H<sub>2</sub>O Sol in cold, more easily sol in hot H<sub>2</sub>O. (Wempe, Z anorg 1912, 78. 312.)

Rb<sub>2</sub>O, MoO<sub>3</sub>, Rb<sub>2</sub>O, 3MoO<sub>3</sub>+5H<sub>2</sub>O Sol in cold or hot H<sub>2</sub>O (Wempe, Z anorg 1912, 78. 312.)

Rb<sub>2</sub>O, H<sub>2</sub>O, 8MoO<sub>3</sub>+3H<sub>2</sub>O. Difficultly sol in cold, easily in hot H<sub>2</sub>O (Wempe, Z anorg 1912, 78. 312.)

Rb<sub>2</sub>O, 11MoO<sub>3</sub>+5.5H<sub>2</sub>O. Ppt. (Ephraim, Z anorg. 1909, 64. 263)

Rb<sub>2</sub>O, 13MoO<sub>3</sub>+4H<sub>2</sub>O. Ppt (Ephraim.)

Rb<sub>2</sub>O, 18MoO<sub>3</sub>. Ppt. (Ephraim)

**Samarium molybdate, Sm<sub>2</sub>(MoO<sub>4</sub>)<sub>3</sub>.**

Insol in H<sub>2</sub>O. (Cleve.)

**Samarium sodium molybdate,**



Insol. in H<sub>2</sub>O. Easily sol. in warm dil. HNO<sub>3</sub>+Aq. (Cleve.)

Silver (argentous) molybdate,  $\text{Ag}_2\text{O}$ ,  $2\text{MoO}_3$   
Sol. in  $\text{HNO}_3 + \text{Aq. KOH} + \text{Aq.}$  dissolves  
 $\text{MoO}_3$  and  $\text{Ag}_2\text{O}$  separates out. Not decomp.  
by dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Wohler and Rauten-  
berg, A. 114. 119)  
Does not exist. (Muthmann, B. 20. 933)

Silver (argentic) molybdate,  $\text{Ag}_2\text{MoO}_4$ .  
Somewhat sol. in  $\text{H}_2\text{O}$ , less when  $\text{HNO}_3$  is  
present (Richter)

Very sl. sol. in pure  $\text{H}_2\text{O}$ ; easily sol. in  
 $\text{H}_2\text{O}$  acidulated with  $\text{HNO}_3$ . (Struve and  
Svanberg.)

Sol. in  $\text{KCN}$  or  $\text{NaOH} + \text{Aq.}$  (Smith and  
Bradbury.)

$\text{Ag}_2\text{O}$ ,  $2\text{MoO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  
 $\text{KCN} + \text{Aq.}$  (Junius, Dissert 1905.)

$2\text{Ag}_2\text{O}$ ,  $5\text{MoO}_3$ . Somewhat sol. in  $\text{H}_2\text{O}$   
(Svanberg and Struve, J. B. 1847-48. 412)

$\text{Ag}_2\text{O}$ ,  $4\text{MoO}_3 + 6\text{H}_2\text{O}$  Sl. sol. in  $\text{H}_2\text{O}$  with  
decomp (Wempe, Z. anorg. 1912, 78. 322.)

Silver thorium molybdate.

See Thoromolybdate, silver.

Silver molybdate ammonia,  $\text{Ag}_2\text{MoO}_4$ ,  $4\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$  with rapid decomposition  
(Widmann, Bull. Soc. (2) 20. 64)

Silver molybdate hydrogen dioxide,  $13\text{Ag}_2\text{O}$ ,  
 $2\text{H}_2\text{O}_2$ ,  $32\text{MoO}_3$ .

Ppt. (Barwald, B. 17. 1206)

Sodium molybdate,  $\text{Na}_2\text{MoO}_4$ .

Anhydrous. Easily and completely sol. in  
 $\text{H}_2\text{O}$ .

+  $2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

+  $10\text{H}_2\text{O}$ . Efflorescent.

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

Solid phase	$t^\circ$	Per cent of anhydrous salt	Mols. $\text{H}_2\text{O}$ to 1 mol of anhydrous salt	Mols of anhydrous salt to 100 mols $\text{H}_2\text{O}$
$\text{Na}_2\text{MoO}_4$ , $10\text{H}_2\text{O}$	0	30.63	25.92	3.88
"	4	33.83	23.38	4.47
"	6	35.58	20.72	4.83
"	90	38.16	18.54	5.39
$\text{Na}_2\text{MoO}_4$ , $2\text{H}_2\text{O}$	10	39.28	17.70	5.65
"	15	39.27	17.70	5.65
"	32	39.82	17.30	5.78
"	51	41.27	16.28	6.14
"	100	45.57	13.67	7.32

(Funk, B. 1900, 33. 3699)

Insol. in methyl acetate (Naumann, B.  
1909, 42. 3790.)

$\text{Na}_2\text{Mo}_2\text{O}_7$ . After ignition, very difficultly  
sol. in cold, and very slowly sol. in hot  $\text{H}_2\text{O}$   
(Svanberg and Struve)

+  $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ .

+  $3\frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in cold or hot  $\text{H}_2\text{O}$   
(Wempe, Dissert 1911.)

+  $4\text{H}_2\text{O}$ . Easily and completely sol. in  
cold  $\text{H}_2\text{O}$  (Ullik)

+  $6\frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in cold, very easily sol.  
in hot  $\text{H}_2\text{O}$ . (Wempe, Dissert 1911.)

+  $7\text{H}_2\text{O}$ . Difficultly sol. in cold  $\text{H}_2\text{O}$ , but  
more easily than the corresponding K salt.  
100 pts.  $\text{H}_2\text{O}$  dissolve 3.878 pts at  $20^\circ$  and  
13.7 pts at  $100^\circ$  (Ullik, A. 144. 244.)

+  $9\text{H}_2\text{O}$ . Easily sol. in cold, very easily  
sol. in hot  $\text{H}_2\text{O}$  (Wempe.)

+  $11\text{H}_2\text{O}$ . (Junius, Z. anorg. 1905, 46.  
437.)

$3\text{Na}_2\text{O}$ ,  $7\text{MoO}_3$ . Easily sol. in cold, very  
easily sol. in hot  $\text{H}_2\text{O}$  (Ott, Dissert 1911.)

+  $20\text{H}_2\text{O}$ . (Westphal, Dissert 1895.)

+  $22\text{H}_2\text{O}$ . Efflorescent. Easily sol. in  
 $\text{H}_2\text{O}$  (Ullik, A. 144. 219)

$\text{Na}_2\text{O}$ ,  $8\text{MoO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . Very sol. in cold  
or hot  $\text{H}_2\text{O}$ . (Wempe, Dissert 1911.)

+  $4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  (Ullik, W. A. B.  
60, 2. 312.)

+  $15\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1897, 15.  
188)

$\text{Na}_2\text{O}$ ,  $10\text{MoO}_3 + 6\text{H}_2\text{O}$ . Very sl. sol. in  
 $\text{H}_2\text{O}$ . 100 g  $\text{H}_2\text{O}$  dissolve 0.842 g. at  $100^\circ$ .  
(Felix, Dissert 1912.)

+  $7\text{H}_2\text{O}$ . (Felix.) Nearly insol. in hot and  
cold  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1903, 37.  
323)

+  $12\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$

+  $21\text{H}_2\text{O}$ . Abundantly but slowly sol. in  
cold  $\text{H}_2\text{O}$ . =  $\text{NaHN}_2\text{O}_{11} + 10\text{H}_2\text{O}$  (Ullik)

$5\text{Na}_2\text{O}$ ,  $12\text{MoO}_3 + 8\text{H}_2\text{O}$ . Sl. sol. in cold,  
easily sol. in hot  $\text{H}_2\text{O}$  (Wempe, Dissert.  
1911.)

+  $20\text{H}_2\text{O}$ . Sl. sol. in cold, easily sol. in  
hot  $\text{H}_2\text{O}$  (Wempe, Dissert. 1911.)

+  $36\text{H}_2\text{O}$ . (Junius, Z. anorg. 1905, 46. 436.)

+  $44\text{H}_2\text{O}$ . Sl. sol. in cold, easily sol. in hot  
 $\text{H}_2\text{O}$  (Wempe, Dissert. 1911.)

Sodium tetramolybdate,  $\text{Na}_2\text{Mo}_4\text{O}_{18} + 6\text{H}_2\text{O}$

Difficultly sol. in cold, easily in hot  $\text{H}_2\text{O}$ .  
(Ullik)

100 cc  $\text{H}_2\text{O}$  dissolve at  $21^\circ$ , 28.39 g  
of the salt. Sp. gr. of the solution = 1.47.

(Wempe, Z. anorg. 1912, 78. 306)

+  $17\text{H}_2\text{O}$ . (Felix, Dissert. 1912.)

$\text{Na}_4\text{H}_4(\text{H}_2(\text{Mo}_2\text{O}_7)_2) + 21\text{H}_2\text{O}$ . Slowly sol  
in cold, easily sol. in hot  $\text{H}_2\text{O}$  (Rosenheim,  
Z. anorg. 1913, 78. 298.)

$\text{NaHM}_2\text{O}_4\text{O}_{18} + 8\text{H}_2\text{O}$ . Very sol. in hot or  
cold  $\text{H}_2\text{O}$  (Ullik, A. 144. 333)

$\text{NaHM}_2\text{O}_4\text{O}_{18} + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .  
(Ullik.)

Sodium manganous molybdate,  $2\text{Na}_2\text{O}$ ,  $\text{MnO}$ ,

$6\text{MoO}_3 + 19\text{H}_2\text{O}$ .

(Marekwald, Dissert. 1895.)

Sodium molybdate molybdenum oxide,

$\text{Na}_2\text{Mo}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  and aqua  
regia. Insol. in  $\text{HCl}$  and in  $\text{H}_2\text{SO}_4$ . Sol. in

alkalies. (Stavenhagen and Engels, B. 1895, 28. 2280.)

### Strontium molybdate, $\text{SrMoO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Schultze.)  
Sol. in 9600 pts  $\text{H}_2\text{O}$  at  $17^\circ$ . (Smith and Bradbury, B. 24. 2930.)

$\text{SrO}$ ,  $3\text{MoO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . Scarcely sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)  
 $\text{SiO}_2$ ,  $\text{H}_2\text{O}$ ,  $8\text{MoO}_3 + 6\text{H}_2\text{O}$ . Scarcely sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

$2\text{SrO}$ ,  $3\text{H}_2\text{O}$ ,  $20\text{MoO}_3 + 21\text{H}_2\text{O}$ . Ppt. (Wempe, Z. anorg. 1912, 78. 321.)

### Thallous molybdate, $\text{Tl}_2\text{MoO}_4$

Insol. in  $\text{H}_2\text{O}$ . Sol. in alkalies. Insol. in alcohol. (Oettinger, J. B. 1864, 254.)

Sl. sol. in hot or cold  $\text{H}_2\text{O}$ . (Ullik, J. B. 1867, 234.)

$8\text{Tl}_2\text{O}$ ,  $11\text{MoO}_3$ . Sol. in hot  $\text{H}_2\text{O}$ . (Fleming, J. B. 1868, 250.)

$3\text{Tl}_2\text{O}$ ,  $8\text{MoO}_3$ . (Fleming.)

### Thallous tetramolybdate, $\text{Tl}_2\text{O}$ , $4\text{MoO}_3 + \text{H}_2\text{O}$

Sl. sol. in  $\text{H}_2\text{O}$  with decomp. (Wempe, Z. anorg. 1912, 78. 323.)

### Thallous paramolybdate, $5\text{Tl}_2\text{O}$ , $12\text{MoO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in mineral acids and in alkali hydroxides and carbonates. (Junius, Z. anorg. 1905, 46. 432.)

### Tin (stannic) molybdate.

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. or conc.  $\text{HCl} + \text{Aq.}$  or in  $\text{KOH} + \text{Aq.}$  Not decomp. by  $\text{HNO}_3 + \text{Aq.}$  (Berzelius.)

### Uranous molybdate.

Precipitate. Sol. in  $\text{HCl} + \text{Aq.}$  Decomp. by  $\text{KOH} + \text{Aq.}$

$\text{U}(\text{MoO}_4)_2$ . (Lancien, C. C. 1908, I. 1763.)

### Uranyl molybdate, $(\text{UO}_2)\text{MoO}_4$ .

Insol. in  $\text{H}_2\text{O}$ , methyl and ethyl alcohol, ether, acetic acid,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$  and  $\text{C}_7\text{H}_8$ . Sol. in mineral acids. (Lancien, C. C. 1907, I. 784.)

$2\text{UO}_3$ ,  $3\text{MoO}_3$  (?). Insol. in  $\text{H}_2\text{O}$ . Sol. in strong acids and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Berzelius.)

$3\text{UO}_3$ ,  $7\text{MoO}_3$ . Insol. in hot and cold  $\text{H}_2\text{O}$ . Insol. in  $\text{NaOH}$ ,  $\text{KOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in all min. acids and decomp. by an excess of  $\text{H}_2\text{O}$ . Insol. in acetic acid. (Lancien, C. C. 1908, I. 1763.)

$\text{UO}_3$ ,  $8\text{MoO}_3$ . (Lancien.)  
 $+13\text{H}_2\text{O}$ . Insol. in  $\text{HNO}_3$ . (Lancien.)

### Ytterbium molybdate, $\text{Yb}_2\text{O}_3$ , $7\text{MoO}_3 + 6\text{H}_2\text{O}$ .

Insol. in hot  $\text{H}_2\text{O}$ . (Cleve, Z. anorg. 1902, 32. 152.)

$2\text{Yb}_2\text{O}_3$ ,  $\text{MoO}_3$ . Ppt. (Cleve.)

### Yttrium molybdate.

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq.}$  (Berlin.)

### Zinc molybdate, $\text{ZnMoO}_4$

Difficultly sol. in  $\text{H}_2\text{O}$ ; easily in acids. (Schultze, A. 126. 40.)

$+ \text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Colornato, Bull. Soc. (2) 50. 451.)

$\text{ZnMo}_2\text{O}_7 + 10\text{H}_2\text{O}$ . Very difficultly sol. in cold, but extraordinarily easily sol. in hot  $\text{H}_2\text{O}$ . (Ullik, W. A. B. 55, 2. 767.)

### Zinc tetramolybdate, $\text{ZnMo}_4\text{O}_{12} + 8\text{H}_2\text{O}$ .

Easily sol. in cold  $\text{H}_2\text{O}$ . (Ullik.)

$\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $8\text{MoO}_3 + 14\text{H}_2\text{O}$ . Ppt. (Wempe, Z. anorg. 1912, 78. 324.)

### Zinc molybdate ammonia, $\text{ZnMoO}_4$ , $2\text{NH}_3 + \text{H}_2\text{O}$

(Sonnenschein, J. pr. 53. 339.)

### Permolybdic acid.

See Permolybdic acid.

### Molybdic sulphuric acid, $\text{MoO}_3$ , $\text{SO}_3$ .

Deliquescent. (Schultz-Sellack, B. 4. 14.)  
Very deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Muthmann, A. 1886, 238. 126.)

$\text{MoO}_3$ ,  $3\text{SO}_3 + 2\text{H}_2\text{O}$  (?).

### Molybdocyanhydric acid, $\text{H}_4\text{Mo}(\text{CN})_8 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and abs. alcohol. Solutions are stable at ord. temp. (Rosenheim and Garfunkel, Z. anorg. 1910, 65. 168.)

### Cadmium molybdocyanide, $\text{Cd}_2\text{Mo}(\text{CN})_8 + \text{SH}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

### Cadmium molybdocyanide ammonia,

$\text{Cd}_2\text{Mo}(\text{CN})_8$ ,  $4\text{NH}_3 + 2\text{H}_2\text{O}$ .

(Rosenheim.)

### Cupric molybdocyanide ammonia,

$\text{Cu}_2\text{Mo}(\text{CN})_8$ ,  $4\text{NH}_3 + 7\text{H}_2\text{O}$

(Rosenheim.)

### Potassium molybdocyanide, $\text{K}_4\text{Mo}(\text{CN})_8 + 2\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

### Thallous molybdocyanide, $\text{Tl}_4\text{Mo}(\text{CN})_8$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

### Molybdoiodic acid, $\text{HIO}_3$ , $\text{H}_2\text{MoO}_4 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Blomstrand, J. pr. (2) 40. 320.)

$\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3 + 2\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Insol. in cold, sol. in hot  $\text{HNO}_3$ . Sol. in alcohol. (Chrétien, A. ch. 1898, (7) 15. 402.)

**Ammonium molybdoiodate,  $\text{NH}_4\text{IO}_6$ ,  $\text{H}_2\text{MoO}_4$**

Somewhat more sol. than K salt. (Blomstrand.)

$(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ . Very sl sol in cold  $\text{H}_2\text{O}$ . More sol. in hot  $\text{H}_2\text{O}$ . (Rosenheim and Liebitnecht, A. 1899, 308. 50)

+ $\text{H}_2\text{O}$ . 1 l.  $\text{H}_2\text{O}$  dissolves 5.39 g. salt at  $15^\circ$ ; 30.94 g. at  $100^\circ$ . More sol. in dil.  $\text{HNO}_3$  + Aq. (Chrétien, A. ch. 1898, (7) 15. 409.)

$3(\text{NH}_4)_2\text{O}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$  +  $6\text{H}_2\text{O}$ . (Chrétien.)

**Barium molybdoiodate,  $\text{BaO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $2\text{H}_2\text{O}$ .**

4.23 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at ord. temp. (Chrétien.)

**Cadmium molybdoiodate, acid,  $3\text{CdO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$  +  $16\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Chrétien.)

**Calcium molybdoiodate,  $\text{CaO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $6\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 7.8 g. of the salt at  $15^\circ$ ; 20.89 g. at  $90^\circ$ . (Chrétien.)

**Cobaltous molybdoiodate,  $\text{CoO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $6\text{H}_2\text{O}$ .**

5.11 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ ; 22.27 g. at  $100^\circ$ . (Chrétien.)

**Cobaltous molybdoiodate acid,  $\text{CoO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$  +  $18\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Chrétien.)

**Cupric molybdoiodate,  $\text{CuO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $3\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 10.63 g. of the salt at  $15^\circ$ ; 25.55 g. at  $100^\circ$ . (Chrétien.)

**Lithium molybdoiodate,  $\text{Li}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $2\frac{1}{2}\text{H}_2\text{O}$ .**

197.83 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ . Sol. in dil.  $\text{HNO}_3$  + Aq. (Chrétien.)

**Magnesium molybdoiodate,  $\text{MgO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $6\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 3.85 g. of the salt at  $15^\circ$ ; 18.2 g. at  $100^\circ$ . (Chrétien.)

**Manganous molybdoiodate,  $3\text{MnO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$  +  $9\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 17.05 g. of the salt at  $15^\circ$ ; 55.05 g. at  $100^\circ$ . (Chrétien.)

**Nickel molybdoiodate,  $\text{NiO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $6\text{H}_2\text{O}$ .**

5.43 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ ; 21.8 g. at  $100^\circ$ . (Chrétien.)

$2\text{NiO}$ ,  $2\text{I}_2\text{O}_5$ ,  $3\text{MoO}_3$  +  $23\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Not decomp. by acids. (Maass, Dissert. 1901.)

**Nickel molybdoiodate, acid,  $2\text{NiO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$  +  $15\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Chrétien.)

**Potassium molybdoiodate,  $\text{KHO}_2\text{IO}_5\text{MoO}_3\text{OH}$ , or  $\text{KIO}_5$ ,  $\text{MoO}_3$  +  $2\text{H}_2\text{O}$ .**

Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . (Blomstrand, J. pr (2) 40. 320.)

$\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ . Only sl. sol. in cold  $\text{H}_2\text{O}$ ; sol. on long boiling. 4.48 grs are sol. in 1 l.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Compare Blomstrand: not identical.) (Rosenheim, A. 1899, 308. 50)

+ $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . 3.45 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ ; 23.38 g. at  $100^\circ$ . More sol. in dil.  $\text{HNO}_3$  + Aq. (Chrétien, A. ch. 1898, (7) 15. 404.)

**Potassium molybdoiodate, acid.**

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $4\text{K}_2\text{O}$  +  $7\text{H}_2\text{O}$ .

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $2\text{K}_2\text{O}$  +  $13\text{H}_2\text{O}$ .

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $\text{K}_2\text{O}$  +  $4\text{H}_2\text{O}$ .

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $\text{K}_2\text{O}$  +  $7\text{H}_2\text{O}$ .

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $\text{K}_2\text{O}$  +  $5\text{H}_2\text{O}$ .

(Chrétien.)

**Silver molybdoiodate,  $\text{Ag}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $1\frac{1}{2}\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ .

$4\text{Ag}_2\text{O}$ ,  $4\text{I}_2\text{O}_5$ ,  $3\text{MoO}_3$ . Sol. in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ . (Chrétien.)

**Sodium molybdoiodate,  $\text{Na}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  with decomp. (Chrétien, C. R. 1896, 123. 178.)

1 l.  $\text{H}_2\text{O}$  dissolves 6.97 g. of the salt at  $15^\circ$ ; 22.75 g. at  $90^\circ$ .

1 l.  $\text{HNO}_3$  + Aq (1.10) dissolves 23.78 g. of the salt at ord. temp. (Chrétien, A. ch. 1898, (7) 15. 410.)

+ $2\text{H}_2\text{O}$ . Only sl. sol. in cold  $\text{H}_2\text{O}$ ; sol. on long boiling. 3.35 grams are sol. in 1 l.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Rosenheim, A. 1899, 308. 50.)

**Strontium molybdoiodate,  $\text{SrO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $3\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Chrétien, A. ch. 1898, (7) 15. 415.)

**Strontium molybdoiodate, acid,  $3\text{SrO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$  +  $15\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 2.94 g. of the salt at  $15^\circ$ ; 13.64 g. at  $100^\circ$ . (Chrétien.)

**Uranyl molybdoiodate,  $2\text{UO}_3$ ,  $4\text{I}_2\text{O}_5$ ,  $3\text{MoO}_3$  +  $3\text{H}_2\text{O}$ . (Chrétien.)**

**Zinc molybdoiodate,  $\text{ZnO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $5\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 4.08 g. of the salt at  $15^\circ$ ; 16.26 g. at  $100^\circ$ . (Chrétien.)

**Zinc molybdoiodate acid**,  $\text{ZnO}$ ,  $(\text{I}_2\text{O}_5, 2\text{MoO}_3)_2$   
 $+16\text{HI}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$  (Chrétien)

### Molybdoperiodic acid.

**Ammonium molybdoperiodate**,  $5(\text{NH}_4)_2\text{O}$ ,  
 $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+12\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Blomstrand, Sv. V. A. II. Bih. 1892, No. 6.)

$4(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $8\text{MoO}_3+7\text{H}_2\text{O}$  Very sl. sol. in cold  $\text{H}_2\text{O}$  (Blomstrand)

**Ammonium sodium** —,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  
 $\text{I}_2\text{O}_7$ ,  $2\text{MoO}_3+10\text{H}_2\text{O}$

Very sl. sol in  $\text{H}_2\text{O}$ . (B.)

**Barium sodium** —,  $9\text{BaO}$ ,  $\text{Na}_2\text{O}$ ,  $2\text{I}_2\text{O}_7$ ,  
 $24\text{MoO}_3+28\text{H}_2\text{O}$ .

Very sl. sol in  $\text{H}_2\text{O}$ . (B.)

**Calcium** —,  $5\text{CaO}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+26\text{H}_2\text{O}$   
 Extremely sol in  $\text{H}_2\text{O}$ . (Blomstrand.)

$\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+21\text{H}_2\text{O}$  Less sol. in  
 $\text{H}_2\text{O}$  than above salt

**Lithium** —,  $5\text{Li}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+30\text{H}_2\text{O}$   
 Not so efflorescent as Na salt Sol in  $\text{H}_2\text{O}$ .

(B.)

$+18\text{H}_2\text{O}$  (B.)

**Manganous sodium** —,  $2\text{MnO}$ ,  $3\text{Na}_2\text{O}$ ,  
 $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+32\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  (B.)

**Potassium** —,  $5\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+12\text{H}_2\text{O}$ .

Not efflorescent. (Blomstrand)

**Sodium** —,  $5\text{Na}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+34\text{H}_2\text{O}$ .

Efflorescent Very sol in  $\text{H}_2\text{O}$ . (Blomstrand, Sv. V. A. II. Bih. 1892, No. 6, 21)

$+26\text{H}_2\text{O}$ . Not efflorescent. Very sol. in  
 $\text{H}_2\text{O}$  (Blomstrand)

**Sodium strontium** —,  $\text{Na}_2\text{O}$ ,  $4\text{SrO}$ ,  $\text{I}_2\text{O}_7$ ,  
 $12\text{MoO}_3+20\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (B.)

### Molybdophosphoric acid.

See Phosphomolybdic acid.

### Molybdosulphosphoric acid.

**Sodium molybdosulphosphate**,

$\text{Na}_2[\text{HP}(\text{MoO}_3)_2]_2+8\text{H}_2\text{O}$ .

Ppt (Rosenheim, Z. anorg. 1913, 84, 222)

### Molybdophosphorous acid.

**Potassium molybdophosphate**,  
 $\text{K}_2[\text{HP}(\text{MoO}_3)_2]_2+11\text{H}_2\text{O}$ .

Difficultly sol in cold  $\text{H}_2\text{O}$ . (Rosenheim,  
 Z. anorg. 1913, 84, 219.)

**Sodium molybdophosphate**,

$\text{Na}_2[\text{HP}(\text{MoO}_3)_2]_2+11\text{H}_2\text{O}$

Sl sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg  
 1913, 84, 218.)

### Molybdophosphovanadic acid.

See Phosphovanadiomolybdic acid.

### Molybdoselenious acid.

**Ammonium molybdoselenite**,  $4(\text{NH}_4)_2\text{O}$ ,  
 $3\text{SeO}_2$ ,  $10\text{MoO}_3+4\text{H}_2\text{O}$

More sol. in hot than cold  $\text{H}_2\text{O}$ , insol in  
 alcohol. (Péchar, A. ch. (6) 30, 403.)

**Ammonium potassium molybdoselenite**,  
 $2(\text{NH}_4)_2\text{O}$ ,  $2\text{K}_2\text{O}$ ,  $3\text{SeO}_2$ ,  $10\text{MoO}_3+5\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , insol in alcohol (Péchar  
 and)

**Barium molybdoselenite**,  $4\text{BaO}$ ,  $3\text{SeO}_2$ ,  
 $10\text{MoO}_3+3\text{H}_2\text{O}$

Sl sol in cold, easily in warm  $\text{H}_2\text{O}$   
 (Péchar)

**Potassium molybdoselenite**,  $4\text{K}_2\text{O}$ ,  $3\text{SeO}_2$ ,  
 $10\text{MoO}_3+5\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ , insol. in alcohol (Péchar  
 and)

**Sodium molybdoselenite**,  $4\text{Na}_2\text{O}$ ,  $3\text{SeO}_2$ ,  
 $10\text{MoO}_3+15\text{H}_2\text{O}$ .

Very efflorescent, and sol in  $\text{H}_2\text{O}$ , insol. in  
 alcohol (Péchar)

### Molybdosilicic acid.

See Silicomolybdic acid.

### Molybdosilicovanadic acid.

See Silicovanadiomolybdic acid.

### Molybdosulphuric acid.

Appreciably sol in  $\text{H}_2\text{O}$  (Hoffmann,  
 Dissert. 1903.)

**Ammonium molybdosulphate**,  $(\text{NH}_4)_2\text{O}$ ,  
 $2\text{MoO}_3$ ,  $8\text{O}_2+4\text{H}_2\text{O}$ , and  $+6\text{H}_2\text{O}$ .

Decomp by  $\text{H}_2\text{O}$  (Weinland, Z. anorg.  
 1907, 54, 261)

$(\text{NH}_4)_2\text{O}$ ,  $2\text{MoO}_3$ ,  $3\text{SO}_3+10\text{H}_2\text{O}$  (Wein-  
 land)

**Ammonium molybdenyl molybdosulphate**,  
 $(\text{NH}_4)_2\text{O}$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $8\text{O}_2+1\text{H}_2\text{O}$ .

$1\frac{1}{2}(\text{NH}_4)_2\text{O}$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $8\text{O}_2+5\text{H}_2\text{O}$ .

$2(\text{NH}_4)_2\text{O}$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $8\text{O}_2+14\text{H}_2\text{O}$   
 (Hoffmann, Dissert. 1903.)

$3\text{NH}_3$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $8\text{O}_2+10\text{H}_2\text{O}$ . Very  
 sol in  $\text{H}_2\text{O}$  Very sl. sol in  $\text{NH}_4$  salts + Aq.

Very stable toward alkali + Aq (Péchar,  
 C. R. 1893, 116, 1411)

$5\text{NH}_3$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+8\text{H}_2\text{O}$  (Pé-  
chard, C R. 1893, 116. 1441.)

Potassium molybdosulphate,  $\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  
 $\text{SO}_3+2\text{H}_2\text{O}$

$\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $\text{SO}_3+6\text{H}_2\text{O}$   
 $\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $3\text{SO}_3+6\text{H}_2\text{O}$ . (Weinland, Z  
anorg. 1907, 54. 260.)

Potassium molybdenyl molybdosulphate,  
 $\text{K}_2\text{O}$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+8\text{H}_2\text{O}$   
(Hoffmann, Dissert. 1903.)

### Molybdosulphurous acid.

Ammonium molybdosulphite,  $4(\text{NH}_4)_2\text{O}$ ,  
 $3\text{SO}_3$ ,  $10\text{MoO}_3+6\text{H}_2\text{O}$ .

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$   
Insol in alcohol (Péchard, A. ch. (6) 30.  
396.)

$3(\text{NH}_4)_2\text{O}$ ,  $8\text{MoO}_3$ ,  $2\text{SO}_3+5\text{H}_2\text{O}$ . Sl. sol  
in cold, easily sol in warm  $\text{H}_2\text{O}$ . Easily de-  
comp by  $\text{H}_2\text{O}$ , and can be recryst. only in  
presence of an excess of sulphurous acid.  
(Rosenheim, Z. anorg 1894, 7. 177.)

Ammonium potassium molybdosulphite,  
 $2(\text{NH}_4)_2\text{O}$ ,  $2\text{K}_2\text{O}$ ,  $3\text{SO}_3$ ,  $10\text{MoO}_3+6\text{H}_2\text{O}$   
Sl sol in cold  $\text{H}_2\text{O}$  Decomp on warming  
(Péchard.)

Barium molybdosulphite,  $2\text{BaO}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_3+10\text{H}_2\text{O}$   
(Rosenheim, Z. anorg. 1897, 15. 185.)

Cæsium molybdosulphite,  $2\text{Cs}_2\text{O}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_3+6\text{H}_2\text{O}$   
Unstable As K salt (Rosenheim.)

Potassium molybdosulphite,  $4\text{K}_2\text{O}$ ,  $3\text{SO}_3$ ,  
 $10\text{MoO}_3+10\text{H}_2\text{O}$

Very sl. sol in  $\text{H}_2\text{O}$ , but decomp. on warm-  
ing (Péchard.)

$2\text{K}_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{SO}_3+\text{H}_2\text{O}$  (Rosenheim.)

Rubidium molybdosulphite,  $2\text{Rb}_2\text{O}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_3+12\text{H}_2\text{O}$ .

As K salt. (Rosenheim.)

Sodium molybdosulphite,  $4\text{Na}_2\text{O}$ ,  $3\text{SO}_3$ ,  
 $10\text{MoO}_3+12\text{H}_2\text{O}$ .

Very sol in cold  $\text{H}_2\text{O}$ ; insol in alcohol.  
(Péchard.)

$+10\text{H}_2\text{O}$  Very efflorescent (Péchard.)  
 $2\text{Na}_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{SO}_3+8\text{H}_2\text{O}$  In dry state  
it gradually gives off  $\text{SO}_2$  and soon effloresces.  
(Rosenheim.)

Strontium molybdosulphite,  $2\text{SrO}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_3+12\text{H}_2\text{O}$   
(Rosenheim.)

### Molybdotitanic acid.

See Titanomolybdic acid.

### Molybdous acid.

Magnesium molybdate,  $\text{Mg}_2\text{Mo}_2\text{O}_8=2\text{MgO}$ ,  
 $3\text{MoO}_3$

Not attacked by  $\text{KOH}$ , and  $\text{HCl}+\text{Ag}$   
(Muthmann, A. 238. 108.)

Zinc molybdate,  $\text{Zn}_2\text{Mo}_2\text{O}_8=2\text{ZnO}$ ,  $3\text{MoO}_3$ .

Easily sol in aqua regia. (Muthmann, A.  
238. 108.)

### Molybdovanadates.

See Vanadiomolybdates.

### Neodymicotungstic acid.

Ammonium neodymicotungstate,  $3(\text{NH}_4)_2\text{O}$ ,  
 $\text{Nd}_2\text{O}_3$ ,  $16\text{WO}_3+20\text{H}_2\text{O}$ .

Difficultly sol in  $\text{H}_2\text{O}$  (E F Smith, J.  
Am Chem Soc 1904, 26. 1480.)

Barium neodymicotungstate,  $6\text{BaO}$ ,  $\text{Nd}_2\text{O}_3$ ,  
 $16\text{WO}_3+17\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (E F. Smith.)

### Neodymium.

See also under Didymium.

Neodymium bromide,  $\text{NdBr}_3$

(Matignon, C R 1903, 140. 1638.)

Neodymium carbide,  $\text{NdC}_2$ .

Decomp by  $\text{H}_2\text{O}$ ; insol in conc  $\text{HNO}_3$ ;  
decomp by chl  $\text{HNO}_3$ . (Moissan, C. R.  
1900, 131. 597.)

Neodymium chloride,  $\text{NdCl}_3$

100 g  $\text{H}_2\text{O}$  dissolve 98.68 g.  $\text{NdCl}_3$  at  $13^\circ$ ;  
140.4 g at  $100^\circ$

Sp gr. at  $15^\circ/4^\circ$  of the solution sat at  $13^\circ$  =  
1.74. (Matignon, A. ch 1906, (8) 8. 249.)

44.5 g are sol in 100 g abs alcohol at  $20^\circ$ .  
1.8 g. " " " " pyridine at  $15^\circ$ .

Insol in ether,  $\text{CHCl}_3$ , quinoline, toluene,  
etc Sl. sol. in aniline and in phenylhydraz-  
ine (Matignon, A. ch 1906, (8) 8. 266.)

$+6\text{H}_2\text{O}$ . Deliquescent

At  $13^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 246.2 pts of  
the hydrated salt

At  $100^\circ$ , 100 pts.  $\text{H}_2\text{O}$  dissolve 511 pts. of  
hydrated salt

Sat. solution at  $13^\circ$  has a sp. gr.  $15^\circ/4^\circ$  =  
1.741. (Matignon, C. R. 1901, 133. 289.)

Neodymium chloride ammonia,  $\text{NdCl}_3$ ,  
 $12\text{NH}_3$ .

Decomposes on heating into  $\text{NdCl}_3+\text{NH}_3$ ;  
 $+2\text{NH}_3$ ;  $+4\text{NH}_3$ ;  $+5\text{NH}_3$ ;  $+8\text{NH}_3$ , and  
 $+11\text{NH}_3$ . (Matignon, C. R. 1906, 142. 1043.)

### Neodymium hydroxide.

Sol in citric acid. (Baskerville, J. Am.  
Chem. Soc. 1904, 26. 49.)

Solubility in glycerine+Aq containing about 60% by vol. of glycerine. 100 cm. of the solution contain 4.5 g. neodymium oxide. (Müller, Z. anorg. 1905, 43. 322.)

### Neodymium hydride, NdH<sub>3</sub> (?)

Slowly attacked by boiling H<sub>2</sub>O Sol. in acids with violent evolution of H<sub>2</sub>. (Muthmann, A. 1904, 331. 58.)

### Neodymium iodide, NdI<sub>3</sub>

(Matignon, C. R. 1905, 140. 1638.)

### Neodymium nitride, NdN.

Decomp. in moist air with evolution of NH<sub>3</sub>. (Muthmann, A. 1904, 331. 59.)

### Neodymium oxide, Nd<sub>2</sub>O<sub>3</sub>.

Easily sol. in acids. (v. Welsbach, M. 6. 477.)

### Neodymium oxychloride, NdOCl.

(Matignon, C. R. 1905, 140. 1638.)

### Neon, Ne

Less sol. than argon in H<sub>2</sub>O, sol. in liquid oxygen. (Ramsay, B. 1898, 31. 3118.)

#### Absorption by H<sub>2</sub>O at t°.

t°	Coefficient of absorption
0	0.0114
10	0.0118
20	0.0147
30	0.0158
40	0.0203
50	0.0317

(Antropoff, Roy. Soc. Proc. 1910, 83. A, 480.)

### Nickel, Ni

Not attacked by H<sub>2</sub>O. Very slowly sol. in dilute H<sub>3</sub>PO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>, or HCl+Aq. (Tupputi, A. ch. 78. 133.)

Very easily attacked by HNO<sub>3</sub>+Aq, and difficultly by hot H<sub>2</sub>SO<sub>4</sub>. When pure, is converted into passive condition by conc. HNO<sub>3</sub>. (Nicklès, C. R. 38. 284.)

Very sl. attacked by cold acids, except HNO<sub>3</sub>+Aq. (Tissier, C. R. 50. 106.)

Not attacked by NaOH+Aq (Venator, Dingl. 261. 133.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 828.)

### Nickel amide, Ni(NH<sub>2</sub>)<sub>2</sub>.

Decomp. by H<sub>2</sub>O; slowly sol. in min. acids. Insol. in liquid NH<sub>3</sub>. (Bohart, J. phys. Chem. 1915, 19. 590.)

### Nickel antimonide, NiSb.

Insol. in HCl+Aq; easily sol. in HNO<sub>3</sub>+Aq. (Christoffe, 1863.)

Min. *Breithauptite*. Insol. in acids; easily sol. in aqua regia.

Ni<sub>2</sub>Sb<sub>2</sub>. (Christoffe.)

### Nickel antimonide sulphide, NiSb<sub>2</sub>, NiS<sub>2</sub> = NiSbS

Min. *Nickel glance*, *Ullmannite*.

Decomp. by HNO<sub>3</sub>+Aq; completely sol. in aqua regia with separation of S.

### Nickel arsenide, NiAs

Min. *Niccolite*. Sol. in conc. HNO<sub>3</sub>+Aq with separation of As<sub>2</sub>O<sub>3</sub>; more easily sol. in aqua regia.

NiAs<sub>2</sub>. Min. *Chloanthite*, *Rammelsbergite*. Sol. in HNO<sub>3</sub>+Aq.

Ni<sub>2</sub>As<sub>3</sub>. Sol. in HNO<sub>3</sub> and in aqua regia. Readily attacked by fused alkali (Granger, C. R. 1900, 130. 915.)

### Nickel arsenide sulphide, NiAs<sub>2</sub>, NiS<sub>2</sub>

Min. *Gersdorffite*. Partly sol. in HNO<sub>3</sub>+Aq with separation of S and As<sub>2</sub>O<sub>3</sub>; not attacked by KOH+Aq.

### Nickel azoimide, basic, Ni(OH)N<sub>3</sub>

Insol. in H<sub>2</sub>O. (Curtius, J. pr. 1898, (2) 58. 300.)

### Nickel azoimide, NiN<sub>2</sub>+H<sub>2</sub>O.

Sol. in H<sub>2</sub>O, insol. in alcohol and ether. (Curtius, J. pr. 1900, (2) 61. 418.)

### Nickel potassium azoimide, Ni(N<sub>3</sub>)<sub>2</sub>, KN<sub>3</sub> (?)

Sol. in H<sub>2</sub>O. (Curtius, J. pr. 1898, (2) 58. 302.)

### Nickel boride, Ni<sub>2</sub>B.

Attacked by HNO<sub>3</sub>. Slowly sol. in hot HCl. (Jassoneix, C. R. 1907, 145. 240.)

NiB. Decomp. by moist air and by alkali nitrates, chlorates, hydroxides and carbonates; decomp. by steam at red heat. Not attacked by HCl. Easily attacked by HNO<sub>3</sub> and aqua regia; by H<sub>2</sub>SO<sub>4</sub> only on heating. (Moissan, C. R. 1896, 122. 425.)

NiB<sub>2</sub>. (Jassoneix, C. R. 1907, 145. 241.)

### Nickel bromide, NiBr<sub>2</sub>.

Deliquescent. Slowly sol. in H<sub>2</sub>O.

Sat. NiBr<sub>2</sub>+Aq contains at.

-21°	-6°	+19°	38°
47.1	51.7	56.6	58.9% NiBr <sub>2</sub>
58°	77°	98°	100°
60.5	60.3	61.0	61.0
			60.7% NiBr <sub>2</sub>

(Étard, A. ch. 1894, (7) 2. 542.)

Somewhat hygroscopic. Nearly insol. in cold H<sub>2</sub>O but begins to dissolve appreciably at 50°, and somewhat more rapidly at 90°, but even at that temp. 1 g. requires 1-2 hours for solution. HNO<sub>3</sub> does not appreciably hasten solution. (Richards and Cushman, Z. anorg. 1898, 16. 169.)

Sl. sol. in benzonitrile (Naumann, B. 1914, 47, 1369.)  
 Sol. in gumoline. (Beckmann and Gabel, Z. anorg. 1906, 51, 236.)  
 +3H<sub>2</sub>O. Deliquescent. Very sol. in H<sub>2</sub>O, HCl+aq, NH<sub>4</sub>OH+aq, alcohol, and ether (Berthelot, A. ch. 44, 389.)  
 +6H<sub>2</sub>O. (Bolschakoff, C. C. 1897, II, 331 and 726.)  
 +9H<sub>2</sub>O. (Bolschakoff, C. C. 1897, II, 726 and 331.)

Nickel stannic bromide.

See Bromostannate, nickel.

Nickel bromide ammonia, NiBr<sub>3</sub>·6NH<sub>3</sub>.

Sol. in little H<sub>2</sub>O, but decomp. by more (Rammelsberg, Pogg. 55, 243.)

Sol. in warm conc. NH<sub>4</sub>OH+aq, insol in cold (Richards and Cushman, Z. anorg. 1898, 16, 175.)

Nickel bromide cupric oxide, NiBr<sub>3</sub>·3CuO+4H<sub>2</sub>O.

Not decomp. by H<sub>2</sub>O. (Mailhe, A. ch. 1902, (7) 27, 377.)

Nickel bromide hydrazine, NiBr<sub>3</sub>·2N<sub>2</sub>H<sub>4</sub>.

Easily sol. in dil acids and NH<sub>4</sub>OH+aq. NiBr<sub>3</sub>·3N<sub>2</sub>H<sub>4</sub>. Sol. in dil acids (Franzen, Z. anorg. 1908, 60, 263-4.)

Nickel carbonyl, Ni(CO)<sub>4</sub>.

Insol. in H<sub>2</sub>O; not attacked by dil acids or alkalis or conc. HCl+aq. Easily sol. in conc. HNO<sub>3</sub>+aq and in aqua regia. Sol. in alcohol, benzene, and chloroform. (Mond, Langer, and Quincke, Chem. Soc. 57, 749.)

Sol. in hydrocarbons, especially oil of turpentine. (Berthelot, C. R. 1891, 112, 1346.)

Sol. in acetone, toluene, methyl and ethyl alcohol, etc (Lenher and Loos, J. Am. Chem. Soc. 1900, 22, 114.)

Nickel chloride, NiCl<sub>2</sub>.

Anhydrous. Not immediately sol. in H<sub>2</sub>O, but gradually dissolves on boiling or by addition of HCl+aq. Deliquesces on air, and is then easily sol. in H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH+aq. Sol. in alcohol. Sol. in hot HCl+aq only slowly.

Sp. gr. of NiCl<sub>2</sub>+aq containing:

	5	10	15	20	25% NiCl <sub>2</sub>
1.0493	1.0995	1.1578	1.2245	1.3000	

(B. Franz, J. pr. (2) 6, 285.)

Sp. gr. of NiCl<sub>2</sub>+aq containing, in 1000 grms. H<sub>2</sub>O, g. NiCl<sub>2</sub>+7H<sub>2</sub>O at 23.1°:

	128 g. (= 1/2 mol.)	256	384	512
1.057		1.107	1.149	1.187
	640	768	896	1024
	1.220	1.249	1.276	1.301

Containing g. NiCl<sub>2</sub> (anhydrous):

65 g. (= 1/2 mol.)	130	195	260	325	390
1.061	1.119	1.176	1.230	1.284	1.335

(Gerlach, Z. anal. 28, 468.)

Sp. gr. of NiCl<sub>2</sub>+aq at room temp. containing.

	11.440	22.69	30.40%	NiCl <sub>2</sub>
	1.1093	1.2264	1.3371	

(Wagner, W. Ann. 1883, 18, 269.)

Sp. gr. of NiCl<sub>2</sub>+aq at 25°.

Concentration of NiCl <sub>2</sub> +aq	Sp. gr.
1-normal	1.0591
1/5-	1.0308
1/10-	1.0144
1/15-	1.0087

(Wagner, Z. phys. Ch. 1890, 5, 39.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20, 828.)

100 pts. absolute alcohol dissolve at room temperature 10.05 pts. NiCl<sub>2</sub> (Bödtker, Z. phys. Ch. 1897, 22, 511.)

Sol. in gumoline. (Beckmann and Gabel, Z. anorg. 1906, 51, 236.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

Solubility in glycol=16.1-16.3%. (de Connick, C. C. 1905, II, 1234.)

Sl. sol. in benzonitrile (Naumann, B. 1914, 47, 1369.)

Anhydrous NiCl<sub>2</sub> is insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)

Insol. in acetone and in methylal. (Edmann, C. C. 1899, II, 1014.)

+H<sub>2</sub>O. (Baubigny.)

11. sat. HCl+aq at 12° contains 40 g. NiCl<sub>2</sub> dissolved from NiCl<sub>2</sub>, H<sub>2</sub>O (Ditte.)

+2H<sub>2</sub>O. (Sabatier, Bull. Soc. (3) 1, 88.)

+6H<sub>2</sub>O. Deliquescent in moist, efflorescent in dry air; sol. in H<sub>2</sub>O with evolution of heat. Sol. in 1.5 to 2 pts. H<sub>2</sub>O. Easily sol. in alcohol. (Tupputi.)

1 l. H<sub>2</sub>O dissolves 600 g. NiCl<sub>2</sub>+6H<sub>2</sub>O. (Ditte, A. ch. 1879, (5) 22, 551.)

Sat. aq. solution contains at.

-17°	-16°	+10°	18°
29.7	31.0	37.3	38.5% NiCl <sub>2</sub>

38°	59°	78°	96°
41.9	45.0	46.6	46.7% NiCl <sub>2</sub>

(Étard, A. ch. 1894, (7) 2, 539.)

Solubility of NiCl<sub>2</sub>+6H<sub>2</sub>O=37.53% NiCl<sub>2</sub> at 25°. (Foote, J. Am. Chem. Soc. 1912, 34, 882.)

100 pts. absolute alcohol dissolve at room temperature 53.71 pts. NiCl<sub>2</sub>+6H<sub>2</sub>O. (Bödtker, Z. phys. Ch. 1897, 22, 511.)

+7H<sub>2</sub>O. 100 g absolute alcohol dissolve 2.16 g NiCl<sub>2</sub>·7H<sub>2</sub>O at 17° and 1.4 g. at 3°. (de Bruyn, R. C. a. 1892, 11, 156)

**Nickel hydrogen chloride**, 3NiCl<sub>2</sub>·2HCl+11H<sub>2</sub>O  
(Rietzenstein, Z. anorg. 1898, 18, 270)

**Nickel rubidium chloride**, NiCl<sub>2</sub>·2RbCl  
Easily sol. in H<sub>2</sub>O and HCl+Ag (Godefroy, B. 8, 9)

**Nickel thallic chloride**, NiCl<sub>2</sub>·2TlCl<sub>3</sub>+8H<sub>2</sub>O  
Deliquescent. Can be cryst. from H<sub>2</sub>O (Gewecke, A. 1909, 366, 221)

**Nickel tin (stannous) chloride**, NiCl<sub>2</sub>·SnCl<sub>2</sub>+6H<sub>2</sub>O  
Sol. in H<sub>2</sub>O (Jorgensen)

**Nickel tin (stannic) chloride.**  
See Chlorostannate, nickel.

**Nickel chloride ammonia**, NiCl<sub>2</sub>·2NH<sub>3</sub>  
Sol. in H<sub>2</sub>O, decomp. on boiling, insol. in alcohol

NiCl<sub>2</sub>·3NH<sub>3</sub>+3H<sub>2</sub>O (André, C. R. 1888, 106, 937)

NiCl<sub>2</sub>·6NH<sub>3</sub>. Sol. in cold H<sub>2</sub>O without decomp. Insol. in alcohol. Very sl. sol. in conc. NH<sub>4</sub>OH+Ag

Neu. insol. in a sat. solution of NH<sub>4</sub>Cl in NH<sub>4</sub>OH+Ag (Sorensen, Z. anorg. 1894, 5, 363)

**Nickel chloride cupric oxide**, NiCl<sub>2</sub>·3CuO+H<sub>2</sub>O

Not decomp. by H<sub>2</sub>O (Muller, A. ch. 1902, (7) 27, 377)

**Nickel chloride hydrazine**, NiCl<sub>2</sub>·2N<sub>2</sub>H<sub>4</sub>

Sol. in dil. acids and NH<sub>3</sub>+Ag. (Frumzen, Z. anorg. 1908, 60, 262)

NiCl<sub>2</sub>·3N<sub>2</sub>H<sub>4</sub>. Sol. in dil. acids (F)

**Nickel fluoride**, NiF<sub>2</sub>.

Sol. in about 5000 pts. H<sub>2</sub>O; insol. in alcohol and ether. Not attacked by HCl, HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub> even when hot (Poulenc, C. R. 114, 1426)

Insol. in liquid NH<sub>3</sub> (Gore, Am. Ch. J. 1898, 20, 828)

+2H<sub>2</sub>O. Decomp. by pure H<sub>2</sub>O. Sol. in H<sub>2</sub>O acidulated with HF. (Berzelius)

+3H<sub>2</sub>O (Clarke, Sil. Am. J. (3) 13, 291)

**Nickel hydrogen fluoride**, NiF<sub>2</sub>·5HF+6H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O and dil. acids. Sol. in NH<sub>4</sub>OH+Ag with decomp. (Bohm, Z. anorg. 1905, 43, 340)

**Nickel potassium fluoride**, NiF<sub>2</sub>·KF.

+H<sub>2</sub>O. Sol. in H<sub>2</sub>O (Wagner, B. 19, 896)

NiF<sub>2</sub>·2KF. Sl. sol. in H<sub>2</sub>O. Scarcely sol. in methyl or ethyl alcohol or benzene. (Poulenc, C. R. 114, 747)

**Nickel potassium zirconium fluoride.**

See Fluozirconate, nickel potassium.

**Nickel manganic fluoride.**

See Fluomanganate, nickel.

**Nickel sodium fluoride**, NiF<sub>2</sub>·NaF+H<sub>2</sub>O.

Sol. in H<sub>2</sub>O (Wagner, B. 19, 896)

**Nickel stannic fluoride.**

See Fluostannate, nickel.

**Nickel titanium fluoride.**

See Fluotitanate, nickel.

**Nickel tungstic fluoride.**

See Fluoxytungstate, nickel.

**Nickel vanadium fluoride.**

See Fluovanadate, nickel.

**Nickel zirconium fluoride.**

See Fluozirconate, nickel.

**Nickel fluoride ammonia**, 5NiF<sub>2</sub>·6NH<sub>3</sub>+8H<sub>2</sub>O

Insol. in cold H<sub>2</sub>O. Decomp. by hot H<sub>2</sub>O. Easily sol. in dil. acids. (Bohm, Z. anorg. 1905, 43, 341)

**Nickelous hydroxide**, 4NiO<sub>2</sub>·H<sub>2</sub>O.

Very sl. sol. in H<sub>2</sub>O. Sol. in acids. Insol. in KOH or NaOH+Ag. Somewhat difficultly sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> or NH<sub>4</sub>OH+Ag, but easily sol. in presence of NH<sub>4</sub> salts. Sol. in NH<sub>3</sub> salts+Ag. Sol. in KCN+Ag (Rodgers, 1834.)

Sol. in boiling NH<sub>4</sub>Cl+Ag

NiO<sub>2</sub>·H<sub>2</sub>O

Solubility in NH<sub>4</sub>OH+Ag at 25°

NH <sub>3</sub> norm.	G. Ni ps. l.	G. NiO <sub>2</sub> ·H <sub>2</sub> O per l.
1	0.081	0.00287
2	0.170	0.00579
3	0.257	0.00875
4	0.360	0.01227
4.911	2.580	0.0879
3.900	1.780	0.0607
2.101	0.835	0.0284
0.602	0.158	0.0054

The non-agreement of the results is due to the formation of different modifications of NiO<sub>2</sub>·H<sub>2</sub>O.

(Bonsdorff, Z. anorg. 1904, 41, 185)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$   
 Conc. of  $\text{Ni} = 0.014\text{N}$  in  $1\text{N } \text{NH}_4\text{OH} + \text{Aq}$   
 " " " "  $= 0.036\text{N}$  "  $2\text{N } \text{NH}_4\text{OH} + \text{Aq}$   
 (Starek, B 1903, 38, 3840.)  
 Sol in hot  $\text{NH}_4\text{F} + \text{Aq}$ . (von Helmholt, Z anorg 1893, 3, 133.)  
 Insol in methyl or amyl amine. (Wurtz.)  
 Not pptd in presence of Na citrate (Spiller.)

Not pptd in presence of a large number of non-volatile organic substances, particularly  $\text{H}_2\text{C}_4\text{H}_6\text{O}_6$  (Rose.)

#### Nickelomelic hydroxide, $\text{Ni}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ .

Sol. in acids, insol in  $\text{H}_2\text{O}$  and alkalies (Dudley, J Am Chem. Soc. 1896, 18, 901)

#### Nickelic hydroxide, $\text{Ni}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ (?).

(Wernicke, Pogg 141, 122)  
 $\text{Ni}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$  (?). Sol in acids as nickelous salts. Not attacked by boiling  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ . Slowly sol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$   
 Sol in  $\text{NH}_4\text{OH}$ , and  $\text{NH}_4$  salts +  $\text{Aq}$  (Odling)

#### Nickel iodide, $\text{NiI}_2$

Deliquescent and sol. in  $\text{H}_2\text{O}$ . (Eidmann, J pr 7 254)

Sat.  $\text{NiI}_2 + \text{Aq}$  contains at

$-23^\circ$	$-6^\circ$	$+11^\circ$	$16^\circ$
51.8	54.3	57.8	59.0% $\text{NiI}_2$

$43^\circ$	$80^\circ$	$85^\circ$	$90^\circ$
64.1	65.0	65.2	65.7% $\text{NiI}_2$

(Etard, A. ch 1894, (7) 2, 546)

+  $6\text{H}_2\text{O}$  Deliquescent Easily sol. in  $\text{H}_2\text{O}$  (Eidmann)

#### Nickel iodide ammonia, $\text{NiI}_2 \cdot 4\text{NH}_3$

(Rummeisberg, Pogg 48, 119.)  
 $\text{NiI}_2 \cdot 6\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  Sol in warm dil  $\text{NH}_4\text{OH} + \text{Aq}$ . Very sl sol in conc  $\text{NH}_4\text{OH} + \text{Aq}$ . (Eidmann)

#### Nickel iodide hydrazine, $\text{NiI}_2(\text{N}_2\text{H}_4)_2$

Insol in  $\text{H}_2\text{O}$  Sol in acids (Franzen, Z anorg 1911, 70, 150)

#### Nickel sulfoxide, $\text{Ni}_2\text{O}_3 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ , also in  $\text{KCN} + \text{Aq}$  (Moore, C. N 1895, 71, 81.)

#### Nickelous oxide, $\text{NiO}$

Insol in  $\text{H}_2\text{O}$  Sol. in conc. acids, except when crystalline, when it is scarcely attacked by acids (Ebelmen, C R 33 256.)

Very sl sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$  (De-marcay)

Very slowly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol in  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq}$ .

Sol in min acids, especially  $\text{HCl} + \text{Aq}$ , when warmed; insol in  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{NH}_4\text{Cl}$ ,

and  $\text{NH}_4\text{SCN} + \text{Aq}$ . Insol in conc  $\text{NaOH} + \text{Aq}$  (Zimmerman, A 232, 324)

1 l solution containing 418.6 g. sugar and 34.3 g.  $\text{CaO}$  dissolves 0.29 g.  $\text{NiO}$ . (Boden-bender, J B 1865, 600.)

Min Bunsenite

#### Nickelomelic oxide, $\text{Ni}_2\text{O}_4$

Sol in acids (Bauhigny, C. R 87, 1082.) +  $2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , and in alkalies +  $\text{Aq}$ . Sol in acids. (Dudley, J. Am Chem Soc 1896, 18, 901.)

$6\text{NiO}$ ,  $\text{Ni}_2\text{O}_3 + \text{H}_2\text{O}$ . (Schonbein, J. pr 93, 35)

#### Nickelic oxide, $\text{Ni}_2\text{O}_3$

Sol in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq}$  with decomp., also in  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Winkelblech, A. 13, 259)

#### Nickel peroxide, $\text{Ni}_2\text{O}_4$ (?)

(Bayley, C N 39, 81)  
 Correct composition is  $\text{Ni}_2\text{O}_4$ . (Carnot, C R. 108 610)

$\text{Ni}_2\text{O}_7$  (?). (Wicke, Zeit Ch. 1865, 303)

$\text{NiO}_4$ . (Holland, C. R. 1903, 136, 230)

#### Nickel oxychloride.

Sl sol. in  $\text{H}_2\text{O}$ . (Berzelius)

$\text{NiCl}_2$ ,  $8\text{NiO} + 13\text{H}_2\text{O}$ . (Raoult, C. R. 69, 826)

#### Nickel oxyiodide, $\text{NiI}_2 \cdot 9\text{NiO} + 15\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3 + \text{Aq}$  or acetic acid Insol in  $\text{NH}_4\text{OH} + \text{Aq}$ . Alcohol dissolves out  $\text{NiI}_2$ . (Eidmann.)

#### Nickel oxyselenide.

Almost insol in boiling  $\text{HCl}$ ; decomp by  $\text{HNO}_3$ . (Fonzen-Diacon, C. R. 1900, 131, 557.)

#### Nickel phosphide, $\text{Ni}_3\text{P}$

Sol in  $\text{HNO}_3 + \text{Aq}$  and aqua regia, insol. in  $\text{HCl} + \text{Aq}$ . (Struve, J. pr 79, 321)

Sol in aqua regia and in  $\text{HNO}_3$ , sol. in fused alkali (Granger, Bull Soc. 1896, (3) 15, 1089)

Easily sol in  $\text{HNO}_3$ . (Granger, C N 1898, 77, 229.)

When prepared by heating phosphorus, copper and nickel in electric furnace, is insol in all acids except a mixture of  $\text{HNO}_3$  and  $\text{HCl}$  (Maronneau, C R 1900, 130, 657)

$\text{NiP}_2$  Sol in  $\text{HNO}_3$ ; decomp. by fused  $\text{NaOH}$  (Johbus, C R 1910, 150, 107.)

$\text{NiP}_3$  Sol in  $\text{HNO}_3$ , decomp by fused  $\text{NaOH}$  (J.)

$\text{Ni}_2\text{P}_2$  Insol in  $\text{HNO}_3$ ,  $\text{HCl}$  and aqua regia. stable in the air even when heated (Granger, Bull. Soc. 1896, (3) 15, 1086)

$\text{Ni}_3\text{P}_2$  Not attacked by  $\text{HCl}$ . Easily attacked by  $\text{HNO}_3$ . (Rose, Pogg. 1832, 24, 232)

$\text{Ni}_3\text{P}_2$ . Sol. in  $\text{HNO}_3$ , aqua regia and in fused alkali. (Granger, C. R. 1896, 123. 177.)

#### Nickel phosphosulphide, $\text{Ni}_3\text{P}_2\text{S}_2$

Decomp. by hot  $\text{H}_2\text{O}$  or by aqua regia. Sl. attacked by  $\text{HNO}_3$ . (Ferrand, A. ch. 1899, (7) 17. 417.)

#### Nickel semiselenide, $\text{Ni}_3\text{Se}$ .

Almost insol. in boiling  $\text{HCl}$ , decomp. by  $\text{HNO}_3$ . (Fonze-Ducon, C. R. 1900, 131. 557.)

#### Nickel selenide, $\text{NiSe}$

Insol. in  $\text{H}_2\text{O}$ , dil. or cone.  $\text{HCl} + \text{Aq}$ ; slowly sol. in  $\text{HNO}_3 + \text{Aq}$ ; easily in aqua regia (Little, A. 112. 211.)

Almost insol. in boiling  $\text{HCl}$ , decomp. by  $\text{HNO}_3$ . (Fonze-Ducon, C. R. 1900, 131. 557.)

$\text{NiSe}_2$ . (Fonze-Ducon.)

$\text{Ni}_2\text{Se}_3$  } Almost insol. in boiling  $\text{HCl}$ ;  
 $\text{Ni}_3\text{Se}_4$  } decomp. by  $\text{HNO}_3$  (Fonze-Ducon.)

#### Nickel silicide, $\text{Ni}_3\text{Si}$ .

Sol. in  $\text{HF}$  and aqua regia, insol. in cold  $\text{H}_2\text{O}$ , decomp. by steam at red heat, sol. in fused alkali carbonates. (Vigouroux, C. R. 1895, 121. 687.)

#### Nickel semisulphide, $\text{Ni}_3\text{S}$ .

Sol. in  $\text{HNO}_3 + \text{Aq}$ , with residue of  $\text{S}$ . Difficultly sol. in cone.  $\text{HCl} + \text{Aq}$ ; insol. in dil.  $\text{HCl} + \text{Aq}$ . (Arfvedson, Pogg. 1. 65; Gautier, C. R. 108. 1111.)

Does not exist. (Bornemann, C. A. 1908. 1680.)

#### Nickel monosulphide, $\text{NiS}$ .

Anhydrous. Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$  or aqua regia.

Min. *Mellerite*.

$+x\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ , but decomp. by  $\text{H}_2\text{O}$  in contact with the air (Clermont and Guilot, C. R. 84. 714), or by boiling with  $\text{H}_2\text{O}$  (Geitner, A. 139. 354.)

When pptd. with  $(\text{NH}_4)_2\text{S}$ , is somewhat sol. in  $\text{H}_2\text{O}$ . 1 l.  $\text{H}_2\text{O}$  dissolves  $39.87 \times 10^{-6}$  moles  $\text{NiS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 68. 294.)

Very sl. sol. in dil.  $\text{HCl} + \text{Aq}$ , and still less in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Fresenius.)

More sol. in  $\text{HNO}_3 + \text{Aq}$ , and easily in aqua regia.

Somewhat sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  or solutions of alkali sulphides. Insol. in  $\text{NH}_4\text{SH} + \text{Aq}$  (Fresenius.)

Sol. at moment of formation in  $\text{Na}_2\text{S}$  but not in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Vilhers, C. R. 1894, 119. 1264.)

Sol. while yet moist in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Berthier.)

When recently pptd., sol. in  $\text{KCN} + \text{Aq}$  (Haudlen.)

Pptd. in presence of non-volatile organic substances as tartaric acid, etc. (Rose.)

Sol. in potassium thiocarbonate +  $\text{Aq}$  (Rosenbladt, Z. anal. 26. 15.)

Exists in a colloidal form in a very dil. solution (Winnings, Bull. Soc. (2) 49. 452.)

$\alpha$  modification.

Very sol. in  $2\text{N-HCl} + \text{Aq}$  sat. with  $\text{H}_2\text{S}$ .

$\beta$  modification.

0.033 g. is sol. in 1 l.  $2\text{N-HCl} + \text{Aq}$  sat.

with  $\text{H}_2\text{S}$ ; very sol. in  $2\text{N-HCl} + \text{Aq}$ .

$\gamma$  modification.

Insol. in  $2\text{N-HCl} + \text{Aq}$  sat. with  $\text{H}_2\text{S}$ . 0.013 g. is sol. in  $2\text{N-HCl} + \text{Aq}$ . (Thuel, C. C. 1914, I 19.)

#### Nickel sulphide, $\text{Ni}_3\text{S}_2$

(Bornemann, C. A. 1908. 1686.)

$\text{Ni}_2\text{S}_4$ . (Bornemann.)

$\text{Ni}_3\text{S}_4$ . (Bornemann.)

$\text{Ni}_4\text{S}_5$  Min. *Polydymite*. Insol. in  $\text{HCl} + \text{Aq}$ .

Sol. in  $\text{HNO}_3 + \text{Aq}$  with separation of  $\text{S}$ .  $\text{Ni}_3\text{S}_7$  Min. *Beyrichite* Sol. in  $\text{HCl} + \text{Aq}$

#### Nickel disulphide, $\text{NiS}_2$ .

(Fellenberg, Pogg. 50. 75.)

Does not exist. (Bellucci, C. A. 1909. 293.)

#### Nickel potassium sulphide, $3\text{NiS}$ , $\text{K}_2\text{S}$

Insol. in  $\text{H}_2\text{O}$  (Schneider, J. pr. (2) 9. 209.)

$\text{K}_2\text{Ni}_3\text{S}_{10}$  Not attacked by hot  $(\text{NH}_4)_2\text{S}$ ; slowly attacked by  $\text{HCl}$  or cold aqua regia; quickly by hot aqua regia.  $\text{HF}$  and  $\text{H}_2\text{SO}_4$  dissolve only on heating. Insol. in organic acids, alkalis and 12%  $\text{HCl}$ , also in  $\text{KCN}$ ,  $\text{AgNO}_3$  or  $\text{CuSO}_4 + \text{Aq}$ . (Milbauer, Z. anorg. 1904, 42. 447.)

#### Nickel telluride, $\text{Ni}_3\text{Te}_2$

Min. *Melonite*. Sol. in  $\text{HNO}_3 + \text{Aq}$

$\text{NiTe}$  (Fabre, C. R. 105. 277.)

#### Nickelicotungstic acid.

Ammonium nickelicotungstate,  $2(\text{NH}_4)_2\text{O}$ ,  $2\text{Ni}_2\text{O}_3$ ,  $8\text{WO}_3 + 14\text{H}_2\text{O}$ .

(Rogers and Smith, J. Am. Chem. Soc. 1904, 26. 1476.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{Ni}_2\text{O}_3$ ,  $16\text{WO}_3 + 22\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$  (Rogers and Smith.)

Barium nickelicotungstate,  $10\text{BaO}$ ,  $\text{Ni}_2\text{O}_3$ ,  $16\text{WO}_3$ .

Ppt. Very insol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

#### Nickelimolybdic acid.

Barium nickelimolybdate,  $3\text{BaO}$ ,  $\text{NiO}_3$ ,  $9\text{MoO}_3 + 12\text{H}_2\text{O}$ .

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 702.)

Potassium nickelomolybdate,  $3K_2O, NiO_3, 9MoO_3 + 6\frac{1}{2}H_2O$

Very insol. even in hot  $H_2O$ . (Hall.)

### Nickelomolybdic acid.

Ammonium hydrogen nickelomolybdate,  $(NH_4)_4H_4[Ni(MoO_4)_4] + 5H_2O$

Sl. sol. in  $H_2O$ , easily in dil. acids (Barbieri, C. A. 1916. 897)

Barium hydrogen nickelomolybdate,  $Ba_4H_4[Ni(MoO_4)_4] + 10H_2O$ .

Ppt. (Barbieri)

Potassium hydrogen nickelomolybdate,  $K_4H_4[Ni(MoO_4)_4] + 5H_2O$ .

Sl. sol. in  $H_2O$ , easily in acids (Barbieri.)

Silver hydrogen nickelomolybdate,  $Ag_4H_4[Ni(MoO_4)_4] + 3H_2O$ .

Insol. in  $H_2O$ ; sol. in  $NH_4OH$ , or  $HNO_3 + Aq$ . (Barbieri)

### Nickelonickelous acid.

Potassium nickelonickelite,  $K_2Ni_2O_4$  or  $K_2O, NiO, NiO_2$ .

(Hofmann and Hiendlmaier. B. 1906, 39. 3188.)

Sodium nickelonickelite,  $Na_2Ni_2O_4 = Na_2O, NiO, 2NiO_2$ .

(Bellucci and Rubegni, C. C. 1907, I. 794)

### Nickelous acid.

Barium *nickelite*,  $BaO, 2NiO_2$ .

Unstable; decomp. by cold  $H_2O$ ; slowly and very rapidly by hot  $H_2O$  (Dufau, C. R. 1896, 123. 498.)

### Niobium, Nb.

For niobium and its compounds, see columbium, Cb, and the corresponding compounds

### Nitramide, $NH_2NO_2$ .

Decomp. by conc.  $H_2SO_4$ . Easily sol. in  $H_2O$ , alcohol, ether and acetone. Less sol. in benzol. Almost insol. in ligroin. (Thiele and Lachman, A. 1895, 288. 297.)

Sol. in ether, insol. in petroleum ether. Very unstable; decomp. by hot  $H_2O$ . (Thiele and Lachman, B. 1894, 27. 1909.)

### Nitratochloroplatinamine comps.

See Chloronitratoptatinamine comps.

### Nitrato cobalt octamine comps.

See Nitratooctamine cobaltic comps.

### Nitratooctamine cobaltic carbonate,

$(NO_2)_2Co_2(NH_3)_8(CO_3)_2 + H_2O$ .

Less sol. than other octamine carbonates. (Vortmann and Blasberg, B. 22. 2650.)

— chloride,  $(NO_2)_2Co_2(NH_3)_8Cl_4 + 4H_2O$ . (Vortmann and Blasberg, B. 22. 2652)

— iodide,  $(NO_2)_2Co_2(NH_3)_8I_4 + 2H_2O$ . (Vortmann and Blasberg.)

— nitrate.

See Octamine cobaltic nitrate.

— sulphate,  $(NO_2)_2Co_2(NH_3)_8(SO_4)_2 + 2H_2O + 4H_2O$ . (Vortmann and Blasberg, B. 22. 2652)

### Nitratoptatinamine nitrate,

$(NO_2)_2Pt(NH_3NO_2)_2$

Sl. sol. in cold, more easily in hot  $H_2O$ ; easily sol. in dil.  $HNO_3 + Aq$  (Cleve.)

— nitrite,  $(NO_2)_2Pt(NH_3NO_2)_2$ .

Easily sol. in  $H_2O$ . (Cleve)

### Nitratoptatindiamine chloride,

$(NO_2)_2Pt(N_2H_5Cl)_2 + H_2O$

Moderately sol. in cold, very easily in hot  $H_2O$ .

— chloroplatinate,  $(NO_2)_2Pt(N_2H_5Cl)_2, PtCl_4 + 2H_2O$ .

Ppt.

— chromate,  $(NO_2)_2Pt(N_2H_5)_2CrO_4$ .

Nearly insol. in  $H_2O$  (Cleve.)

— dichromate,  $(NO_2)_2Pt(N_2H_5)_2Cr_2O_7$

Sl. sol. in  $H_2O$ .

— nitrate,  $(NO_2)_2Pt(N_2H_5NO_2)_2$ .

Sol. in  $H_2O$ . Insol. in  $HNO_3 + Aq$ .

— phosphate,  $NO_2Pt(N_2H_5)_2 + H_2O$ .



Very sl. sol. in  $H_2O$  (Cleve.)

### Nitratoptatindiamine nitrate,

$(NO_2)_2Pt_2(N_2H_5)_4(NO_2)_4$ .

Sol. in  $H_2O$  with decomp.

### Nitratopurpureocobaltic bromide,

$Co(NO_2)(NH_3)_5Br_2$ .

Resembles the chloride in its properties. (Jorgensen, J. pr (2) 23. 227.)

**Nitratopurpureocobaltic carbonate,**  
 $\text{Co}(\text{NO}_3)(\text{NH}_3)_4(\text{CO}_3) + \text{H}_2\text{O}.$ 

Less sol. in  $\text{H}_2\text{O}$  than other purpureocarbonates. (Vortmann and Blasberg, B 22, 2648.)

— chloride,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{Cl}_2$ 

Sl sol in cold  $\text{H}_2\text{O}$ , but more than nitrate, more easily sol. in hot  $\text{H}_2\text{O}$ , but is converted into roseo salt. Insol in  $\text{HCl} + \text{Aq}$  or alcohol. (Jørgensen, J. pr. (2) 23, 227.)

— mercuric chloride,  
 $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{Cl}_2, \text{HgCl}_2$ 

Not wholly insol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

— chloroplatinate,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{Cl}_2,$   
 $\text{PtCl}_4$ 

Ppt. Nearly insol. in cold  $\text{H}_2\text{O}$  (Jørgensen.)

— chromate,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{CrO}_4$ 

Nearly insol. in  $\text{H}_2\text{O}$  (Jørgensen.)

## — dichromate.

Sl. sol. in  $\text{H}_2\text{O}$ , but more easily than the neutral salt. (Jørgensen.)

— dithionate,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{S}_2\text{O}_6$ 

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$  (Jørgensen.)

— nitrate,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5(\text{NO}_3)_2$ 

Sol. in 273 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . Much more sol. in hot  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$  (Jørgensen, J. pr. (2) 23, 227.)

— cobaltic nitrite,  $3\text{Co}(\text{NO}_3)(\text{NH}_3)_5,$   
 $2\text{Co}(\text{NO}_2)_6 + 2\text{H}_2\text{O}.$ 

Very sl. sol. in  $\text{H}_2\text{O}$  (Jørgensen, Z anorg 5, 176.)

— diamine cobaltic nitrite,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_4,$   
 $(\text{NO}_2)_2, \text{Co}(\text{NH}_3)_2$ 

Ppt. (Jørgensen.)

— oxalate,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_4\text{C}_2\text{O}_4.$ 

Ppt.

— sulphate,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{SO}_4 + \text{H}_2\text{O}$ 

Rather difficultly sol. in cold  $\text{H}_2\text{O}$  (Jørgensen.)

**Nitratopurpureorhodium chloride,**  
 $(\text{NO}_3)\text{Rh}(\text{NH}_3)_5\text{Cl}_2.$ 

Sl sol. in cold  $\text{H}_2\text{O}$ , but more easily than the nitrate. (Jørgensen, J. pr. (2) 34, 394.)

— dithionate,  $(\text{NO}_3)\text{Rh}(\text{NH}_3)_5\text{S}_2\text{O}_6 + \text{H}_2\text{O}.$ 

Nearly insol. in cold  $\text{H}_2\text{O}$ . (Jørgensen.)

**Nitratopurpureorhodium nitrate,**  
 $(\text{NO}_3)\text{Rh}(\text{NH}_3)_5(\text{NO}_3)_2.$ 

Very sl sol in cold  $\text{H}_2\text{O}$ . Insol. in alcohol. (Jørgensen.)

**Nitric acid,  $\text{HNO}_3$** 

Miscible with  $\text{H}_2\text{O}$ . When  $\text{HNO}_3 + \text{Aq}$  is distilled at 760 mm. pressure, an acid containing 68%  $\text{HNO}_3$  is formed, which boils at  $120.5^\circ$  under 735 mm. pressure. By distilling at 150 mm. pressure the acid contains 67.6%  $\text{HNO}_3$ ; at 70 mm. (b.-pt.  $65-70^\circ$ ) the acid contains 66.7%  $\text{HNO}_3$ . The percentage of  $\text{HNO}_3$  in the liquid obtained by passing dry air into  $\text{HNO}_3 + \text{Aq}$  containing 64-68%  $\text{HNO}_3$  varies with the temp., the higher the temp. the greater the percentage of  $\text{HNO}_3$ . (Roscoe, Chem Soc. 13, 150.)

$\text{HNO}_3 + \text{Aq}$ of 1	51	sp. gr.	contains	07%	$\text{N}_2\text{O}_5$
"	1.42	"	"	51	"
"	1.35	"	"	44	4
"	1.315	"	"	38	6

(Dalton)

$\text{HNO}_3 + \text{Aq}$ of 1	52	sp. gr.	contains	58	82%	$\text{N}_2\text{O}_5$
"	1.322	"	"	80	17	"
"	1.1	"	"	11	"	"

(Mitscherlich)

$\text{HNO}_3 + \text{Aq}$  of 1.298 sp. gr. contains 80.75%  $\text{N}_2\text{O}_5$  (Kirman)

$\text{HNO}_3 + \text{Aq}$  of 1.298 sp. gr. contains 18% (Davvy.)

$\text{HNO}_3 + \text{Aq}$  of 1.298 sp. gr. contains 32-33% (Berthollet)

For Ure's table of sp. gr. of  $\text{HNO}_3 + \text{Aq}$ , see Watt's Diet. 1st ed.

Sp. gr. of  $\text{HNO}_3 + \text{Aq}$  at  $0^\circ$  and  $15^\circ$ .

$\text{HNO}_3$	% $\text{N}_2\text{O}_5$	Sp. gr. at $0^\circ$	Sp. gr. at $15^\circ$
100 00	85 71	1 559	1 530
99 84	85 57	1 559	1 530
99 72	85 47	1 558	1 530
99 52	85 30	1 557	1 529
97 89	83 90	1 551	1 523
97 00	83 14	1 548	1 520
96 00	82 28	1 544	1 516
95 27	81 06	1 542	1 514
94 00	80 57	1 537	1 509
93 01	79 72	1 533	1 506
92 00	78 85	1 529	1 503
91 00	78 00	1 526	1 499
90 00	77 15	1 522	1 495
89 56	76 77	1 521	1 494
88 00	75 43	1 514	1 488
87 45	74 95	1 513	1 486
86 17	73 86	1 507	1 482
85 00	72 86	1 503	1 478
84 00	72 00	1 499	1 474
83 00	71 14	1 495	1 470
82 00	70 28	1 492	1 467
80 96	69 39	1 488	1 463
80 00	68 77	1 484	1 460
79 00	67 71	1 481	1 456
77 66	66 56	1 476	1 451
76 00	65 14	1 469	1 445
75 00	64 28	1 465	1 442
74 01	63 44	1 462	1 438

Sp. gr. of  $\text{HNO}_3$ , etc.—Continued.

$\% \text{HNO}_3$	$\% \text{N}_2\text{O}_5$	Sp. gr. at 0°	Sp. gr. at 15°
73.00	62.57	1.157	1.435
72.39	62.05	1.455	1.432
71.24	61.06	1.450	1.429
69.96	60.00	1.444	1.423
69.20	59.31	1.441	1.419
68.00	58.29	1.435	1.414
67.00	57.43	1.430	1.410
66.00	56.57	1.425	1.405
65.07	55.77	1.420	1.400
64.00	54.84	1.415	1.395
63.59	54.50	1.413	1.393
62.00	53.14	1.404	1.386
61.21	52.46	1.400	1.381
60.00	51.43	1.393	1.374
59.59	51.08	1.391	1.372
58.88	50.47	1.387	1.368
58.00	49.71	1.382	1.363
57.00	48.86	1.376	1.358
56.10	48.08	1.371	1.353
55.00	47.14	1.365	1.346
54.00	46.29	1.359	1.341
53.81	46.12	1.358	1.339
53.00	45.40	1.353	1.335
52.33	44.85	1.349	1.331
50.99	43.70	1.341	1.323
49.97	42.83	1.334	1.317
49.00	42.00	1.328	1.312
48.00	41.14	1.321	1.307
47.18	40.44	1.315	1.308
46.64	39.97	1.312	1.295
45.00	38.57	1.300	1.284
43.53	37.31	1.291	1.274
42.00	36.00	1.280	1.264
41.00	35.14	1.274	1.257
40.00	34.28	1.267	1.251
39.00	33.43	1.260	1.244
37.95	32.53	1.253	1.237
36.00	30.86	1.240	1.225
35.00	29.99	1.234	1.218
33.86	29.02	1.226	1.211
32.00	27.43	1.214	1.198
31.00	26.57	1.207	1.192
30.00	25.71	1.200	1.185
29.00	24.85	1.194	1.179
28.00	24.00	1.187	1.172
27.00	23.14	1.180	1.166
25.71	22.04	1.171	1.157
23.00	19.71	1.153	1.138
20.00	17.14	1.132	1.120
17.47	14.97	1.115	1.105
15.00	12.85	1.099	1.089
13.00	11.14	1.085	1.077
11.41	9.77	1.075	1.067
7.72	6.62	1.050	1.045
4.00	3.42	1.026	1.022
2.00	1.71	1.013	1.010
0.00	0.00	1.000	0.999

(Kolb, A. ch. (4) 10. 140.)

Sp. gr. of  $\text{HNO}_3 + \text{Aq}$  at 15°.  $a = \% \text{O}_2$ ;  $b = \text{sp. gr. if } \% \text{ is } \text{N}_2\text{O}_5$ ;  $c = \text{sp. gr. if } \% \text{ is } \text{HNO}_3$ .

a	b	c	a	b	c
1	1.007	1.006	51	1.372	1.323
2	1.014	1.012	52	1.378	1.329
3	1.021	1.018	53	1.385	1.335
4	1.027	1.024	54	1.390	1.341
5	1.034	1.029	55	1.396	1.346
6	1.040	1.035	56	1.401	1.356
7	1.047	1.040	57	1.407	1.358
8	1.053	1.045	58	1.413	1.363
9	1.061	1.051	59	1.418	1.369
10	1.069	1.057	60	1.423	1.374
11	1.076	1.064	61	1.427	1.380
12	1.083	1.070	62	1.432	1.386
13	1.091	1.077	63	1.436	1.390
14	1.098	1.083	64	1.440	1.395
15	1.104	1.089	65	1.445	1.400
16	1.112	1.095	66	1.449	1.405
17	1.120	1.100	67	1.452	1.410
18	1.126	1.106	68	1.457	1.414
19	1.134	1.112	69	1.461	1.419
20	1.141	1.120	70	1.466	1.422
21	1.149	1.126	71	1.470	1.427
22	1.156	1.132	72	1.474	1.430
23	1.165	1.138	73	1.478	1.435
24	1.172	1.145	74	1.482	1.439
25	1.180	1.151	75	1.486	1.442
26	1.187	1.159	76	1.490	1.445
27	1.195	1.166	77	1.494	1.449
28	1.202	1.172	78	1.499	1.452
29	1.211	1.179	79	1.503	1.456
30	1.218	1.185	80	1.507	1.460
31	1.225	1.192	81	1.511	1.463
32	1.232	1.198	82	1.515	1.467
33	1.240	1.204	83	1.519	1.470
34	1.248	1.210	84	1.523	1.474
35	1.255	1.218	85	1.527	1.478
36	1.264	1.225	86	1.530	1.481
37	1.271	1.230	87		1.484
38	1.280	1.236	88		1.488
39	1.286	1.244	89		1.491
40	1.295	1.251	90		1.495
41	1.304	1.257	91		1.499
42	1.312	1.264	92		1.503
43	1.318	1.270	93		1.506
44	1.325	1.276	94		1.509
45	1.332	1.284	95		1.512
46	1.340	1.290	96		1.516
47	1.346	1.298	97		1.520
48	1.352	1.304	98		1.523
49	1.360	1.312	99		1.526
50	1.366	1.316	100		1.530

(Kolb, calculated by Gerlach, Z. anal. 8. 292.)

Sp. gr. of  $\text{HNO}_3 + \text{Aq}$  at 17.5°.

$\% \text{N}_2\text{O}_5$	Sp. gr.	$\% \text{N}_2\text{O}_5$	Sp. gr.	$\% \text{N}_2\text{O}_5$	Sp. gr.
5	1.032	9	1.060	13	1.089
6	1.038	10	1.068	14	1.096
7	1.045	11	1.075	15	1.104
8	1.053	12	1.082	16	1.111

Sp. gr. of $\text{HNO}_3$ , etc.—Continued.						Most accurate table.			
$\% \text{N}_2\text{O}_5$	Sp. gr.	$\% \text{N}_2\text{O}_5$	Sp. gr.	$\% \text{N}_2\text{O}_5$	Sp. gr.	Sp. gr. of $\text{HNO}_3 + \text{Aq}$ at $15^\circ$ ; $\text{H}_2\text{O}$ at $d^\circ = 1$ .			
						Sp. gr.	$\% \text{N}_2\text{O}_5$	$\% \text{HNO}_3$	Kg. $\text{HNO}_3$ in 1 l.
17	1.118	40	1.294	63	1.434	1.000	0.08	0.10	0.001
18	1.125	41	1.301	64	1.438	1.005	0.85	1.00	0.010
19	1.132	42	1.308	65	1.442	1.010	1.62	1.90	0.019
20	1.140	43	1.315	66	1.447	1.015	2.39	2.80	0.028
21	1.147	44	1.323	67	1.451	1.020	3.17	3.70	0.038
22	1.155	45	1.330	68	1.456	1.025	3.94	4.60	0.047
23	1.163	46	1.338	69	1.460	1.030	4.71	5.50	0.057
24	1.170	47	1.345	70	1.465	1.035	5.47	6.38	0.066
25	1.178	48	1.352	71	1.469	1.040	6.22	7.26	0.075
26	1.186	49	1.358	72	1.472	1.045	6.97	8.13	0.085
27	1.194	50	1.364	73	1.476	1.050	7.71	8.99	0.094
28	1.201	51	1.371	74	1.480	1.055	8.43	9.84	0.104
29	1.209	52	1.377	75	1.484	1.060	9.15	10.68	0.113
30	1.217	53	1.383	76	1.488	1.065	9.87	11.51	0.123
31	1.224	54	1.389	77	1.492	1.070	10.57	12.33	0.132
32	1.232	55	1.394	78	1.496	1.075	11.27	13.15	0.141
33	1.239	56	1.400	79	1.500	1.080	11.96	13.95	0.151
34	1.247	57	1.406	80	1.504	1.085	12.64	14.74	0.160
35	1.255	58	1.413	81	1.508	1.090	13.31	15.53	0.169
36	1.263	59	1.416	82	1.512	1.095	13.99	16.32	0.179
37	1.271	60	1.421	83	1.516	1.100	14.67	17.11	0.188
38	1.279	61	1.426	84	1.519	1.105	15.34	17.89	0.198
39	1.287	62	1.430	85	1.523	1.110	16.00	18.67	0.207
(Hager, Comm 1883.)						1.115	16.07	19.45	0.217
Sp. gr. $\text{HNO}_3 + \text{Aq}$ at $17.5^\circ$ .						1.120	17.34	20.23	0.227
$\% \text{N}_2\text{O}_5$	Sp. gr.	$\% \text{N}_2\text{O}_5$	Sp. gr.	$\% \text{N}_2\text{O}_5$	Sp. gr.	1.125	18.00	21.00	0.236
10	1.008	40	1.293	70	1.465	1.130	18.66	21.77	0.246
15	1.104	50	1.361	80	1.500	1.135	19.32	22.54	0.256
20	1.140	60	1.417	85	1.514	1.140	19.98	23.31	0.266
30	1.217					1.145	20.64	24.08	0.276
(Hager, Adjuncta varia, Leipzig, 1876.)						1.150	21.29	24.84	0.286
Sp. gr. of $\text{HNO}_3 + \text{Aq}$ at $15^\circ$ .						1.555	21.94	25.60	0.296
$\% \text{HNO}_3$	Sp. gr.	$\% \text{HNO}_3$	Sp. gr.	1.160	22.60	26.36	0.306		
1	1.00581	26	1.15809	1.165	23.25	27.12	0.316		
2	1.01186	27	1.16600	1.170	23.90	27.88	0.326		
3	1.01713	28	1.17371	1.175	24.54	28.63	0.336		
4	1.02246	29	1.18073	1.180	25.18	29.38	0.347		
5	1.02851	30	1.18830	1.185	25.83	30.13	0.357		
6	1.03439	31	1.19552	1.190	26.47	30.88	0.367		
7	1.04019	32	1.20276	1.195	27.10	31.62	0.378		
8	1.04592	33	1.20635	1.200	27.74	32.36	0.388		
9	1.05234	34	1.21300	1.205	28.56	33.09	0.399		
10	1.05746	35	1.22013	1.210	29.39	33.82	0.409		
11	1.06330	36	1.22675	1.215	29.61	34.55	0.420		
12	1.06951	37	1.23347	1.220	30.24	35.28	0.430		
13	1.07581	38	1.23980	1.225	30.88	36.03	0.441		
14	1.08126	39	1.24510	1.230	31.53	36.78	0.452		
15	1.08443	40	1.25235	1.235	32.17	37.53	0.463		
16	1.09500	41	1.25850	1.240	32.82	38.29	0.475		
17	1.10102	42	1.26475	1.245	33.47	39.05	0.486		
18	1.10725	43	1.27125	1.250	34.13	39.82	0.498		
19	1.11321	44	1.28895	1.255	34.78	40.58	0.509		
20	1.12024	45	1.28450	1.260	35.44	41.34	0.521		
21	1.12714	46	1.29110	1.265	36.09	42.10	0.533		
22	1.13349	47	1.29780	1.270	36.75	42.87	0.544		
23	1.13890	48	1.30443	1.275	37.41	43.64	0.556		
24	1.14460	49	1.31101	1.280	38.07	44.41	0.568		
25	1.15164	50	1.31722	1.285	38.73	45.18	0.581		
(Squires, Pharm. Era, Jan, 1891.)						1.290	39.39	45.95	0.593
						1.295	40.05	46.72	0.605

Sp. gr. of  $\text{HNO}_3$ , etc.—Continued.

Sp. gr.	% $\text{N}_2\text{O}_5$	% $\text{HNO}_3$	Kg $\text{HNO}_3$ in 1 l
1 300	40.71	47.49	0 617
1 305	41.37	48.26	0 630
1 310	42.06	49.07	0 643
1 315	42.76	49.89	0 656
1 320	43.47	50.71	0 669
1 325	44.17	51.53	0 683
1 330	44.89	52.37	0 697
1 335	45.62	53.22	0 710
1 340	46.35	54.07	0 725
1 345	48.07	54.93	0 739
1 350	47.82	55.79	0 753
1 355	48.57	56.66	0 768
1 360	49.35	57.57	0 783
1 365	50.13	58.48	0 798
1 370	50.91	59.39	0 814
1 375	51.69	60.30	0 829
1 380	52.52	61.27	0 846
1 385	53.35	62.24	0 862
1 390	54.20	63.23	0 879
1 395	55.07	64.25	0 896
1 400	55.97	65.30	0 914
1 405	56.92	66.40	0 933
1 410	57.86	67.60	0 952
1 415	58.83	68.63	0 971
1 420	59.83	69.80	0 991
1 425	60.84	70.98	1 011
1 430	61.86	72.17	1 032
1 435	62.91	73.39	1 053
1 440	64.01	74.68	1 075
1 445	65.13	75.98	1 098
1 450	66.24	77.28	1 121
1 455	67.38	78.60	1 144
1 460	68.56	79.98	1 168
1 465	69.79	81.42	1 193
1 470	71.06	82.90	1 219
1 475	72.39	84.45	1 246
1 480	73.76	86.05	1 274
1 485	75.18	87.70	1 302
1 490	76.80	89.60	1 335
1 495	78.57	91.60	1 369
1 500	80.65	94.09	1 411
1 501	81.09	94.60	1 420
1 502	81.50	95.08	1 428
1 503	81.91	95.55	1 436
1 504	82.29	96.00	1 444
1 505	82.68	96.39	1 451
1 506	82.94	96.76	1 457
1 507	83.26	97.13	1 464
1 508	83.58	97.50	1 470
1 509	83.87	97.84	1 476
1 510	84.09	98.10	1 481
1 511	84.28	98.32	1 486
1 512	84.46	98.53	1 490
1 513	84.63	98.73	1 494
1 514	84.87	98.90	1 497
1 515	84.92	99.07	1 501
1 516	85.04	99.21	1 504
1 517	85.15	99.34	1 507
1 518	85.26	99.46	1 510
1 519	85.35	99.57	1 512
1 520	85.44	99.67	1 515

Sp. gr. of  $\text{N-HNO}_3$ +Aq at  $18^\circ/4^\circ=1.0324$ .  
(Loomis, W. Ann 1896, 60, 550.)

Sp. gr. (reduced to a vacuum) of  $\text{HNO}_3$  from  
78–100% concentration at  $4^\circ/4^\circ$ ,  
14  $2^\circ/4^\circ$  and 24  $2^\circ/4^\circ$ .

% $\text{HNO}_3$	Sp. gr.		
	$4^\circ/1^\circ$	14 $2^\circ/4^\circ$	24 $2^\circ/4^\circ$
78 22	1 47129	1 45504	1 43064
79 14		1 46011	1 44372
79 59	1 47496		
81 97	1 48391	1 46680	1 45092
84 90	1 49495		...
85 21	1 49581		
85 80		1 47826	1 46224
87 55	1 50211		
87 90		1 48491	1 46891
89 73	1 50898	1 49125	
92 34	1 51804	1 49968	1 48264
94 04	1 51949	1 50149	1 48516
95 62	1 52192	1 50358	1 48677
96 64	1 52510	1 50632	1 48887
97 33		1 50911	1 49137
98 07	1 53212	1 51298	1 49543
99 97	1 54212	1 52236	1 50394

(Velej and Manley, Chem Soc. 1903, 83, 1016.)

Sp. gr. at  $20^\circ$  of  $\text{HNO}_3$ +Aq containing M  
g. mols.  $\text{HNO}_3$  per liter.

M 0.025 0.05 0.075 0.10  
Sp. gr. 1.000926 1.001798 1.002653 1.003496

M 0.25 0.5 0.75 1.0  
Sp. gr. 1.008481 1.01686 1.02503 1.0336

M 2.0  
Sp. gr. 1.0670

(Jones and Pearce, Am. Ch. J. 1907, 38, 732.)

For sp. gr. of  $\text{HNO}_3$ + $\text{H}_2\text{SO}_4$ , see under  $\text{H}_2\text{SO}_4$ .

Partition coefficient for  $\text{HNO}_3$  between ether and  $\text{H}_2\text{O}$  is increased by the addition of nitrates. (Tanret, C R 1897, 124, 464.)

The hydrates described by Erdmann do not exist. There are only two authentic hydrates, the mono- and the tri-hydrate. (Kuster, Ch. Z. 1904, 28, 132)

The composition of the hydrates formed by  $\text{HNO}_3$  at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by  $\text{HNO}_3$  and of the conductivity and sp. gr. of  $\text{HNO}_3$ +Aq (Jones, Am. Ch. J. 1905, 34, 328)

Dinitric acid,  $\text{H}_2\text{N}_2\text{O}_{11}=2\text{N}_2\text{O}_5$ ,  $\text{H}_2\text{O}$ .

Fumes on air. Miscible with  $\text{H}_2\text{O}$ , with evolution of much heat. (Weber, J. pr. (2) 6, 342.)

## Nitrates.

All nitrates are sol. in  $\text{H}_2\text{O}$  except a few basic compounds. Most nitrates are insol. in

conc.  $\text{HNO}_3 + \text{Aq}$ ; many are sol. in alcohol; some are sol. in glycerine

Aluminum nitrate, basic,  $2\text{Al}_2\text{O}_3, 3\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ordway, *Sill. Am. J.* (2) 26. 203.)

Basic aluminum nitrates containing 2 mols or less of  $\text{Al}_2\text{O}_3$  to one of  $\text{N}_2\text{O}_5$  may be obtained sol. in  $\text{H}_2\text{O}$ , but the compounds containing more than 2 mols.  $\text{Al}_2\text{O}_3$  are insol. in  $\text{H}_2\text{O}$ . (Ordway, *l. c.*)

$2\text{Al}_2\text{O}_3, \text{N}_2\text{O}_5 + 10\text{H}_2\text{O}$ . (Ditte, *C. R.* 110. 782.)

$\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}, \text{HNO}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Schlumberger, *Bull. Soc.* 1895, (3) 13. 59.)

Aluminum nitrate,  $\text{Al}(\text{NO}_3)_3 + 9\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}, \text{HNO}_3 + \text{Aq}$ , or alcohol. (Berzelius.)

Melts in its crystal  $\text{H}_2\text{O}$  at  $72^\circ$ . (Ordway.)

Sol. in 1 pt. strong alcohol. (Wenzel.)

Difficultly sol. in acetone. (Naumann, *B.* 1904, 37. 4328.)

Insol. in ethyl acetate. (Naumann, *B.* 1910, 43. 314.)

Ammonium nitrate,  $\text{NH}_4\text{NO}_3$ .

Deliquescent.

Sol. in 0.502 pt.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Karsten.)

Sol. in 0.54 pt.  $\text{H}_2\text{O}$  at  $10^\circ$ . (Harris, *C. R.* 24. 816.)

Much more sol. in hot than cold  $\text{H}_2\text{O}$ . (Harris.)

Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $15.3^\circ$  and 0.5 pt. boiling  $\text{H}_2\text{O}$  (Fourcroy.)

Sol. in 1 pt. cold, and 0.5 pt. boiling  $\text{H}_2\text{O}$  (Fourcroy.)

Sol. in 0.6 pt.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Berzelius.)

Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Abl.)

Decomp. by boiling  $\text{H}_2\text{O}$ .

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	$\text{Pt}_{100}$ $\text{NH}_4\text{NO}_3$	$t^\circ$	$\text{Pt}_{100}$ $\text{NH}_4\text{NO}_3$	$t^\circ$	$\text{Pt}_{100}$ $\text{NH}_4\text{NO}_3$
0	97	24	205	48	351
1	101	25	210	49	358
2	105	26	216	50	365
3	100	27	221	51	372
4	113	28	226	52	379
5	117	29	232	53	387
6	121	30	238	54	395
7	125	31	244	55	402
8	130	32	250	56	410
9	134	33	256	57	418
10	139	34	262	58	425
11	143	35	268	59	433
12	148	36	274	60	441
13	152	37	280	61	449
14	157	38	286	62	457
15	161	39	292	63	465
16	166	40	298	64	473
17	170	41	304	65	481
18	175	42	311	66	490
19	180	43	317	67	499
20	185	44	324	68	508
21	190	45	331	69	517
22	195	46	337	70	526
23	200	47	344	..	..

(Mulder, Scheik. Verhandl. 1864. 95.)

100 pts.  $\text{H}_2\text{O}$  dissolve 183 pts.  $\text{NH}_4\text{NO}_3$  at  $19.5^\circ$ . (Mulder.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Specific gravity of the saturated solution	Mols of $\text{NH}_4\text{NO}_3$ soluble in 100 mols of water
12.2	1.2945	34.50
20.2	1.3116	43.30
23.0	1.3159	46.57
25.0	1.3197	48.19
27.7	1.3257	51.67
28.0	1.3260	51.86
30.0	1.3299	54.40
30.2	1.3308	54.61
31.9	1.3348	57.20
32.1	1.3344	57.60
32.7	1.3356	57.90
34.0	1.3375	58.89
35.0	1.3394	59.80
35.1	1.3397	60.00
35.6	1.3408	60.02
36.0	1.3412	61.00
36.6	1.3420	.. ..
37.5	1.3432	62.90
38.0	1.3438	63.60
38.5	1.3440	64.10
39.0	1.3448	65.09
39.5	1.3460	65.88
40.0	1.3464	66.80

(Muller and Kaufmann, *Z. phys. Ch.* 1908, 42. 499.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	$\text{G NH}_4\text{NO}_3$ per 100 g.		Solid phase
	solution	water	
0	51.19	118.3	$\text{NH}_4\text{NO}_3$ rhomb. $\beta$
12.2	60.53	153.4	"
20.2	65.80	192.4	"
25.0	68.17	214.2	"
30.0	70.73	241.8	"
32.1	71.97	256.9	$\text{NH}_4\text{NO}_3$ rhomb. $\beta +$ rhomb. $\alpha$
35	72.64	265.8	$\text{NH}_4\text{NO}_3$ rhomb. $\alpha$
40	74.82	297.0	"
50	77.49	344.0	"
60	80.81	421.0	"
70	83.32	499.0	"
80	85.25	580.0	"
90	88.03	740.0	$\text{NH}_4\text{NO}_3$ rhomb. (?)
100	89.71	871.0	"

(Seidell's Solubilities 1st ed. 28. Calc. from Muller & Kaufmann, see above, and Schwarz, Ostwald's Lehrb., p. 425.)

100 g.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  contain:

54.19 g.  $\text{NH}_4\text{NO}_3$  at  $0^\circ$ .

70.10 g. " "  $30^\circ$ .

84.03 g. " "  $70^\circ$ .

(de Waal, Dissert. Leiden, 1910.)

70.19 g  $\text{NH}_4\text{NO}_3$  are contained in 100 g.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  sat. at  $30^\circ$ . (Schrenemakers and de Baat, Arch. neer. Sc. 1911, (2) 15. 415.)

60 pts.  $\text{NH}_4\text{NO}_3$  mixed with 100 pts.  $\text{H}_2\text{O}$  lower the temperature from  $13.6^\circ$  to  $-13.6^\circ$ , that is  $27.2^\circ$ , but if the initial temperature is  $0^\circ$  it will fall only to  $-16.7^\circ$ , the freezing-point of the mixture. (Rudorff, B. 2. 68.)

Sp. gr. of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $18^\circ$

Pts $\text{NH}_4\text{NO}_3$	Pts $\text{H}_2\text{O}$	Sp. gr.
80	1800	1.0180
80	900	1.0331
80	360	1.0743

(Thomsen and Gerlach, Z. anal. 28. 520.)

Sp. gr. of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $15^\circ$ .

% $\text{NH}_4\text{NO}_3$	Sp. gr.	% $\text{NH}_4\text{NO}_3$	Sp. gr.
5	1.0201	30	1.1304
10	1.0419	40	1.1780
20	1.0860	50	1.2279

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $17.5^\circ$

% $\text{NH}_4\text{NO}_3$	Sp. gr.	% $\text{NH}_4\text{NO}_3$	Sp. gr.
1	1.0042	33	1.1454
2	1.0085	34	1.1502
3	1.0127	35	1.1550
4	1.0170	36	1.1598
5	1.0212	37	1.1646
6	1.0255	38	1.1694
7	1.0297	39	1.1742
8	1.0340	40	1.1790
9	1.0382	41	1.1841
10	1.0425	42	1.1892
11	1.0468	43	1.1942
12	1.0512	44	1.1994
13	1.0555	45	1.2045
14	1.0599	46	1.2096
15	1.0642	47	1.2147
16	1.0686	48	1.2198
17	1.0729	49	1.2249
18	1.0773	50	1.2300
19	1.0816	51	1.2353
20	1.0860	52	1.2407
21	1.0905	53	1.2460
22	1.0950	54	1.2514
23	1.0995	55	1.2567
24	1.1040	56	1.2621
25	1.1085	57	1.2674
26	1.1130	58	1.2728
27	1.1175	59	1.2781
28	1.1220	60	1.2835
29	1.1265	61	1.2888
30	1.1310	62	1.2942
31	1.1358	63	1.3005
32	1.1406	64	1.3059

(Gerlach, Z. anal. 27. 310.)

Sp. gr. of  $\text{NH}_4\text{NO}_3 + \text{Aq}$

% $\text{NH}_4\text{NO}_3$	Sp. gr. $10^\circ/16^\circ$
0	1.000000
0.6419	1.000271
1.4101	1.000593
2.7501	1.001153
5.4890	1.002300
11.7981	1.004916
23.4480	1.009758
47.9500	1.019952

(Dyken Z. phys. Ch. 1897, 24. 107.)

Sp. gr.  $20^\circ/4^\circ$  of a normal solution of  $\text{NH}_4\text{NO}_3$  = 1.030435; of a 0.5-normal solution = 1.014505. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

B-pt. of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  containing pts.  $\text{NH}_4\text{NO}_3$  to 100 pts.  $\text{H}_2\text{O}$ . G = according to Gerlach (Z. anal. 26. 445); L = according to Legrand (A. ch. (2) 59. 426.)

$\frac{G}{L}$	G	L	$\frac{G}{L}$	G	L
101°	10	10	140°	682	770.5
102	20	20.5	141	719	..
103	30	31.3	142	737	840.6
104	41	42.4	143	765	..
105	52	53.8	144	793	915.5
106	63	65.4	145	823	..
107	74	77.3	146	853	995.5
108	85	89.4	147	883	..
109	96	101.9	148	914	1081.5
110	108	114.9	149	945	..
111	120	128.4	150	977	1173.5
112	132	142.4	151	1009	..
113	145	156.9	152	1043	1273
114	158	172	153	1079	..
115	172	188	154	1116	1383
116	187	204.4	155	1155	..
117	202	221.4	156	1196	1504
118	217	238.4	157	1238	..
119	232	256.8	158	1281	1637
120	248	275.3	159	1325	..
121	265	..	160	1370	1775
122	283	314	161	1417	..
123	301	..	162	1464	1923
124	319	354	163	1511	..
125	337	..	164	1558	2084
126	356	396	165	1606	..
127	376	..	166	1653	..
128	396	440.2	167	1700	..
129	417	..	168	1748	..
130	439	487.4	169	1796	..
131	461	..	170	1844	..
132	484	537.3	180	2400	∞
133	507	..	190	3112	..
134	530	590	200	4099	..
135	554	..	210	5618	..
136	578	645	220	8547	..
137	603	..	230	16950	..
138	629	705.5	240	∞	..
139	655	...	...	..	..

Very sol in  $\text{HNO}_3 + \text{Aq.}$  (Schulz, Zeit. Ch. 1869, 531.)

Solubility of  $\text{NH}_4\text{NO}_3$  in  $\text{HNO}_3$ .

Solution temp	% by wt $\text{H}_2\text{NO}_3$	Solid phase
+5°	21.1	$\text{NH}_4\text{NO}_3, 2\text{HNO}_3$ (solution in $\text{HNO}_3$ )
23.0	28.7	"
28.5	34.5	"
29.5*	38.8	(solution in $\text{NH}_4\text{NO}_3$ )
27.5	44.6	"
27.0	45.8	"
23.5	49.4	"
23.0	50.0	"
17.5	54.0	"
10.5	54.3	"
4.0	45.8	$\text{NH}_4\text{NO}_3, \text{HNO}_3$ labile (solution in $\text{HNO}_3$ )
9.5	49.4	"
11.0	51.7	"
11.5	52.7	"
12.0	54.3	"
12.0	54.7	"
11.5	57.6	(solution in $\text{NH}_4\text{NO}_3$ )
11.5	54.0	$\text{NH}_4\text{NO}_3$ (labile)
14.5	54.3	"
17.0	51.7	stable
26.0	55.9	"
27.0	56.2	"
33.5	57.5	"
49.0	60.4	"
79.0	68.1	"

\* Mpt. of  $\text{NH}_4\text{NO}_3, 2\text{HNO}_3$ .

(Groschuff, Z. anorg. 1904, 40. 6.)

Solubility of  $\text{NH}_4\text{NO}_3$  in  $\text{NH}_4\text{OH} + \text{Aq.}$

Grams of $\text{NH}_4\text{NO}_3$	Grams of $\text{NH}_3$	Molecules of $\text{NH}_4\text{NO}_3$ in 100 molecules $\text{NH}_4\text{NO}_3 + \text{NH}_3$	Temperature at which the solutions are in equilibrium with the solid phase
		100	about 168°
0.7578	0.0588	74.2	109.8
0.6439	0.0665	67.3	94.0
4.2615	0.7747	53.8	68.8
0.7746	0.1857	47.0	35.9
0.9358	0.2352	45.9	33.3
0.7600	0.2607	38.3	0
0.9675	0.3515	36.9	-10.5
0.8308	0.3700	32.3	-30.0
0.9526	1.2457	13.9	-44.5
1.3018	4.4327	6.25	-60
0	100	0	about -80

(Kuriloff, Z. phys. Ch. 1898, 25. 109.)

$\text{NH}_4\text{NO}_3 + \text{NH}_4\text{Cl}$

100 pts.  $\text{H}_2\text{O}$  dissolve 20.1 pts.  $\text{NH}_4\text{Cl}$  and 173.8 pts.  $\text{NH}_4\text{NO}_3$ . (Rudorff, B. 6. 484.)

Sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  with pptn. of  $\text{NH}_4\text{Cl}$  until a state of equilibrium is reached. (Karsten.)

Addition of  $\text{KClO}_3$  to  $\text{NH}_4\text{Cl} + \text{Aq}$  prevents pptn. of  $\text{NH}_4\text{Cl}$ , and dissolves any  $\text{NH}_4\text{Cl}$  that may have been pptd. (Margueritte, C. R. 38. 306.)

See also under Ammonium chloride.

$\text{NH}_4\text{NO}_3 + \text{KNO}_3$

100 pts.  $\text{H}_2\text{O}$  dissolve:

	At 0° (1)	At 11° (2)	At 11° (3)	At 15° (4)	At 15° (5)	At 15° (6)
$\text{KNO}_3$	20.2	40.6		26.0	46.2	
$\text{NH}_4\text{NO}_3$		88.8	143		130.4	161

2, Sat. at 11° with  $\text{NH}_4\text{NO}_3$  and then at 0° with  $\text{KNO}_3$ ; 5, sat. at 11° with  $\text{NH}_4\text{NO}_3$  and then at 15° with  $\text{KNO}_3$ . (Mulder.)

Sol. in sat.  $\text{HNO}_3 + \text{Aq}$  without causing ppt. (Karsten), with separation of  $\text{KNO}_3$  (Rudorff).

Composition of solution is dependent on the relative excess of the salts present. (Rudorff.) 100 pts.  $\text{H}_2\text{O}$  dissolve 77.1 pts.  $\text{NaNO}_3$  and 162.9 pts.  $\text{NH}_4\text{NO}_3$  at 16°. (Rudorff, B. 6. 484.)

If a sat. solution of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at 11° is sat. with  $\text{Ba}(\text{NO}_3)_2$  at 0°, 100 pts.  $\text{H}_2\text{O}$  dissolve.

	At 11°	At 0°
$\text{NH}_4\text{NO}_3$	143	101.3
$\text{Ba}(\text{NO}_3)_2$		6.2
		6.8

(Mulder.)

Solubility of  $\text{NH}_4\text{NO}_3 + \text{AgNO}_3$  in  $\text{H}_2\text{O}$  at t°.

t°	$\text{AgNO}_3$	$\text{NH}_4\text{NO}_3$	Solid phase
-7.3°	47.1	0	$\text{Ice} + \text{AgNO}_3 \alpha$ , rhomb.
-10.7°	44.52	8.43	"
-14.9°	42.0	10.80	$\text{Ice} + \text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{AgNO}_3$ rh.
-14.8°	39.51	18.79	$\text{Ice} + \text{AgNO}_3, \text{NH}_4\text{NO}_3$
-18.7°	15.99	37.30	$\text{Ice} + \text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3 \beta$ rh.
-17.4°	0	41.2	$\text{Ice} + \text{NH}_4\text{NO}_3 \beta$ rh.
0	50.36	19.59	$\text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{AgNO}_3$ rh.
18	55.36	22.06	"
30	58.89	23.42	"
55	63.32	26.12	"
109.6	67.9	32.1	"
0	22.13	44.87	$\text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3 \beta$ rh.
18	27.07	40.22	"
30	29.76	52.50	"
40	32.68	52.22	$\text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3 \alpha$ rh.
55	36.60	52.38	"
101.5	47.5	52.5	$\text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$ , rhb.

(Schreinemakers and de Baat, Arch. néer. Sc. 1911 (2) 15. 414.)

Solubility in  $\text{NH}_4\text{NO}_3$  and  $\text{AgNO}_3$  in  $\text{H}_2\text{O}$  at  $30^\circ$ .

Composition of the solution		Solid phase
$\text{NH}_4\text{NO}_3$	$\text{AgNO}_3$	
0	73.0	$\text{AgNO}_3$
0.59	69.08	"
15.62	63.27	"
23.40	58.84	$\text{AgNO}_3 + \text{AgNO}_3, \text{NH}_4\text{NO}_3$
23.45	58.93	"
24.33	57.93	$\text{AgNO}_3, \text{NH}_4\text{NO}_3$
26.22	55.32	"
28.86	52.45	"
34.47	45.85	"
39.60	41.09	"
46.44	35.62	"
52.49	29.77	$\text{NH}_4\text{NO}_3 + \text{AgNO}_3, \text{NH}_4\text{NO}_3$
52.11	29.86	"
52.89	29.66	"
54.12	27.75	$\text{NH}_4\text{NO}_3$
58.64	21.31	"
63.59	12.51	"
70.10	0	"

(Schreinemakers and de Baat, Z. phys. Ch. 1909, 65, 572.)

Solubility of  $\text{NH}_4\text{NO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g per 100 g $\text{H}_2\text{O}$		Sp gr
	$\text{NH}_4\text{NO}_3$	$\text{NaNO}_3$	
0	0	73.33	1.354
	105.5	66	1.407
	118.4	0	1.264
15	0	83.9	1.375
	24.03	81.21	1.386
	42.81	79.34	1.392
	64.6	78.06	1.401
	110.9	75.81	1.417
	152.	75.35	1.428
	155.3	75.38	1.429
	156.1	60.76	1.405
	159	36.50	1.364
	160	27.79	1.350
	162.3	17.63	1.330
	167.4	0	1.298
30	0	96.12	1.401
	220.8	88.31	1.450
	232.6	0	1.329

(Fedotieff and Koltunoff, Z. anorg. 1914, 85, 251.)

Solubility of  $\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at  $30^\circ$ .

$\text{NH}_4\text{NO}_3$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
70.1	0	$\text{NH}_4\text{NO}_3$
67.63	2.38	"
66.93	3.46	$\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$
		$3\text{NH}_4\text{NO}_3$
63.84	4.96	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3$
58.06	8.22	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
52.75	11.42	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
49.80	13.27	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$
37.20	19.48	$(\text{NH}_4)_2\text{SO}_4$
19.91	28.83	"
12.05	34.7	"
0	44.1	"

(Schreinemakers and Haenen, Chem. Weekbl. 1909, 6, 51.)

Solubility of  $\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$  in  $\text{H}_2\text{O}$ .

Temp. $-0^\circ$		
$\text{NH}_4\text{NO}_3$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
0	41.4	$(\text{NH}_4)_2\text{SO}_4$
5.61	37.89	"
29.58	41.64	$(\text{NH}_4)_2\text{SO}_4 + (\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
29.81	21.33	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
31.04	20.40	"
30.87	20.43	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3$
31.61	19.50	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3$
45.99	9.53	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$
49.12	6.00	$\text{NH}_4\text{NO}_3$
54.19	0	"
Temp. $-70^\circ$		
$\text{NH}_4\text{NO}_3$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
0	47.81	$(\text{NH}_4)_2\text{SO}_4$
11.10	40.81	"
70.15	6.71	$(\text{NH}_4)_2\text{SO}_4 + (\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
71.58	5.82	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
73.48	5.14	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3$
76.01	3.96	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3$
80.25	2.68	"
81.01	2.45	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$
81.38	2.41	$\text{NH}_4\text{NO}_3$
84.03	0	"

(de Waal Dissert. Leiden. 1910.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 826.)

1 pt.  $\text{NH}_4\text{NO}_3$  dissolves in 2.29 pts. alcohol of 66.8% at 25° (Pohl, W. A. B. 6, 599)  
1 pt.  $\text{NH}_4\text{NO}_3$  dissolves in 1.1 pt. bushing alcohol (Wenzel)

100 pts. absolute methyl alcohol dissolve 17.1 pts. at 20.5°. (de Bruyn, Z. phys. Ch. 10, 783.)

100 g. absolute methyl alcohol dissolve 14.6 g.  $\text{NH}_4\text{NO}_3$  at 14° and 16.3 g. at 18.5°. (Schiff and Monsacchi, Z. phys. Ch. 1896, 21, 277.)

100 pts. absolute ethyl alcohol dissolve 3.8 pts. at 20.5°. (de Bruyn, Z. phys. Ch. 10, 783.)

100 g. absolute ethyl alcohol dissolve 4.6 g. at 14°. (Schiff and Monsacchi, Z. phys. Ch. 1896, 21, 277.)

Solubility of  $\text{NH}_4\text{NO}_3$  in  $\text{H}_2\text{O}$  is decreased by presence of ethyl alcohol but increased by presence of methyl alcohol.  $\text{NH}_4\text{NO}_3$  is only very sl. sol. in abs. ethyl alcohol and the solubility increases slowly with rise in temp.; it is more sol. in abs. methyl alcohol and the solubility increases rapidly with rise in temp (Fleckenstein, Phys. Zeit. 1905, 6, 419.)

#### Solubility in methyl alcohol + Aq. at 30°.

% by wt $\text{H}_2\text{O}$	% by wt alcohol	% by wt $\text{NH}_4\text{NO}_3$
29.9	0	70.1
21.6	21.5	53.9
20.6	31.3	48.1
16.5	46.0	37.5
11.5	59.4	29.1
0	83.3	16.7

(Schreinemakers, Z. phys. Ch. 1909, 65, 556)

#### Solubility of $\text{NH}_4\text{NO}_3$ in ethyl alcohol + Aq at 30°. Composition of sat. solution.

% by wt $\text{H}_2\text{O}$	% by wt alcohol	% by wt $\text{NH}_4\text{NO}_3$
29.9	0	70.1
26.0	18.6	54.5
23.2	39.3	37.5
18.3	58.5	23.2
11.6	76.5	11.9
5.8	86.2	8.0
0	96.4	3.6

(Schreinemakers, Z. phys. Ch. 1909, 65, 555.)

#### Solubility of $\text{NH}_4\text{NO}_3$ in alcohol.

t°	% $\text{NH}_4\text{NO}_3$	% Alcohol	% $\text{H}_2\text{O}$
0	54.19	0	45.81
"	42.69	12.70	44.61
"	1.96	97.93	0.11
30	70.10	0	29.90
"	59.83	10.60	29.57
"	8.06	85.30	6.64
"	3.60	96.51	0
70	84.03	0	15.97
"	72.37	11.12	16.51
"	61.11	22.87	16.02
"	41.25	44.64	14.11
"	24.71	67.23	8.06
"	7.51	92.49	0

(de Waal Dissert. Leiden, 1910.)

#### Sp. gr. of alcoholic solution of $\text{NH}_4\text{NO}_3$ at 15°.

Pts. $\text{NH}_4\text{NO}_3$	Pts. alcohol	Sp gr
0	100	0.83904
2	98	0.84746
4	96	0.85604
6	94	0.86524

(Gerlach, Z. anal. 28, 521.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)

Sol. in acetone. (Eidmann, C. C. 1899, II 1014.)

#### Ammonium hydrogen nitrate, $\text{NH}_4\text{H}(\text{NO}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 89, 576, 641.)

Decomp. by  $\text{H}_2\text{O}$ . (Groschuff, B. 1904, 37, 1487.)

#### Ammonium dihydrogen nitrate, $\text{NH}_4\text{H}_2(\text{NO}_3)_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte.)

#### Solubility in $\text{H}_2\text{O}$ .

Solution temp	% by wt $\text{NH}_4\text{NO}_3$	% by wt $\text{HNO}_3$
-8.0	34.2	53.9
-2.5	34.8	54.8
+3.0	35.4	55.8
3.5	36.0	56.8
19.5	37.4	58.9
25.0	38.1	60.0
29.5 mpt.	38.8	61.2

(Groschuff, Z. anorg. 1904, 40, 7.)

**Ammonium cerous nitrate**,  $3\text{NH}_4\text{NO}_3$ ,  
 $2\text{Ce}(\text{NO}_3)_3 + 12\text{H}_2\text{O}$ .

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Holzmann, J. pr. 84. 78.)  
+  $10\text{H}_2\text{O}$ . Hygroscopic. Sol. in  $\text{H}_2\text{O}$ .  
(Drossbach, B. 1900, 33. 3507.)  
 $2\text{NH}_4\text{NO}_3$ ,  $\text{Ce}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$ . As above.  
(Marignac, A. ch. (4) 30. 64.)

Solubility in  $\text{H}_2\text{O}$   
100 g.  $\text{H}_2\text{O}$  dissolve at:  
8.75° 25° 45°  
235.5 296.8 410.2 g. anhydrous salt,

60° 65.06°  
681.2 817.4 g. anhydrous salt.  
(Wolff, Z. anorg. 1905, 45. 98.)

**Ammonium ceric nitrate**,  $2\text{NH}_4\text{NO}_3$ ,  
 $\text{Ce}(\text{NO}_3)_4$ .

Very sol. in  $\text{H}_2\text{O}$  without decomp. Sol. in  $\text{HNO}_3$ . (Meyer, B. 1900, 33. 2137.)  
Sol. in alcohol. (Meyer, Z. anorg. 1901, 27. 369.)

Solubility in  $\text{H}_2\text{O}$ .  
100 g.  $\text{H}_2\text{O}$  dissolve at t°:  
25° 35.2° 45.3°  
140.9 161.7 174.9 g. anhydrous salt,  
64.5° 85.60° 122°  
201.6 226.8 735.4 g. anhydrous salt.  
(Wolff, Z. anorg. 1905, 45. 94.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . Very deliquescent. (Holzmann, J. pr. 84. 78.)

**Ammonium cobalt nitrate**.  
Permanent. Sol. in  $\text{H}_2\text{O}$ . (Thenard.)

**Ammonium copper nitrate**,  $2\text{NH}_4\text{NO}_3$ ,  
 $\text{Cu}(\text{NO}_3)_2$ .  
Very sol. in  $\text{H}_2\text{O}$ .

**Ammonium didymium nitrate**,  $2\text{NH}_4\text{NO}_3$ ,  
 $\text{Dy}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$ .  
Somewhat deliquescent.

**Ammonium gadolinium nitrate**,  $2\text{NH}_4\text{NO}_3$ ,  
 $\text{Gd}(\text{NO}_3)_3$ .  
Deliquesces in the air. (Benedicks, Z. anorg. 1900, 22. 407.)

**Ammonium gold (auric) nitrate** (Ammonium auronitrate),  $\text{NH}_4\text{Au}(\text{NO}_3)_4$ .  
Extremely deliquescent.  
 $\text{H}(\text{NH}_4)_2\text{Au}(\text{NO}_3)_4$ . (Schottlander, A. 217. 312.)

**Ammonium lanthanum nitrate**,  $2\text{NH}_4\text{NO}_3$ ,  
 $\text{La}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$ .  
Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Ammonium magnesium nitrate**,  $2\text{NH}_4\text{NO}_3$ ,  
 $\text{Mg}(\text{NO}_3)_2$ .

Slowly deliquescent. Sol. in 10 pts.  $\text{H}_2\text{O}$  at 12.5°, and much less hot  $\text{H}_2\text{O}$ . (Fourcroy.)

**Ammonium mercurous nitrate**,  $4\text{NH}_4\text{NO}_3$ ,  
 $\text{Hg}_2(\text{NO}_3)_2 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Pagenstecher, Repert. 14. 188.)

**Ammonium nickel nitrate**.

Sol. in 3 pts. cold  $\text{H}_2\text{O}$ . (Thénard, Scher. J. 10. 428.)

**Ammonium praseodymium nitrate**,  $2\text{NH}_4\text{NO}_3$ ,  
 $\text{Pr}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (von Scheele, Z. anorg. 1898, 18. 356.)

**Ammonium silver nitrate**,  $\text{NH}_4\text{NO}_3$ ,  $\text{AgNO}_3$ .  
Very sol. in  $\text{H}_2\text{O}$ . (Russell and Maskelyne, Roy. Soc. Proc. 26. 357.)

Sol. in  $\text{H}_2\text{O}$  without decomp. (Schreinemakers and de Baat, Chem. Weekbl. 1910, 7. 6.)

See also solubility of  $\text{NH}_4\text{NO}_3 + \text{AgNO}_3$  under  $\text{NH}_4\text{NO}_3$ .

**Ammonium thorium nitrate**,  $(\text{NH}_4)_2\text{Th}(\text{NO}_3)_6$ .  
Sol. in strong  $\text{HNO}_3$ . (Meyer, Z. anorg. 1901, 27. 383.)

$\text{NH}_4\text{Th}(\text{NO}_3)_5 + 5\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  of sp gr. 1.25. (Meyer, Z. anorg. 1901, 27. 382.)

**Ammonium uranyl nitrate**,  $\text{NH}_4\text{NO}_3$ ,  
 $\text{UO}_2(\text{NO}_3)_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HNO}_3$ . (Meyer, B. 1903, 36. 4057.)

Solubility in  $\text{H}_2\text{O}$  at t°.

t°	In 100 pts by wt of the solution			Solid phase
	by wt $\text{UO}_2$	by wt $\text{NH}_4$	by wt total salt	
0 5	29 71	2 92		Double salt + $\text{UO}_2(\text{NO}_3)_2$
13 5	32 35	3 42		"
24 9 a	36 40	3 54	68 72	"
b	36 63	3 54	68 97	"
35 0	42 07	3 44		"
59 0	44 37	2 90		"
80 7 a	44 80	2 98	78 78	Double salt
b	45 01	2 98	78 79	"

Ammonium uranyl nitrate is decomp. by  $\text{H}_2\text{O}$  at temp. below 60°: above 60° it is sol. in  $\text{H}_2\text{O}$  without decomp. (Rumbach, B. 1904, 37. 475.)

**Ammonium nitrate ammonia**,  $2\text{NH}_4\text{NO}_3$ ,  
 $3\text{NH}_3$ .

Known only as a solution of  $\text{NH}_3$  in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Troost, C. R. 94. 789.)  
 $\text{NH}_4\text{NO}_3$ ,  $3\text{NH}_3$ . As above.

**Ammonium nitrate mercuric chloride,**

Insol. in  $\text{H}_2\text{O}$ . Ether dissolves out  $\text{HgCl}_2$ .  
(Kosmann, A. ch. (3) 27. 210.)

$2\text{NH}_4\text{NO}_3, \text{HgCl}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Hofmann and Marburg, A. 1899, 305. 199.)

**Ammonium nitrate sulphate,  $2(\text{NH}_4)_2\text{O}, \text{N}_2\text{O}_5, 2\text{SO}_3, \text{H}_2\text{O}$** 

Very hygroscopic and sol. in  $\text{H}_2\text{O}$ . (Friedheim, Z. anorg. 1894, 6. 297.)

$2\text{NH}_4\text{NO}_3, (\text{NH}_4)_2\text{SO}_4$ . (de Waal, Dissert. 1910.)

$3\text{NH}_4\text{NO}_3, (\text{NH}_4)_2\text{SO}_4$ . (de Waal.)  
See also solubility of  $\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$  under  $\text{NH}_4\text{NO}_3$ .

**Ammonium nitrate metatungstate,  $\text{Ni}_4\text{NO}_3, 2(\text{NH}_4)_2\text{W}_6\text{O}_{19} + 4\text{H}_2\text{O}$** 

Decomposes by recrystallising out of  $\text{H}_2\text{O}$ .  
(Marignac, A. ch. (3) 69. 61.)

**Antimony nitrate,  $\text{Sb}_2\text{O}_5, \text{N}_2\text{O}_5$** 

Decomp. by cold  $\text{H}_2\text{O}$ . (Bueholz.)

Aqueous solution sat. at  $10^\circ$  contains 30.4% salt. (Eller)

Sol. in strong, less sol. in dil.  $\text{HNO}_3 + \text{Aq}$ .  
(Peligot, A. ch. (3) 20. 288.)

Insol. in acetone (Naumann, B. 1904, 37. 4329.)

**Barium nitrate,  $\text{Ba}(\text{NO}_3)_2$** 

Sol. in  $\text{H}_2\text{O}$  with absorption of heat.

100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 5.0 parts  
 $\text{Ba}(\text{NO}_3)_2$ . (Gay-Lussac, A. ch. 11. 313.)

100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 5.2 parts  
 $\text{Ba}(\text{NO}_3)_2$  (Mulder.)

$\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  sat. at  $20^\circ$  contains 8.57 pts  
 $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , and has 1.0679 sp. gr. (Karsten); sat. at  $20^\circ$  has 1.064 sp. gr., and contains 7.94 pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ . (Michel and Krafft.)

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Ba}(\text{NO}_3)_2$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{Ba}(\text{NO}_3)_2$	$t^\circ$	Pts. $\text{Ba}(\text{NO}_3)_2$
0	5.00	52.11	17.97
14.95	8.18	73.75	25.01
17.62	8.54	86.21	29.57
37.87	13.67	101.65	35.18
49.22	17.07		

(Gay-Lussac, A. ch. (2) 11. 313.)

**Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .**

$t^\circ$	Pts. $\text{Ba}(\text{NO}_3)_2$	$t^\circ$	Pts. $\text{Ba}(\text{NO}_3)_2$
0	5.0	52	17.7
1	5.1	53	18.1
2	5.3	54	18.4
3	5.5	55	18.7
4	5.7	56	19.0
5	6.0	57	19.3
6	6.2	58	19.6
7	6.4	59	20.0
8	6.6	60	20.3
9	6.8	61	20.6
10	7.0	62	20.9
11	7.3	63	21.0
12	7.5	64	21.6
13	7.7	65	21.0
14	7.9	66	22.3
15	8.1	67	22.6
16	8.3	68	22.9
17	8.5	69	23.3
18	8.8	70	23.6
19	9.0	71	23.9
20	9.2	72	24.3
21	9.5	73	24.9
22	9.7	74	25.0
23	9.9	75	25.4
24	10.1	76	25.7
25	10.4	77	26.0
26	10.6	78	26.4
27	10.8	79	26.7
28	11.1	80	27.0
29	11.3	81	27.4
30	11.6	82	27.7
31	11.8	83	28.1
32	12.1	84	28.4
33	12.3	85	28.8
34	12.6	86	29.1
35	12.8	87	29.5
36	13.1	88	29.8
37	13.4	89	30.2
38	13.7	90	30.6
39	14.0	91	30.9
40	14.2	92	31.3
41	14.5	93	31.7
42	14.8	94	32.0
43	15.1	95	32.4
44	15.4	96	32.7
45	15.6	97	33.1
46	15.9	98	33.5
47	16.2	99	33.8
48	16.5	100	34.2
49	16.8	101	34.5
50	17.1	101.9	34.8
51	17.4	..	...

(Mulder, calculated from his own and other experiments, Scheik. Verhandl. 1864. 50.)

Sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  contains %  $\text{Ba}(\text{NO}_3)_2$  at  $t^\circ$ .

$t^\circ$	% $\text{Ba}(\text{NO}_3)_2$	$t^\circ$	% $\text{Ba}(\text{NO}_3)_2$
0.4	4.3	60.0	16.1
2.1	4.9	73.0	19.4
6.0	5.6	92.0	23.4
6.5	5.6	110.0	27.4
11.0	6.4	132.0	31.8
15.3	7.1	134.0	32.5
18.0	7.7	150.0	34.9
28.5	9.7	152.0	35.4
45.5	12.8	171.0	38.3
52.0	14.9	215.0	45.8

(Étard, A. ch. 1894, (7) 2 528.)

100 g.  $\text{H}_2\text{O}$  dissolve 8.54 g.  $\text{Ba}(\text{NO}_3)_2$  at  $17^\circ$ . (Gmelin-Kraut, Handbuch der anorg. Chemie.)

100 g.  $\text{H}_2\text{O}$  dissolve 7.87 g.  $\text{Ba}(\text{NO}_3)_2$  at  $15^\circ$ ; 8.52 g. at  $17^\circ$  (Euler, Z. phys. Ch. 1904, 49, 315.)

1000 g.  $\text{H}_2\text{O}$  dissolve 0.72 gram-equivalents  $\text{Ba}(\text{NO}_3)_2$  at  $21.5^\circ$ . (Euler, Z. phys. Ch. 1904, 49, 312.)

10.30 g. anhydrous  $\text{Ba}(\text{NO}_3)_2$  are sol. in 100 g.  $\text{H}_2\text{O}$  at  $25^\circ$  (Parsons and Colson, J. Am. Chem. Soc. 1910, 32, 1385.)

4.74 g.  $\text{Ba}(\text{NO}_3)_2$  are contained in 100 g.  $\text{Ba}(\text{NO}_3)_2$  sat. at  $0^\circ$ . (Coppadoro, Gazz. ch. it. 1911, 42, 1, 233.)

Solubility of  $\text{Ba}(\text{NO}_3)_2$  in  $\text{H}_2\text{O} = 0.427$  mol. l. at  $30^\circ$ . (Masson, Chem. Soc. 1911, 99, 1136.)

Solubility of  $\text{Ba}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  at  $30^\circ = 10.38\%$ . (Coppadoro, Gazz. ch. it. 1913, 43, I, 240.)

Solubility in  $\text{H}_2\text{O}$

100 g. of the sat. solution contain at:

$9.1^\circ$	$21.1^\circ$	$35^\circ$
6.25	8.46	11.39 g $\text{Ba}(\text{NO}_3)_2$

(Findlay, Chem. Soc. 1914, 105, 780.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $19.5^\circ$ .

% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.	% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.
1	1.009	6	1.050
2	1.017	7	1.060
3	1.025	8	1.069
4	1.034	9	1.078
5	1.042	10	1.087

(Calculated by Gerlach, Z. anal. 8, 286, from Kremers, Pogg. 95, 110.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $18^\circ$ .

% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.
4.2	1.0340
8.4	1.0712

(Kohlrausch, W. Ann. 1879, 1.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $17.5^\circ$ .

% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.	% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.
1	1.0085	6	1.0510
2	1.0170	7	1.0600
3	1.0255	8	1.0690
4	1.0340	Sat. sol.	1.0690
5	1.0425		..

(Gerlach, Z. anal. 27, 283.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at room temp

% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.
5.25	1.0507
2.98	1.0274

(Wagner, W. Ann. 1883, 18, 264.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
$\frac{1}{2}$ normal	1.0518
$\frac{1}{4}$ "	1.0259
$\frac{1}{8}$ "	1.0130

(Wagner, Z. phys. Ch. 1890, 5, 35.)

$\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  containing 6.08%  $\text{Ba}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.0517$ .

$\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  containing 6.97%  $\text{Ba}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.0597$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 279.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $20^\circ$  containing M g. mols. salt per liter.

M	0.01	0.025	0.05
Sp. gr.	1.002031	1.005224	1.010591

M	0.075	0.10	0.15
Sp. gr.	1.015671	1.021143	1.031770

(Jones and Pearce, Am. Ch. J. 1907, 38, 708.)

Sp. gr. of sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	g $\text{Ba}(\text{NO}_3)_2$ sol. in 100 g $\text{H}_2\text{O}$	Sp. gr.
0	5.2	1.043
10	7.0	1.056
20	9.2	1.073
30	11.6	1.087
40	14.2	1.104
50	17.1	1.121
60	20.3	1.137
70	23.6	1.146

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, 44, 1565.)

Saturated  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  contains:—  
36.18 pts  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , and  
boils at  $101.1^\circ$ . (Griffiths.)

35.2 pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , and boils at 101.65°. (Gay-Lussac.)

34.8 pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , and boils at 101.9°. (Mulder.)

34.8 pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , and boils at 102.5°. (Kremers.)

Sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  forms a crust at 101.1°; highest temp. observed was 101.5°. (Gerlach, Z. anal. 26. 427.)

B. pt. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  containing pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ .

B-pt	Pts. $\text{Ba}(\text{NO}_3)_2$
100 5°	13 5
101 0	26 0
101 1	27 5

(Gerlach, Z. anal. 26. 440.)

Insol. in conc.  $\text{HNO}_3 + \text{Aq}$ , and much less sol. in dil.  $\text{HNO}_3 + \text{Aq}$  or  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ .

Solubility of  $\text{Ba}(\text{NO}_3)_2$  in  $\text{HNO}_3 + \text{Aq}$  at 30°

Sp. gr. of sat. solution	G. mol. per l.	
	$\text{HNO}_3$	$\text{Ba}(\text{NO}_3)_2$
1 0801	0 0000	0.4270
1 0811	0 1318	0 3282
	0 2406	0 3268
1 0663	0 4995	0 2410
1 0619	0 7494	0 1785
1 0609	1 000	0.1353
1 0633	1 247	0.1050
1 0668	1 493	0 0847
1 0783	1 998	0 0598
1 1050	2 993	0 0334
1 1341	3 986	0 0218
1 1341	3 994	0 0223
1 1645	5 012	0 0147

(Masson, Chem. Soc. 1011, 99. 1136.)

Less sol. in dil.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  than in dil.  $\text{HCl} + \text{Aq}$ .

Solubility in  $\text{NH}_4\text{Cl} + \text{Aq}$  is the same as in  $\text{H}_2\text{O}$ .

Less sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Pearson, Zeit. Ch. (2) 5. 662.)

$\text{Ba}(\text{NO}_3)_2$  is sol. in about—

13.33 pts.  $\text{H}_2\text{O}$  at ord. temp., and 4.67 pts. at 100°.

14.07 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (conc.) at ord. temp., and 5.67 pts. at 100°.

16.50 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 vol. conc. + 3 vols.  $\text{H}_2\text{O}$ ) at ord. temp.

28.00 pts.  $\text{HCl} + \text{Aq}$  (1 vol. conc.  $\text{HCl} + 4$  vols.  $\text{H}_2\text{O}$ ) at ord. temp.

29.00 pts.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (1 vol. commercial  $\text{HC}_2\text{H}_3\text{O}_2 + 1$  vol.  $\text{H}_2\text{O}$ ) at ord. temp.

13.67 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 pt.  $\text{NH}_4\text{Cl} + 10$  pts.  $\text{H}_2\text{O}$ ) at ord. temp., and 4.67 pts. at 100°.

24.00 pts.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (1 pt.  $\text{NH}_4\text{NO}_3 + 10$  pts.  $\text{H}_2\text{O}$ ) at ord. temp.

17.33 pts.  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  (dil.  $\text{NH}_4\text{OH}$  neutralised by dil.  $\text{HC}_2\text{H}_3\text{O}_2$ ) at ord. temp., and 4.33 pts. at 100°.

14.67 pts.  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (dil.  $\text{HC}_2\text{H}_3\text{O}_2$  neutralised by  $\text{Na}_2\text{CO}_3$  and dil. with 4 vols.  $\text{H}_2\text{O}$ ) at ord. temp., and 5.33 pts. at 100°.

17.33 pts.  $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  (see Stolba, Z. anal. 2. 390) at ord. temp., and 6.00 pts. at 100°.

18.67 pts. grape sugar (1 pt. grape sugar + 10 pts.  $\text{H}_2\text{O}$ ) at ord. temp. (Pearson, Zeit. Ch. 1869. 662.)

Sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  without pptn. at first, but finally  $\text{NH}_4\text{Cl}$  is pptd. until a certain state of equilibrium is reached. (Karsten.)

Solubility in  $\text{BaO}_2\text{H}_2$ ,  $8\text{H}_2\text{O} + \text{Aq}$  at 25°

Sp. gr. 25°/25°	G. $\text{BaO}$ in $\text{Ba}(\text{OH})_2$ in 100 g. $\text{H}_2\text{O}$	G. $\text{Ba}(\text{NO}_3)_2$ in 100 g. $\text{H}_2\text{O}$
1 0797	0	10 30
1 1002	1.55	10 06
1 1210	3.22	11 04
* 1 1448	5.02	11.48

\* This solution is sat. with respect to both  $\text{Ba}(\text{OH})_2$ ,  $8\text{H}_2\text{O}$  and  $\text{Ba}(\text{NO}_3)_2$ .

(Parsons J. Am. Chem. Soc. 1910, 32. 1385.)

See also under  $\text{BaO}_2\text{H}_2$ .

Solubility in  $\text{BaCl}_2 + \text{Aq}$  at t°.

t°	Sat. solution contains	
	% $\text{BaCl}_2$	% $\text{Ba}(\text{NO}_3)_2$
—7	21.4	4.0
—1	23.0	4.0
+1 5	22.6	4.4
2		5.0
10	24.7	6.1
21	24.5	5.6
32	26.6	7.7
35	26.4	7.7
38	26.7	7.8
48	28.1	8.0
53	28.5	9.0
53	28.3	9.2
66	28.0	10.0
73	30.0	10.5
79	30.3	11.2
90	32.1	12.5
155	32.5	23.1
162	33.1	23.4
210	32.5	31.9

(Etard, A. ch. 1894, (7) 3. 287.)

See also under  $\text{BaCl}_2$ .

$\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2$ .  
Very sl. sol. in sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ . (Karsten.)

100 pts. sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2 + \text{Aq}$  contain 33.95 pts. of the two salts at 19–20°.

(v. Hauer, J pr. 98. 137.)

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2$  at 25°.

G per l		Sp gr.
$\text{Ba}(\text{NO}_3)_2$	$\text{Pb}(\text{NO}_3)_2$	
102.2	0	1.079
54.9	17.63	1.088
86.5	49.80	1.108
79.7	68.10	1.119
77.0	97.20	1.140
69.8	130.7	1.163
66.0	177.3	1.198
57.5	247.7	1.252
25.9	334.3	1.294
28.8	429.7	1.376
0	553.8	1.459

(Fock, Z. Kryst. Min. 1897, 28. 365, 397.)

100 com.  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat. at 17° contain 3.22 g.  $\text{Ba}(\text{NO}_3)_2$  and 38.59 g.  $\text{Pb}(\text{NO}_3)_2$  and solution has sp. gr = 1.350 (Euler, Z. phys. Ch. 1904, 46. 313.)

100 pts. sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2 + \text{Aq}$  contain 45.90 pts. of the three salts at 19–20°. (v. Hauer, l. c.)

$\text{Ba}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2$   
100 pts. sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2 + \text{Aq}$  contain 45.96 pts. of the two salts at 19–20°. (v. Hauer, l. c.)

$\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve.

		(Mulder)			
		(1)			
KNO <sub>3</sub>	29.7	28.8	8 9		
Ba(NO <sub>3</sub> ) <sub>2</sub>	..	5 4			
		34 2			
		(Karsten)		(Kopp)	
		(2)	(3)	(1)	(5)
KNO <sub>3</sub>	13.31	29.03		5.7	8.5
Ba(NO <sub>3</sub> ) <sub>2</sub>	6.91	1.00		33.1	36.3
	20 22	30 03		38 8	39 8

1. Sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  sat. with  $\text{KNO}_3$  at 18.5°.

2. To sat.  $\text{KNO}_3 + \text{Aq}$ ,  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  was added.

3. To sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$ ,  $\text{KNO}_3$  was added.

4. Both salts in excess +  $\text{Aq}$  at 21.5°.

5. Both salts in excess +  $\text{Aq}$  at 23°.

11. of the solution contains 59.1 g.  $\text{Ba}(\text{NO}_3)_2 + 124.2$  g.  $\text{KNO}_3 = 183.35$  g. mixed salts at 17°. Sp. gr.  $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3 + \text{Aq} = 1.120$ .  
11. of the solution contains 88.7 g.  $\text{Ba}(\text{NO}_3)_2 + 213.6$  g.  $\text{KNO}_3 = 302.3$  g. mixed salts at 30°. Sp. gr.  $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3 + \text{Aq} = 1.191$ . (Euler, Z. phys. Ch. 1904, 49. 313.)

Solubility in  $\text{KNO}_3 + \text{Aq}$  at 25°.

100 pts. of solution contain		Solid phase
$\text{KNO}_3$	$\text{Ba}(\text{NO}_3)_2$	
15.24	6.64	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
14.69	6.60	"
14.79	6.62	"
16.30	5.49	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
21.99	3.04	$\text{KNO}_3 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
27.66	2.01	"
27.81	2.09	"
27.94	1.92	"
27.64	2.05	"

These results show that a double salt of potassium and barium nitrates is formed at 25°.

(Foote, Am. Ch. J. 1904, 32. 252.)

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$  at t°.

t°	$\text{Ba}(\text{NO}_3)_2$	$\text{KNO}_3$	Solid phase
9.1	6.25	0	$\text{Ba}(\text{NO}_3)_2$
	4.20	8.15	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	1.98	12.02	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	0.98	16.80	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$
	0	16.76	$\text{KNO}_3$
21.1	8.46	0	$\text{Ba}(\text{NO}_3)_2$
	7.47	2.12	"
	6.35	5.98	"
	6.06	8.47	"
	5.98	13.24	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	3.35	18.24	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	2.30	21.47	"
	1.76	24.86	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$
	0	24.77	$\text{KNO}_3$
35	11.39	0	$\text{Ba}(\text{NO}_3)_2$
	8.18	12.09	"
	8.08	17.43	"
	8.42	19.75	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	5.85	24	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	5.02	26.05	"
	3.02	34.87	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$
	1.77	34.98	$\text{KNO}_3$
	0	35.01	"

(Findlay, Chem. Soc. 1914, 105. 779.)

$\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$ .  
 $\text{Ba}(\text{NO}_3)_2$  is sol in sat  $\text{NaNO}_3$  + Aq without separation.

100 pts  $\text{H}_2\text{O}$  dissolve

	(Karsten) At 18.75°		
	86.6	88.14	8.9
$\text{NaNO}_3$			
$\text{Ba}(\text{NO}_3)_2$		3.77	
	(Kopp) At 20.2°		
	87.7	88.6	9.2
$\text{NaNO}_3$			
$\text{Ba}(\text{NO}_3)_2$		3.6	

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at 0°.

% $\text{NaNO}_3$	% $\text{Ba}(\text{NO}_3)_2$	Solub. phase
0	4.74	$\text{Ba}(\text{NO}_3)_2$
0.41	4.33	"
0.61	4.03	"
1.68	3.34	"
3.54	2.50	"
8.05	1.60	"
12.71	1.56	"
20.24	1.53	"
20.02	1.43	"
27.74	1.56	"
30.81	1.53	"
33.79	1.53	"
35.83	1.40	"
41.30	1.55	$\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$
41.68	0.51	$\text{NaNO}_3$
42.47	0	"

(Coppadoro, Gazz. ch. it, 1912, 42 (1) 233)

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at 30°.

% $\text{NaNO}_3$	% $\text{Ba}(\text{NO}_3)_2$	Solub. phase
0	10.33	$\text{Ba}(\text{NO}_3)_2$
2.33	8.58	"
7.09	5.28	"
12.07	3.89	"
14.41	3.54	"
17.87	3.20	"
19.06	3.07	"
23.55	2.81	"
41.22	2.27	"
48.22	2.11	$\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$
48.50	1.00	$\text{NaNO}_3$
49.16	0	"

(Coppadoro, Gazz. ch. it. 1913, 43, I. 240.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

100 pts. hydrazine dissolves 81.1 pts.  $\text{Ba}(\text{NO}_3)_2$  at 12.5–13°. (de Bruyn, R. t. c. 1899, 18, 297.)

100 pts anhydrous hydroxylamine dissolve 11.4 pts.  $\text{Ba}(\text{NO}_3)_2$ . (de Bruyn, R. t. c. 1892, 11, 18.)

Insol. in absolute alcohol.  
 Solubility in dilute alcohol increases with the temp. (Gerardin, A. ch. (4) 5, 145)

Solubility in ethyl alcohol + Aq at 25°.

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Ba}(\text{NO}_3)_2$ in the solution
0	0	9.55
10.25	9.5	7.63
18.60	17.5	6.02
25.05	23.7	5.25
40.20	38.8	3.53
58.00	57.0	1.85
78.70	78.2	0.62
90.10	89.9	0.18
99.40	99.39	0.005

(D'Ans and Siegler, Z. phys. Ch. 1913, 82, 37.)

Completely insol. in boiling amyl alcohol. (Browning, Sill. Am. J. 143, 314.)

Solubility in organic solvents.

Solvent	% $\text{Ba}(\text{NO}_3)_2$ in the solution at 25°
Methyl alcohol	0.50
Ethyl alcohol	0.005
Acetone	0.005
Ether	very small
Paracetaldehyde	" "

(D'Ans and Siegler, Z. phys. Ch. 1913, 82, 44.)

Solubility in phenol + Aq at 25°.

Concentration of the phenol Mol./Liter	Solubility of $\text{Ba}(\text{NO}_3)_2$ Mol./Liter
0.000	0.3835
0.045	0.3785
0.082	0.3746
0.146	0.3664
0.310	0.3492
0.401	0.3400
0.501	0.3299
0.723 (sat.)	0.3098

(Rothmund and Wilmore, Z. phys. Ch. 1902, 40, 620.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Insol. in methyl acetate (Naumann, B. 1900, 42, 3790); ethyl acetate. (Naumann, B. 1904, 37, 3002.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)

Difficultly sol. in acetone (Naumann, B. 1904, 37, 4328.)

Sol. in acetone. (Eidmann, C. C. 1899, II, 1014.)

**Barium mercurous nitrate**,  $2\text{BaO}$ ,  $2\text{Hg}_2\text{O}$ ,  $8\text{N}_2\text{O}_5$ .

Decomp. by  $\text{H}_2\text{O}$  Sol in hot dil.  $\text{HNO}_3$  + Aq. and hot  $\text{Hg}_2(\text{NO}_3)_2$  + Aq. from which it crystallises on cooling (Stadeler, A. 87. 129.)

**Barium potassium nitrate**,  $\text{Ba}(\text{NO}_3)_2$ ,  $2\text{KNO}_3$ . Ppt. (Wallbridge, Am. Ch. J. 1903, 30. 154.)

Solubility determinations show that the only double salt formed by barium and potassium nitrates at  $25^\circ$  is  $\text{Ba}(\text{NO}_3)_2$ ,  $2\text{KNO}_3$ . See  $\text{Ba}(\text{NO}_3)_2$  +  $\text{KNO}_3$  under  $\text{Ba}(\text{NO}_3)_2$  (Foote, Am. Ch. J. 1904, 32. 252.)

**Barium nitrate melatungstate**,  $2\text{Ba}(\text{NO}_3)_2$ ,  $\text{Ba}_2\text{WO}_{12}$  +  $6\text{H}_2\text{O}$ .

Efflorescent. Sol. in warm  $\text{H}_2\text{O}$ . (Péchar, A. ch. (6) 22. 198.)

**Bismuth nitrate, basic**,  $\text{Bi}_2\text{O}_3$ ,  $\text{N}_2\text{O}_5$  +  $2\text{H}_2\text{O}$ .

Sol. in a large amount of  $\text{H}_2\text{O}$ . Sol in  $\text{HNO}_3$  + Aq. (Reintz.)

Sol. in 135 pts.  $\text{H}_2\text{O}$  at  $90$ – $93^\circ$ . (Ruge, J. B. 1882. 163.)

+  $\frac{1}{2}\text{H}_2\text{O}$  Sol. in much  $\text{H}_2\text{O}$ . (Yvon, C. R. 84. 1161.)

+  $\text{H}_2\text{O}$ . (Ruge.)

$2\text{Bi}_2\text{O}_3$ ,  $\text{N}_2\text{O}_5$ . Not acted upon by  $\text{H}_2\text{O}$  (Ditte, C. R. 84. 1317.)

+  $\text{H}_2\text{O}$ . (Yvon.)

$\text{Bi}_2\text{O}_3$ ,  $2\text{N}_2\text{O}_5$  +  $\text{H}_2\text{O}$ . (Ruge.)

$11\text{Bi}_2\text{O}_3$ ,  $5\text{N}_2\text{O}_5$  +  $16\text{H}_2\text{O}$ . Not decomp. by  $\text{H}_2\text{O}$  (Yvon.)

$5\text{Bi}_2\text{O}_3$ ,  $4\text{N}_2\text{O}_5$  +  $8\text{H}_2\text{O}$  Ppt. Not attacked by  $\text{H}_2\text{O}$ . (Schulten, Bull. Soc. 1903, (3) 29. 722.)

$5\text{Bi}_2\text{O}_3$ ,  $5\text{N}_2\text{O}_5$  +  $9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. (Schulten.)

$6\text{Bi}_2\text{O}_3$ ,  $5\text{N}_2\text{O}_5$  +  $8\text{H}_2\text{O}$ , and +  $9\text{H}_2\text{O}$ . (Rutten, Z. anorg. 1902, 30. 368.)

At  $25^\circ$  the salt  $\text{Bi}_2\text{O}_3(\text{NO}_3)_3$ ,  $9\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq. from 0.03–0.32-N; the salt  $\text{BiO}(\text{NO}_3)_2$ ,  $\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq. from 0.425–0.72-N.

At  $50^\circ$  the salt  $\text{Bi}_2\text{O}_3(\text{NO}_3)_3$ ,  $\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq. from 0.057–0.285-N; the salt  $\text{Bi}_2\text{O}_3(\text{NO}_3)_3$ ,  $9\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq. from 0.285–0.446-N.

At  $75^\circ$  the salt  $\text{Bi}_2\text{O}_3(\text{NO}_3)_3$ ,  $\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq. from 0.109–0.314-N (Allan, Am. Ch. J. 1901, 25. 314.)

**Bismuth nitrate**,  $\text{Bi}(\text{NO}_3)_3$ .

Permanent. Decomp. by little  $\text{H}_2\text{O}$  with separation of a basic salt. This decomposition is prevented by slight excess of  $\text{HNO}_3$ , and then the salt is completely sol. in a large amount of  $\text{H}_2\text{O}$ . (Rose.)

Sol in dil.  $\text{HNO}_3$  + Aq. Not decomp. by  $\text{H}_2\text{O}$  in presence of  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$  or  $\frac{1}{10}$  pt.  $\text{NH}_4\text{NO}_3$ . (Löwe, J. pr. 74. 341.)

Completely sol. in  $\text{HNO}_3$  + Aq. containing 83 g.  $\text{HNO}_3$  per liter. (Ditte.)

Solubility of  $\text{Bi}(\text{NO}_3)_3$  in  $2.3\text{N}$ – $\text{HNO}_3$  + Aq. = 2.04 g. at Bi per l.; in  $0.922\text{N}$ – $\text{HNO}_3$  + Aq. = 2.23 g. at Bi per l. (Dubrisay, C. R. 1911, 153. 1077.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Krug and M'Elroy.)

Solubility of  $\text{Bi}(\text{NO}_3)_3$  in 6.67% acetone +  $2.3\text{N}$ – $\text{HNO}_3$  + Aq. = 1.89 g. at Bi per l.; in 6.67% acetone +  $0.922\text{N}$ – $\text{HNO}_3$  + Aq. = 2.17 g. at Bi per l.; in 13.33% acetone +  $0.922\text{N}$ – $\text{HNO}_3$  + Aq. = 2.08 g. at Bi per l. (Dubrisay, C. R. 1911, 153. 1077.)

When  $\text{Bi}(\text{NO}_3)_3$  is mixed with mannite (dulcitol, sorbite) in proportion to the mol. wts. and  $\text{H}_2\text{O}$  is added, a clear solution is obtained which is not pptd. by addition of much  $\text{H}_2\text{O}$ . These solutions are more stable the greater the proportion of mannitol. (Yanno and Hunser, Z. anorg. 1901, 28. 211.)

+  $11\frac{1}{2}\text{H}_2\text{O}$ . (Ditte.)

+  $5\text{H}_2\text{O}$ . If treated with increasing amts. of  $\text{H}_2\text{O}$ , the amt. of Bi which dissolves decreases, and when 1 pt. is treated with 50,000 pts.  $\text{H}_2\text{O}$ , no Bi goes into solution. (Antony and Gigli, Gazz. ch. it. 1893, 23. 245.)

48.66 pts. are sol. in 100 pts. acetone at  $0^\circ$ .  
41.70 " " " " 100 " " "  $10^\circ$ .

(Laszczyński, B. 1894, 27. 2287.)

+  $51\frac{1}{2}\text{H}_2\text{O}$ . (Yvon, C. R. 84. 1161.)

+  $10\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  with decomp. at  $74^\circ$ . (Ordway.)

**Bismuth cesium nitrate**,  $\text{Bi}(\text{NO}_3)_3$ ,  $2\text{CsNO}_3$ .

Ppt. (Wells, Am. Ch. J. 1901, 26. 277.)

**Bismuth cobalt nitrate**,  $2\text{Bi}(\text{NO}_3)_3$ ,  $3\text{Co}(\text{NO}_3)_2$  +  $24\text{H}_2\text{O}$ .

100 cc. sat. solution in  $\text{HNO}_3$  + Aq. (sp. gr. 1.325) contain 54.67 g. hydrated salt. (Jantsch, Z. anorg. 1912, 76. 321.)

**Bismuth magnesium nitrate**,  $2\text{Bi}(\text{NO}_3)_3$ ,  $3\text{Mg}(\text{NO}_3)_2$  +  $24\text{H}_2\text{O}$ .

Deliquescent. Effloresces in dry air. Decomp. by  $\text{H}_2\text{O}$ . (Urban and Lacombe, C. R. 1903, 137. 569.)

100 cc. sat. solution in  $\text{HNO}_3$  + Aq. (sp. gr. 1.325) contain 41.69 g. hydrated salt. (Jantsch, Z. anorg. 1912, 76. 321.)

**Bismuth manganous nitrate**,  $2\text{Bi}(\text{NO}_3)_3$ ,  $3\text{Mn}(\text{NO}_3)_2$  +  $24\text{H}_2\text{O}$ .

Deliquescent. Effloresces in dry air. Decomp. by  $\text{H}_2\text{O}$ . (Urban and Lacombe, C. R. 1903, 137. 569.)

100 cc. sat. solution in  $\text{HNO}_3$  + Aq. (sp. gr. 1.325) contain 65.77 g. hydrated salt. (Jantsch, Z. anorg. 1912, 76. 321.)

**Bismuth nickel nitrate,  $2\text{Bi}(\text{NO}_3)_3, 3\text{Ni}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .**

Deliquescent. Effloresces in dry air. Decomp. by  $\text{H}_2\text{O}$ . (Urban and Lacombe, C. R. 1903, 37, 569.)

100 cc. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contain 46.20 g. hydrated salt at  $16^\circ$ . (Jantsch.)

**Bismuth zinc nitrate,  $2\text{Bi}(\text{NO}_3)_3, 3\text{Zn}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .**

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Urban and Lacombe, C. R. 1903, 137, 569.)

100 cc. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contain 57.51 g. hydrated salt at  $16^\circ$ . (Jantsch.)

**Cadmium nitrate, basic,  $\text{Cd}(\text{OH})\text{NO}_3 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ , or ordinary alcohol. (Klinger, B. 18, 997.)

$12\text{CdO}, \text{N}_2\text{O}_5 + 11\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ ; more sol. in  $\text{H}_2\text{O}$  than basic sulphate. (Habermann, 5, 432.)

5  $\text{CdO}, 2\text{N}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . (Rousseau and Tite, C. R. 114, 1184.)

**Cadmium nitrate,  $\text{Cd}(\text{NO}_3)_2$ .**

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ , see +4, and  $9\text{H}_2\text{O}$ .

Sp. gr. of aqueous solution containing.

5 10 15 20 25%  $\text{Cd}(\text{NO}_3)_2$ ,  
1.0528 1.0978 1.1516 1.2134 1.2842

30 35 40 45 50%  $\text{Cd}(\text{NO}_3)_2$ ,  
1.3566 1.4372 1.5372 1.6474 1.7608

(Franz, J. pr. (2) 5, 274.)

Sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at  $18^\circ$

%  $\text{Cd}(\text{NO}_3)_2$  1 5 10 15  
Sp. gr. 1.0069 1.0115 1.0869 1.136

%  $\text{Cd}(\text{NO}_3)_2$  20 25 30 35  
Sp. gr. 1.1903 1.25 1.3123 1.3802

%  $\text{Cd}(\text{NO}_3)_2$  40 45 48  
Sp. gr. 1.459 1.543 1.5978

(Grotrian, W. Ann. 1883, 18, 193.)

Sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

7.81 15.71 22.36%  $\text{Cd}(\text{NO}_3)_2$ ,  
1.0744 1.1593 1.2411

(Wagner, W. Ann. 1883, 18, 265.)

Sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$ .

$\text{Cd}(\text{NO}_3)_2$  t° Sp. gr. at t° Sp. gr. at  $18^\circ$

0.0492 17.57 0.99912 0.99904

0.100 21.14 0.99839 0.99845

0.240 18.00 1.0008 1.0007

0.464 17.34 1.0002 1.00025

0.952 20.22 1.0025 1.0065

(Werschofen, Z. phys. Ch. 1890, 5, 493.)

**Sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$** 

Concentration of $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0954
$\frac{1}{2}$ " "	1.0479
$\frac{1}{4}$ " "	1.0249
$\frac{1}{16}$ " "	1.0119

(Wagner, Z. phys. Ch. 1890, 5, 36.)

Sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at  $18^\circ/4^\circ$ .

%  $\text{Cd}(\text{NO}_3)_2$  54.027 43.716 30.879

Sp. gr. 1.711 1.515 1.321

%  $\text{Cd}(\text{NO}_3)_2$  21.353 14.899 8.683

Sp. gr. 1.204 1.134 1.074

(de Muynck, W. Ann. 1894, 53, 561.)

$\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  containing 7.89%  $\text{Cd}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.0673$ .

$\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  containing 12.14%  $\text{Cd}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.1070$ .

(J. e. Blanc and Rohland, Z. phys. Ch. 1896, 19, 282.)

Sat.  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  boils at  $132^\circ$ .

Almost entirely insol. in conc.  $\text{HNO}_3 + \text{Aq}$ . (Wurtz.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Sol. in alcohol

Sol. in ethyl acetate. (Naumann, B. 1904, 37, 3601.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II, 1014.)

$+4\text{H}_2\text{O}$ . M.-pt. of  $\text{Cd}(\text{NO}_3)_2 + 4\text{H}_2\text{O} = 59.5^\circ$ . (Ordway; Tilden, Chem. Soc. 45, 409.)

Solubility in  $\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$  at t°.

t°	% $\text{Cd}(\text{NO}_3)_2$ in the solution	Mols $\text{H}_2\text{O}$ to 1 mol $\text{Cd}(\text{NO}_3)_2$
0	52.31	11.96
18	55.90	10.34
30	58.40	9.34
40	61.42	8.24
59.5 mpt	76.54	4.00

(Funk, B. 1899, 32, 105.)

Sat. solution of  $\text{Cd}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $0^\circ$  contains 52.3%  $\text{Cd}(\text{NO}_3)_2$ ; at  $18^\circ$ , 55.9%  $\text{Cd}(\text{NO}_3)_2$ . (Mylus, Z. anorg. 1912, 74, 411.)

Sol. in liquid  $\text{NH}_3$ . (Johnson and Wilsmore, Elektroch. Z. 1908, 14, 227.)

Sol. in acetone. (Naumann, B. 1904, 37, 4328.)

Sol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

$+9\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

$-13^\circ$   $-1^\circ$   $+1^\circ$

37.37 47.33 52.73%  $\text{Cd}(\text{NO}_3)_2$ .

Cryohydrate is formed at  $-16^{\circ}$ . (Funk, Z. anorg. 1899, 20, 416.)

The composition of the hydrates formed by  $\text{Cd}(\text{NO}_3)_2$  at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by  $\text{Cd}(\text{NO}_3)_2$  and of the conductivity and sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq.}$  (Jones, Am. Ch. J. 1905, 34, 308.)

Cadmium uranyl nitrate,  $\text{Cd}(\text{NO}_3)_2$ ,  
( $\text{UO}_2$ )( $\text{NO}_3$ ) $_2 + 30\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  and acids. Insol. in alcohol and alkalies + Aq. (Lancien, C. C. 1912, 1 208.)

Cadmium nitrate ammoniac,  $\text{Cd}(\text{NO}_3)_2 \cdot 6\text{NH}_3 + \text{H}_2\text{O}$ .

(André, C. R. 104, 987.)

Cadmium nitrate cupric oxide,  $\text{Cd}(\text{NO}_3)_2$ ,  
 $\text{CuO} + 5\text{H}_2\text{O}$ .

Ppt. (Mailhe, C. R. 1902, 134, 235.)

Cadmium nitrate cupric oxide,  $\text{Cd}(\text{NO}_3)_2$ ,  
 $3\text{CuO} + 5\text{H}_2\text{O}$

(Mailhe, A. ch 1902, (7) 27, 383.)

Cadmium nitrate hydrazine,  $\text{Cd}(\text{NO}_3)_2$ ,  
 $3\text{N}_2\text{H}_4$ .

Decomp. by hot  $\text{H}_2\text{O}$ . Sol. in warm  $\text{NH}_4\text{OH}$ . (Franzen, Z. anorg. 1908, 60, 282.)

Cæsium nitrate,  $\text{CsNO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 10.58 pts.  $\text{CsNO}_3$  at  $3.2^{\circ}$  S. Sol. in absolute alcohol. (Bunsen.)

Solubility of  $\text{CsNO}_3$  in  $\text{H}_2\text{O}$  at  $t^{\circ}$ .

$t^{\circ}$	G $\text{CsNO}_3$ per 100 g		$t^{\circ}$	G $\text{CsNO}_3$ per 100 g	
	Solu- tion	Water		Solu- tion	Water
0	8.54	9.33	60	45.6	83.8
10	12.97	14.9	70	51.7	107.0
20	18.7	23.0	80	57.8	134.0
30	25.3	33.9	90	62.0	165.0
40	32.1	47.2	100	66.3	197.0
50	39.2	64.4	106.2	68.8	220.3

(Berkeley, Trans. Roy. Soc 1904, 203 A, 213.)

100 g.  $\text{H}_2\text{O}$  dissolve 26.945 g.  $\text{CsNO}_3$  at  $26^{\circ}$ . (Haigh, J. Am. Chem. Soc. 1912, 34, 1148.)

Sp. gr.  $20^{\circ}/4^{\circ}$  of a normal solution of  $\text{CsNO}_3 = 1.140905$ ; of a 0.5 normal solution = 1.07001. (Haigh.)

Sol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37, 4328.)

Solubility in glycol = 8% at ord. temp. (de Coninck, Belg. Acad. Bull. 1905, 359.)

Cæsium hydrogen nitrate.

$\text{CaNO}_3 \cdot \text{HNO}_3$ . Sol in  $\text{H}_2\text{O}$  (Wells, Am. Ch. J. 1901, 26, 273.)

$\text{CaNO}_3 \cdot 2\text{HNO}_3$  (W.)

Cæsium cerium nitrate,  $\text{Cs}_2\text{Ce}(\text{NO}_3)_6$ .

Sol. in  $\text{H}_2\text{O}$ ; very al. sol. in  $\text{HNO}_3$ . (Meyer, Z. anorg. 1901, 27, 371.)

Sol. in  $\text{HNO}_3$ . (Meyer, B. 1900, 33, 2137.)

Cæsium ferric nitrate,  $\text{CsNO}_3$ ,  $\text{Fe}(\text{NO}_3)_3 + 7\text{H}_2\text{O}$ .

Deliquescent. (Wells, Am. Ch. J. 1901, 26, 276.)

Cæsium silver nitrate,  $\text{CsNO}_3$ ,  $\text{AgNO}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Russell and Maskelyne, Roy. Soc. Proc. 26, 357.)

Cæsium thorium nitrate,  $\text{Cs}_2\text{Th}(\text{NO}_3)_4$ .

Decomp. by  $\text{H}_2\text{O}$ ; al. sol. in  $\text{HNO}_3$  (Meyer, Z. anorg. 1901, 27, 384.)

Cæsium uranyl nitrate,  $\text{Cs}(\text{UO}_2)(\text{NO}_3)_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HNO}_3$ . (Meyer, B. 1903, 36, 4057.)

Decomp. by  $\text{H}_2\text{O}$  at low temp., so that the solid phase in contact with the solution consists of the double salt and  $\text{CsNO}_3$ . At  $16^{\circ}$  100 pts. by wt. of the solution in  $\text{H}_2\text{O}$  contain 31.39 pts.  $\text{UO}_2$  and 6.59 pts.  $\text{Cs}$ . (Rumbach, B. 1904, 37, 477.)

Calcium nitrate, basic,  $\text{Ca}(\text{NO}_3)_2$ ,  $\text{CaO} \cdot \text{H}_2\text{O} + 2\frac{1}{2}\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Werner, A. ch. (6) 27, 570.)

+  $\text{H}_2\text{O}$ . As above. (Rousseau and Tite, C. R. 114, 1184.)

Calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$  with evolution of much heat.

100 pts.  $\text{H}_2\text{O}$  at  $0^{\circ}$  dissolve 84.2 pts.  $\text{Ca}(\text{NO}_3)_2$  (Poggiale.)

100 pts.  $\text{H}_2\text{O}$  at  $0^{\circ}$  dissolve 93.1 pts.  $\text{Ca}(\text{NO}_3)_2$ . (Mulder.)

Sol. in 0.25 pt. cold  $\text{H}_2\text{O}$  with reduction of temp. Sol. in all proportions in boiling  $\text{H}_2\text{O}$  (Berzelius).

Sol. in 2 pts. cold, and 0.6667 pt. boiling  $\text{H}_2\text{O}$  (Fourcroy).

Sat.  $\text{Ca}(\text{NO}_3)_2 + \text{Aq.}$  at  $12^{\circ}$  contains 33.8% (Hansenfruts, A. ch. 23, 23.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the solution contain at:

55° 80° 90° 100°  
78.16 78.20 78.37 78.43 g.  $\text{Ca}(\text{NO}_3)_2$ ,

125° 147.5° 151° (bpt. of sat. solution at 760 mm.)

78.57 78.80 79.00 g.  $\text{Ca}(\text{NO}_3)_2$ .

The anhydrous salt is the stable solid phase above  $51.3^{\circ}$ . (Bassett and Taylor, Chem. Soc. 1912, 101, 580.)

100 g. sat.  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  contain 77.3 g.  $\text{Ca}(\text{NO}_3)_2$  at 25°. (Taylor and Henderson, *J. Am. Chem. Soc.* 1915, **37**, 1692.)

*See also* +2, 3, and 4H<sub>2</sub>O.

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing.

17.55	30.10	40.13%	$\text{Ca}(\text{NO}_3)_2$ .
1.1714	1.2730	1.3857	

(Wagner, *W. Ann.* 1883, **18**, 270.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 17.5°

$\text{Ca}(\text{NO}_3)_2$	Sp. gr.	$\text{Ca}(\text{NO}_3)_2$	Sp. gr.
1	1.009	35	1.328
5	1.045	40	1.385
10	1.086	45	1.447
15	1.129	50	1.515
20	1.174	55	1.588
25	1.222	60	1.666
30	1.272		

(Franz, *J. pr.* (2) **5**, 274.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 17.5°.

$\text{Ca}(\text{NO}_3)_2$	Sp. gr.	$\text{Ca}(\text{NO}_3)_2$	Sp. gr.
10	1.076	40	1.368
20	1.163	50	1.483
30	1.261	60	1.605

(Gerlach, *Z. anal.* **27**, 283.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 18°

$\text{Ca}(\text{NO}_3)_2$	Sp. gr.	$\text{Ca}(\text{NO}_3)_2$	Sp. gr.
6.25	1.0487	37.5	1.3546
12.5	1.1016	50.0	1.5102
25.0	1.2198		

(Kohlrausch, *W. Ann.* 1879, **1**)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 24.65°.  $a = \text{no of g.} \times \frac{1}{2} \text{ mol. wt. dissolved in 1000 g. H}_2\text{O}$ ;  $b = \text{sp. gr. if } a \text{ is } \text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ ,  $\frac{1}{2} \text{ mol. wt.} = 118$ ;  $c = \text{sp. gr. if } a \text{ is } \text{Ca}(\text{NO}_3)_2$ ,  $\frac{1}{2} \text{ mol. wt.} = 82$ .

a	b	c	a	b	c
1	1.038	1.059	6	1.243	1.286
2	1.104	1.112	7	1.270	1.323
3	1.145	1.160	8	1.294	.
4	1.181	1.205	9	1.316	.
5	1.213	1.246	10	1.336	.

(Favre and Valson, *C. R.* **79**, 968.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 25°.

Concentration of $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0590
$\frac{1}{2}$ "	1.0300
$\frac{1}{4}$ "	1.0151
$\frac{1}{8}$ "	1.0076

(Wagner, *Z. phys. Ch.* 1890, **5**, 36.)

$\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing 7.15%  $\text{Ca}(\text{NO}_3)_2$  has sp. gr. 20°/20° = 1.0554.

$\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing 7.91%  $\text{Ca}(\text{NO}_3)_2$  has sp. gr. 20°/20° = 1.0613.

(Le Blanc and Rohland, *Z. phys. Ch.* 1896, **19**, 281.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 20° containing M g. mols. of salt per liter.

M	0.0125	0.025	0.05	0.125
Sp. gr.	1.001846	1.003166	1.00604	1.01523

M	0.25	0.5	0.75
Sp. gr.	1.03074	1.06011	1.08874

M	1.00	1.50
Sp. gr.	1.11751	1.17375

(Jones and Pearce, *Am. Ch. J.* 1907, **38**, 704.)

Saturated  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing 351.2 pts  $\text{Ca}(\text{NO}_3)_2$  to 100 pts. H<sub>2</sub>O boils at 151° (Legrand); 152° (Kremers).

Forms a crust at 141°, and contains 333.5 pts.  $\text{Ca}(\text{NO}_3)_2$  to 100 pts. H<sub>2</sub>O, highest temp. observed, 151°. (Gerlach, *Z. anal.* **26**, 427.)

B-pt. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing pts.  $\text{Ca}(\text{NO}_3)_2$  to 100 pts. H<sub>2</sub>O. G = according to Gerlach (*Z. anal.* **26**, 447), L = according to Legrand (*A. ch.* (2) **59**, 436).

B pt	G	L	B-pt	G	L
101°	10	15	127	215.5	
102	20	25.3	128	222.5	197.0
103	30	34.4	129	230	...
104	40	42.6	130	237.5	209.5
105	50	50.4	131	245	
106	60	57.8	132	253	222.2
107	70	64.9	133	261.5	
108	80	71.8	134	270	235.1
109	90	78.6	135	278.5	
110	98	85.3	136	287	248.1
111	106.5	91.9	137	296	
112	114.5	98.4	138	305	261.3
113	122.5	104.8	139	314.5	
114	130	111.2	140	324	274.7
115	137.5	117.5	141	333.5	
116	144	123.8	142	343.5	288.4
117	150.5	130	143	354	
118	157	136.1	144	364.5	302.6
119	163.5	142.1	145	375	
120	170	148.1	146	386	317.4
121	176	154	147	397.5	
122	182.5	160.1	148	409	333.2
123	189	166	149	420.5	
124	195.5	172.2	150	432.5	351.2
125	202	178	151	444.5	362.2
126	208.5	184.5	151.97	455.68	...

Sat.  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  boils at 132°. (Ordway, *Sill. Am. J.* (2) **27**, 14.)

Conc. HNO<sub>3</sub> precipitates  $\text{Ca}(\text{NO}_3)_2$  from its aqueous solution. (Mitscherlich, *Pogg.* **18**, 159.)

Very sol. in conc. HNO<sub>3</sub>. (Rawson, *J. Soc. Chem. Ind.* 1897, **16**, 113.)

Solubility in $\text{HNO}_3 + \text{Aq}$ at $25^\circ$ .			Solid phase
100 g of the solution contain	G $\text{Ca}(\text{NO}_3)_2$	G $\text{HNO}_3$	
57.98	0.00		$\text{Ca}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$
54.82	3.33		
52.96	5.87		
51.58	7.21		
47.82	11.27		
45.59	13.71		
40.70	19.65		
38.17	22.80		
34.46	28.81		
32.84	32.63		
32.50	33.52		$\text{Ca}(\text{NO}_3)_2 + 3\text{H}_2\text{O}$
33.44	35.63		
29.05	41.66		
27.79	45.70		
31.09	40.56		
26.07	45.70		
17.41	55.48		
12.25	62.05		
9.34	65.69		
8.52	67.20		
5.06	71.12		$\text{Ca}(\text{NO}_3)_2$
2.53	74.77		
1.05	78.56		
0.54	80.83		
0.36	85.83		
0.01 (about)	90.90		
0.00	96.86		

These results show that the hydrates of  $\text{Ca}(\text{NO}_3)_2$ , which are stable at  $25^\circ$  in contact with  $\text{HNO}_3 + \text{Aq}$  are  $\text{Ca}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$ ,  $+3\text{H}_2\text{O}$  and  $+2\text{H}_2\text{O}$ .

(Bassett and Taylor, Chem Soc. 1912, 101, 582.)

Sol. in glacial  $\text{HCl} + \text{H}_2\text{O}_2$ . (Persoz.)

Sol. in sat.  $\text{KNO}_3 + \text{Aq}$  with elevation of temp. and pptn. of a portion of  $\text{KNO}_3$ . (Fourcroy and Vauquelin, A. ch. 11, 135.)

Solubility of $\text{Ca}(\text{NO}_3)_2 + \text{NaNO}_3$ at $t^\circ$ .			
$t^\circ$	% $\text{Ca}(\text{NO}_3)_2$	% $\text{NaNO}_3$	Solid phase
9	47.51	9.51	$\text{Ca}(\text{NO}_3)_2, 4\text{H}_2\text{O}$ " $+ \text{NaNO}_3$ $\text{NaNO}_3$ "
	46.08	12.56	
	26.67	23.32	
	11.76	34.26	
25	54.58	7.25	$\text{Ca}(\text{NO}_3)_2, 4\text{H}_2\text{O}$ " $+ \text{NaNO}_3$ $\text{NaNO}_3$ " " "
	53.22	10.70	
	52.73	12.08	
	52.40	11.58	
	37.31	19.48	
	26.91	24.98	
	14.61	36.12	

(Kremann and Rothmund, Z. anorg. 1914, 86, 373.)

Solubility of $\text{Ca}(\text{NO}_3)_2 + \text{CaS}_2\text{O}_8$ at $t^\circ$ .			
$t^\circ$	% $\text{Ca}(\text{NO}_3)_2$	% $\text{CaS}_2\text{O}_8$	Solid phase
9	46.02	5.46	$\text{Ca}(\text{NO}_3)_2, 4\text{H}_2\text{O}$ " $+ \text{CaS}_2\text{O}_8, 6\text{H}_2\text{O}$ $\text{CaS}_2\text{O}_8, 6\text{H}_2\text{O}$ "
	45.68	6.81	
	27.92	10.46	
	10.49	22.81	
		29.33	$\text{Ca}(\text{NO}_3)_2, 4\text{H}_2\text{O}$ " " $+ \text{CaS}_2\text{O}_8, 6\text{H}_2\text{O}$ $\text{CaS}_2\text{O}_8, 6\text{H}_2\text{O}$ " "
25	54.03	4.27	
	50.25	9.10	
	45.92	13.	
	42.03	13.83	
	32.01	17.09	
	19.51	23.78	
	8.15	29.85	

(Kremann and Rothmund, Z. anorg. 1914, 86, 373.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Sol. in 0.8 pt. alcohol (Macquer); 1 pt. boiling alcohol. (Bergmann.)

Dry  $\text{Ca}(\text{NO}_3)_2$  is sol. in 7 pts. alcohol at  $15^\circ$  and 1 pt. boiling alcohol. (Bergmann.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{alcohol}$ .

% $\text{Ca}(\text{NO}_3)_2$	Sp. gr. $20^\circ/20^\circ$
0	0.7949
4.96	0.8278
6.47	0.8383

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 284.)

Solubility in ethyl alcohol + Aq at  $25^\circ$ .

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Ca}(\text{NO}_3)_2$ in the solution
*0	0	82.5
*25.1	5.8	77.0
*50.1	15.2	69.52
*60.1	20.4	66.08
*63.9	22.4	64.94
70.4	26.5	62.3
72.0	27.39	61.96
73.4	28.5	61.15
75.3	29.9	60.3
*84.9	35.9	57.7
*99.1	48.1	51.4

\* Metastable solutions.

(D'Ans and Siegler, Z. phys. Ch. 1913, 82, 43.)

Solubility of  $\text{Ca}(\text{NO}_3)_2 \cdot 2\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH} + \lambda$  at  $25^\circ$ .

$\% \text{ C}_2\text{H}_5\text{OH}$ in the solvent	$\% \text{ C}_2\text{H}_5\text{OH}$ in the solution	$\% \text{ Ca}(\text{NO}_3)_2$ in the solution
98.1	60.2	38.6
94.1	54.6	41.9
85.8	42.5	50.97
80.5	35.8	55.3
75.3	29.9	60.28

(D'Ans and Siegler, *l. c.*)

See also under  $+4\text{H}_2\text{O}$ .

#### Solubility in organic solvents

Solvent	$\% \text{ Ca}(\text{NO}_3)_2$ in the solution at $25^\circ$
Methyl alcohol	65.5
Ethyl alcohol	52.0
Propyl alcohol	36.5
Isobutyl alcohol	25.0
Amyl alcohol	13.3
Acetone	58.5

(D'Ans and Siegler, *l. c.*)

Sol. in 187 pts ether-alcohol (1.1) (Fresenius, *Z. anal.* 32. 191.)

Ether ppts.  $\text{Ca}(\text{NO}_3)_2$  from its alcoholic solution. Easily sol. in boiling amyl alcohol (Browning, *Sill. Am. J.* 143. 53.)

Sol. in acetone (Naumann, *B.* 1904, 37. 4328.)

Insol. in benzonitrile (Naumann, *B.* 1914, 47. 1370.)

Insol. in methylal. (Eidmann, *C. C.* 1899, II. 1014.)

1 g.  $\text{Ca}(\text{NO}_3)_2$  is sol. in 1.44 g. methyl acetate at  $18^\circ$ . Sp. gr.  $18^\circ/4^\circ$  of sat. solution = 1.313. (Naumann, *B.* 1909, 42. 3795.)

Sol. in ethyl acetate. (Naumann, *B.* 1910, 43. 314.)

$+2\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$

100 g. of the solution contain at

$40^\circ$   $51^\circ$

77.49 78.05 g.  $\text{Ca}(\text{NO}_3)_2$ .

Solutions in stable equilibrium with the dihydrate can only exist between the limits of temp.  $48.1^\circ$  and  $51.3^\circ$ . (Bassett and Taylor, *Chem. Soc.* 1912, 101. 580.)

$+3\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 g. of the solution contain at:

$40^\circ$   $45^\circ$   $50^\circ$   $51^\circ$

70.37 71.45 73.79 74.73 g.  $\text{Ca}(\text{NO}_3)_2$ .

Mpt. of  $\text{Ca}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} = 51.1^\circ$ .

(Bassett and Taylor, *l. c.*)

$+4\text{H}_2\text{O}$ .  $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$  melts in its crystal  $\text{H}_2\text{O}$  at  $44^\circ$ . (Tilden, *Chem. Soc.* 45. 409.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

100 g. of the solution contain g.  $\text{Ca}(\text{NO}_3)_2$  at  $t^\circ$ .

$t^\circ$	G $\text{Ca}(\text{NO}_3)_2$
-26.7	43.37
-10.0	47.31
0.0	50.50
+5.0	51.97
10.0	53.55
15.0	54.94
20.0	56.39
25.0	57.98
30.0	60.41
35.0	62.88
40.0	66.21
42.4	68.68
42.5	68.74
42.7	mpt of $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
42.45	71.70

(Bassett and Taylor, *l. c.*)

Solubility of  $\alpha$  and  $\beta$  modifications in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$\alpha$  modification is the stable form.

$t^\circ$	G $\text{Ca}(\text{NO}_3)_2$ in 100 g. of solution	Solid phase
0	50.17	$\alpha \text{ Ca}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$
22.2	56.88	$\alpha$ "
25.0	57.90	$\alpha$ "
30.0	60.16	$\alpha$ "
30.0	61.57	$\beta$ "
34.0	63.66	$\beta$ "
35.0	62.88	$\alpha$ "
38.0	64.34	$\alpha$ "
38.0	66.65	$\beta$ "
39.0	67.93	$\beta$ "
<sup>1</sup> 39.6	69.50	$\beta$ "
<sup>2</sup> 39.0	75.34	$\beta$ "
40.0	66.21	$\alpha$ "
<sup>1</sup> 42.7	69.50	$\alpha$ "
<sup>2</sup> 42.4	71.70	$\alpha$ "

<sup>1</sup> mpt. of hydrate.

<sup>2</sup> reflex pt

(Taylor and Henderson, *J. Am. Chem. Soc.* 1915, 37. 1692.)

Sp. gr. of solution sat. at  $18^\circ = 1.548$ , containing 54.8%  $\text{Ca}(\text{NO}_3)_2$ . (Mylius, *B.* 1897, 30. 1718.)

## Solubility in ethyl alcohol + Aq at 25°.

% C <sub>2</sub> H <sub>5</sub> OH in the solvent	% C <sub>2</sub> H <sub>5</sub> OH in the solution	% Ce(NO <sub>3</sub> ) <sub>2</sub> in the solution
0	0	57.5
18.3	3.5	56.1
39.2	8.1	55.2
59.2	14.1	52.9
80.4	22.3	50.2
90.4	29.4	49.0
99.4	31.1	49.7
99.4	31.2	52.0
99.4	29.5	56.2
90.1	28.3	58.9
60.1	27.8	60.0
60.1	27.3	60.7
60.1	26.5	62.3

(D'Ans and Siegler, Z. phys. Ch. 1913, 82, 42.)

Calcium nitrate hydrazine, Ca(NO<sub>3</sub>)<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>, +H<sub>2</sub>O.

Ppt. (Franzen, Z. anorg. 1908, 60, 288.)

Calcium nitrate tungstosilicate, Ca<sub>2</sub>W<sub>12</sub>SiO<sub>46</sub>, Ca(NO<sub>3</sub>)<sub>2</sub>.+13H<sub>2</sub>O and +15H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Wyruboff, Chem. Soc. 1897, 72, (2) 176.)Ceric nitrate, Ce(NO<sub>3</sub>)<sub>3</sub> + 6H<sub>2</sub>O.

Not very deliquescent. (Jolin.)

Very sol. in H<sub>2</sub>O; sol. in 2 pts. alcohol. (Vanquelin.)

Sol. in acetone. (Eidmann, C. C. 1899, II 1014; Neumann, B. 1904, 37, 4328.)

Ceric nitrate, Ce(NO<sub>3</sub>)<sub>3</sub>.Deliquescent. Decomp. by hot H<sub>2</sub>O (Berzelius.)

Sol. in alcohol. (Dumas)

Basic compounds containing 12 mols. or less CeO<sub>2</sub> to 1 mol. N<sub>2</sub>O<sub>5</sub> may be obtained, which are sol. in H<sub>2</sub>O (Ordway)Cerous cobaltous nitrate, 2Ce(NO<sub>3</sub>)<sub>3</sub>, 3Co(NO<sub>3</sub>)<sub>2</sub> + 24H<sub>2</sub>O.

Deliquescent. Easily forms supersaturated solutions. (Lange, J. pr. 82, 129.)

1 l. sat. solution in HNO<sub>3</sub> + Aq (sp. gr. 1.325) contains 103.3 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76, 321.)Ceric cobaltous nitrate, CeCo(NO<sub>3</sub>)<sub>6</sub> + 8H<sub>2</sub>O.Decomp. by H<sub>2</sub>O when heated; sol. in cold H<sub>2</sub>O; sl. sol. in HNO<sub>3</sub>. (Meyer, Z. anorg. 1901, 27, 376.)Cerous magnesium nitrate, 2Ce(NO<sub>3</sub>)<sub>3</sub>, 3Mg(NO<sub>3</sub>)<sub>2</sub> + 24H<sub>2</sub>O.Slightly deliquescent. Easily sol. in H<sub>2</sub>O or alcohol, and easily forms supersaturated solutions. (Holzmann, J. pr. 75, 330.)1 l. sat. solution in HNO<sub>3</sub> + Aq (sp. gr. 1.325) contains 63.8 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76, 321.)Ceric magnesium nitrate, CeMg(NO<sub>3</sub>)<sub>6</sub> + 8H<sub>2</sub>O.Decomp. by H<sub>2</sub>O; sol. in HNO<sub>3</sub> + Aq without decomp. (Meyer, Z. anorg. 1901, 27, 373.)Cerous manganous nitrate, 2Ce(NO<sub>3</sub>)<sub>3</sub>, 3Mn(NO<sub>3</sub>)<sub>2</sub> + 24H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Lange, J. pr. 82, 129.)1 l. sat. solution in HNO<sub>3</sub> + Aq (sp. gr. 1.325) contains 193.1 g. hydrous salt at 16°. (Jantsch.)Ceric manganous nitrate, CeMn(NO<sub>3</sub>)<sub>6</sub> + 8H<sub>2</sub>O.Decomp. by H<sub>2</sub>O and dil. HNO<sub>3</sub>; sol. in conc. HNO<sub>3</sub> without decomp. (Meyer, Z. anorg. 1901, 27, 377.)Cerous nickel nitrate, 2Ce(NO<sub>3</sub>)<sub>3</sub>, 3Ni(NO<sub>3</sub>)<sub>2</sub> + 24H<sub>2</sub>O.Easily sol. in H<sub>2</sub>O. (Holzmann, J. pr. 75, 321.)1 l. sat. solution in HNO<sub>3</sub> + Aq (sp. gr. 1.325) contains 80.3 g. hydrous salt at 16°. (Jantsch.)Ceric nickel nitrate, CeNi(NO<sub>3</sub>)<sub>6</sub> + 8H<sub>2</sub>O.Decomp. by H<sub>2</sub>O when heated, sol. in H<sub>2</sub>O in the cold; sl. sol. in HNO<sub>3</sub>. (Meyer, Z. anorg. 1901, 27, 375.)Cerous potassium nitrate, Ce(NO<sub>3</sub>)<sub>3</sub>, 2KNO<sub>3</sub> + 2H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Lange, J. pr. 82, 136.)Ceric potassium nitrate, CeK<sub>2</sub>(NO<sub>3</sub>)<sub>6</sub>.Sol. in H<sub>2</sub>O with decomp. (Meyer, Z. anorg. 1901, 27, 370.)+1½H<sub>2</sub>O Efflorescent. (Holzmann, J. pr. 75, 324.)Ceric rubidium nitrate, CeRu<sub>2</sub>(NO<sub>3</sub>)<sub>6</sub>.Very sol. in H<sub>2</sub>O; sl. sol. in HNO<sub>3</sub>. (Meyer.)

Ceric sodium nitrate.

Deliquescent. Decomp. by recrystallization (Holzmann.)

Cerous thallous nitrate, [Ce(NO<sub>3</sub>)<sub>3</sub>]<sub>2</sub>Tl<sub>2</sub> + 4H<sub>2</sub>O.Very hygroscopic. Decomp. by H<sub>2</sub>O. (Jantsch, Z. anorg. 1911, 69, 229.)Cerous zinc nitrate, 2Ce(NO<sub>3</sub>)<sub>3</sub>, 3Zn(NO<sub>3</sub>)<sub>2</sub> + 24H<sub>2</sub>O.Sol. in H<sub>2</sub>O. Easily forms supersat. solutions (Lange, J. pr. 82, 129.)1 l. sat. solution in HNO<sub>3</sub> + Aq (sp. gr. 1.325) contains 124.1 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76, 321.)Ceric zinc nitrate, ZnCe(NO<sub>3</sub>)<sub>6</sub> + 8H<sub>2</sub>O.Decomp. by H<sub>2</sub>O; sol. in HNO<sub>3</sub> + Aq. (Meyer, Z. anorg. 1901, 27, 374.)

Ceroceric zinc nitrate (?),  $\text{Ce}_2\text{O}_3 \cdot 2\text{ZnO}$ ,  $6\text{N}_2\text{O}_5 + 18\text{H}_2\text{O}$  (?)  
Easily sol. in  $\text{H}_2\text{O}$ . (Holzmann, J. pr. 75. 321)

Chromic nitrate, basic,  $\text{Cr}_2\text{O}(\text{NO}_3)_4$ .  
Sol. in  $\text{H}_2\text{O}$ . (Löw.)  
+  $12\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ordway.)

Chromic nitrate,  $\text{Cr}(\text{NO}_3)_3 + 9\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Löw.)  
Melts in its crystal  $\text{H}_2\text{O}$  at  $36.5^\circ$ . Sat  
 $\text{Cr}(\text{NO}_3)_3 + \text{Aq}$  boils at  $125.6^\circ$ . (Ordway)  
Sp. gr. of  $\text{Cr}(\text{NO}_3)_3 + \text{Aq}$ .  
M = concentration of solution in gram. mols.

W = wt. of 25 cc. of solution.  
M 0.0934 0.1868 0.3736 0.5604 0.9340  
W 25.4300 25.8828 26.7302 27.5524 29.3072

M 1.1208 1.3076 1.4944 1.8680  
W 30.0608 30.8404 31.6327 33.3379  
(Jones and Getman, Z. phys. Ch. 1904, 49. 426.)

Sol in acetone (Naumann, B. 1904, 37. 4328; Eidmann, C. C. 1899, II. 1014.)

Chromic nitrate chloride,  $\text{CrCl}_2(\text{NO}_3)$ .  
Sol. in  $\text{H}_2\text{O}$  and alcohol. (Schiff, A. 124. 177.)  
 $\text{Cr}(\text{NO}_3)_2\text{Cl}$  (Schiff.)

Chromic nitrate sulphate,  $\text{Cr}_2(\text{SO}_4)(\text{NO}_3)_4$ .  
Hygroscopic. Completely sol. in  $\text{H}_2\text{O}$ .  
 $\text{Cr}_2(\text{SO}_4)_2(\text{NO}_3)_2$ . Sol in  $\text{H}_2\text{O}$ . (Schiff, A. 124. 174.)

Cobaltous nitrate, basic,  $6\text{CoO} \cdot \text{N}_2\text{O}_5 + 5\text{H}_2\text{O}$ .  
Ppt. Gradually sol. in  $\text{H}_2\text{O}$  with deposition of  $\text{CoO}$ . (Winkelblech, A. 13. 155)  
Sol. in cold  $\text{HCl}$  and  $\text{HNO}_3 + \text{Aq}$ . Decomp. by hot  $\text{KOH} + \text{Aq}$ .  
 $4\text{CoO} \cdot \text{N}_2\text{O}_5 + 6\text{H}_2\text{O}$ . Ppt. (Habermann, M. 5. 432.)

Cobaltous nitrate,  $\text{Co}(\text{NO}_3)_2$ .  
Deliquescent in moist air. Very sol. in  $\text{H}_2\text{O}$ .  
See +3, 6, and  $9\text{H}_2\text{O}$ .

Sp. gr. of aqueous solution at  $17.5^\circ$  containing:

5 10 15 20%  $\text{Co}(\text{NO}_3)_2$ ,  
1.0462 1.0906 1.1378 1.1936

25 30 35 40%  $\text{Co}(\text{NO}_3)_2$ ,  
1.2538 1.3190 1.3806 1.4662

Sp. gr. of sat. solution = 1.5382.  
(Franz, J. pr. (2) 5. 274)

Sp. gr. of  $\text{Co}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

8.28 15.96 24.528%  $\text{Co}(\text{NO}_3)_2$ .  
1.0732 1.1436 1.2288

(Wagner, W. Ann. 1883, 18. 268.)

Sp. gr. of  $\text{Co}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{Co}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
1-normal	1.0728
$\frac{1}{2}$ - " "	1.0369
$\frac{1}{3}$ - " "	1.0184
$\frac{1}{4}$ - " "	1.0094

(Wagner, Z. phys. Ch. 1890, 5. 37.)

Sp. gr at  $20^\circ$  of  $\text{Co}(\text{NO}_3)_2 + \text{Aq}$  containing  
M g mols.  $\text{Co}(\text{NO}_3)_2$  per liter.

M 0.01 0.025 0.05 0.075  
Sp. gr. 1.001496 1.003863 1.007579 1.011299

M 0.10 0.25 0.5 0.75  
Sp. gr. 1.015084 1.03737 1.07415 1.11204

M 1.0 1.5 2.0  
Sp. gr 1.14612 1.21720 1.28576  
(Jones and Pearce, Am. Ch. J. 1907, 38. 715.)

Sol. in liquid  $\text{NH}_3$ . (Guntz, Bull. Soc. 1909 (4) 5. 1009.)

100 g. sat. solution in glycol contains 80 g.  $\text{Co}(\text{NO}_3)_2$ . (de Connock, C. C. 1906, II. 883.)  
Sol in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

+  $3\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .  
Sat. solution contains at:  
 $55^\circ$   $62^\circ$   $70^\circ$   $84^\circ$   $91^\circ$  mpt.  
61.74 62.88 64.89 68.84 77.21%  $\text{Co}(\text{NO}_3)_2$ .  
(Funk, Z. anorg. 1899, 20. 408.)

+  $6\text{H}_2\text{O}$ . Melts in its crystal  $\text{H}_2\text{O}$  at  $56^\circ$  (Ordway);  $38^\circ$  (Tylden).

Solubility in  $\text{H}_2\text{O}$   
Sat. solution contains at:  
 $-21^\circ$   $-10^\circ$   $-4^\circ$   $0^\circ$   
41.55 43.69 44.85 45.86%  $\text{Co}(\text{NO}_3)_2$ ,

+  $18^\circ$   $41^\circ$   $56^\circ$  mpt.  
49.73 55.96 62.88%  $\text{Co}(\text{NO}_3)_2$ .  
(Funk, Z. anorg. 1899, 20. 408.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Easily sol. in alcohol. Sol. in 1 pt. strong alcohol at  $12.5^\circ$ . (Wenzel.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Sol. in methyl acetate. (Naumann, B. 1900, 42. 3790.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

+  $9\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .  
Sat. solution contains at:

$-26^\circ$   $-23.5^\circ$   $-20.5^\circ$   
39.45 40.40 42.77%  $\text{Co}(\text{NO}_3)_2$ .

Cryohydrate is formed at  $-29^\circ$ . (Funk, Z. anorg. 1899, 20. 409.)

Cobaltous didymium nitrate,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{D}_1(\text{NO}_3)_2 + 48\text{H}_2\text{O}$

Very deliquescent. (Frerichs and Smith, A 191. 331.)

Cobaltous gadolinium nitrate,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{Gd}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l. sat. solution in  $\text{HNO}_3$  (sp gr 1.325) contains 451.4 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 303.)

Cobaltous lanthanum nitrate,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{La}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.325) contains 109.2 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 303.)

Cobaltous neodymium nitrate,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{Nd}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.325) contains 151.6 hydrous salt at  $16^\circ$ . (Jantsch.)

Cobaltous praseodymium nitrate,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{Pr}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.325) contains 12.99 g. hydrous salt at  $16^\circ$ . (Jantsch.)

Cobaltous samarium nitrate,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{Sm}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.325) contains 34.27 g. hydrous salt at  $16^\circ$ . (Jantsch.)

Cobaltous thorium nitrate,  $\text{CoTh}(\text{NO}_3)_6 + 8\text{H}_2\text{O}$

Hydrosopic; sol. in  $\text{HNO}_3 + \text{Aq}$ . (Meyer, Z. anorg. 1901, 27. 387.)

Cobaltous nitrate ammonia,  $\text{Co}(\text{NO}_3)_2$ ,  $6\text{NH}_3 + 2\text{H}_2\text{O}$

Decomp. by  $\text{H}_2\text{O}$  with separation of basic nitrate. (Fremy.)

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Hess.)

Cobaltous nitrate cupric oxide,  $\text{Co}(\text{NO}_3)_2$ ,  $3\text{CuO} + 3\text{H}_2\text{O}$

Ppt. (Maulhe, C. R. 1902, 134. 234.)

Cobaltous nitrate hydrazine,  $\text{Co}(\text{NO}_3)_2$ ,  $3\text{N}_2\text{H}_4$

Decomp. by hot  $\text{H}_2\text{O}$ . (Franzen, Z. anorg. 1908, 60. 274.)

Cupric nitrate, basic,  $2\text{CuO}$ ,  $\text{N}_2\text{O}_5$

(Ditto, A. ch. 1879, (5) 18. 339.)

$4\text{CuO}$ ,  $\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. (Graham, A. 29. 13.)

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids (Athanasesco, Bull. Soc. 1895, (3) 11. 1113.)

$+3\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , and decomp. by heat. (Casselmann, Z. anal. 4. 24.)

Cupric nitrate,  $\text{Cu}(\text{NO}_3)_2$

Deliquescent. Very easily sol. in  $\text{H}_2\text{O}$  or alcohol, also in moderately conc  $\text{HNO}_3 + \text{Aq}$ , but is precipitated from conc. aqueous solution by  $\text{HNO}_3 + \text{Aq}$  of 1.522 sp. gr (Mitscherlich, Pogg. 18. 150.)

Sat.  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  contains at

$-10^\circ$	$-3^\circ$	$+3^\circ$
38.8	41.6	44.5% $\text{Cu}(\text{NO}_3)_2$

$8^\circ$	$20^\circ$	$32^\circ$
48.5	54.1	61.2% $\text{Cu}(\text{NO}_3)_2$

(Étard, A. ch. 1894, (7) 2. 528.)

See +3, 6, and  $9\text{H}_2\text{O}$

Sp. gr. of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at  $17.5^\circ$  containing:

5	10	15% anhydrous salt,
1.0452	1.0942	1.1442

20	25	30% anhydrous salt,
1.2036	1.2644	1.3298

35	40	45% anhydrous salt.
1.3974	1.4724	1.5576

(B. Franz, J. pr. (2) 5. 274.)

Sp. gr. of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at  $15^\circ$ .

% $\text{Cu}(\text{NO}_3)_2$	Sp. gr.
5.22	1.046
10.44	1.094
15.67	1.146
20.85	1.202
26.12	1.262
35.00	1.377

(Long, W. Ann. 1880, 11. 39.)

Sp. gr. of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

18.99	26.68	46.71% $\text{Cu}(\text{NO}_3)_2$
1.1774	1.2637	1.5363

(Wagner, W. Ann. 1883, 13. 272.)

Sp. gr. of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0755
$\frac{1}{2}$ " "	1.0372
$\frac{1}{3}$ " "	1.0185
$\frac{1}{5}$ " "	1.0092

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Sp. gr. of $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$ at $12.5^\circ$			
% $\text{Cu}(\text{NO}_3)_2$	1	5	10
Sp. gr.	1.0059	1.0320	1.0655

% $\text{Cu}(\text{NO}_3)_2$	20	24	30	34
Sp. gr.	1.1350	1.1716	1.2320	1.2712

% $\text{Cu}(\text{NO}_3)_2$	40	44	50	56
Sp. gr.	1.3320	1.3749	1.4440	1.5205

(Hassensratz, Muspratt, 1893, 4. 2243.)

Sp gr. at 20° of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  containing  
M g mols salt per liter.  
M 0.01 0.025 0.05 0.075  
Sp gr. 1.001501 1.001076 1.007859 1.011715

M 0.25 0.50 0.75 0.935  
Sp. gr. 1.010290 1.07723 1.11169 1.14262

Sp gr 1.5 2.0  
M 1.22618 1.20262  
(Jones and Pearce, *Am. Ch. J.* 1917, **38**, 719.)

Sat.  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  boils at about 173°  
(Griffiths.)  
Insol in fuming  $\text{HNO}_3$ . (Ditte, *A. ch.*  
1879 (5) **18**, 339.)

Solubility of  $\text{Cu}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$   
at 20°.

Sp gr	In 1 l. of solution				Solid phase
	$\text{Cu}(\text{NO}_3)_2$		$\text{Pb}(\text{NO}_3)_2$		
	g	g mol	g	g mol	
1.351	70.5	0.475	379.5	1.096	$\text{Pb}(\text{NO}_3)_2$
1.322	139.2	0.712	257.2	0.777	"
1.321	226.5	1.205	175.1	0.529	"
1.311	309.8	1.608	133.1	0.404	"
1.300	411.8	1.821	117.8	0.356	"
1.451	519.1	2.707	70.7	0.213	"
1.540	681.7	3.632	41.0	0.113	"
1.623	798.1	4.272	28.1	0.085	"
1.700	913.2	5.028	17.2	0.052	$\text{Pb}(\text{NO}_3)_2 + \text{Cu}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$

(Fedotief, *Z. anorg.* 1911, **73**, 178.)

Very sol in liqnd  $\text{NH}_3$  (Guntz, *Bull. Soc.*  
1909, (4) **5**, 1007)

Easily sol. in liqnd  $\text{NH}_3$ . (Franklin, *Am.*  
*Ch. J.* 1898, **20**, 827)

Insol in liqnd HF (Franklin, *Z. anorg.*  
1905, **46**, 2)

Insol. in ethyl acetate (Naumann, *B.*  
1910, **43**, 314)

Sl sol. in benzotrile (Naumann, *B.*  
1914, **47**, 1309.)

+3 $\text{H}_2\text{O}$  Melts in crystal  $\text{H}_2\text{O}$  at 114.5°  
(Ordway; Tilden, *Chem. Soc.* **45**, 409.)

Solubility in  $\text{H}_2\text{O}$

Sat. solution contains at:

25° 30° 40° 50°  
60.01 60.44 61.51 62.62%  $\text{Cu}(\text{NO}_3)_2$ .

60° 70° 80° 114.5° Mpt  
64.17 65.79 67.51 77.59%  $\text{Cu}(\text{NO}_3)_2$ .

(Funk, *Z. anorg.* 1899, **20**, 413.)

100 pts.  $\text{HNO}_3$  dissolve 2 pts. at 13°, con-  
siderably more on heating. (Ditte, *A. ch.*  
1879, (5) **18**, 339.)

Sol. in 1 pt. strong alcohol at 12.5°. (Wen-  
zel.)

Insol. in methyl acetate. (Naumann, *B.*  
1900, **42**, 3700.)

+6 $\text{H}_2\text{O}$ . Efflorescent. Melts in crystal  
 $\text{H}_2\text{O}$  at 38°. (Ordway.)

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-21° -10° 0° +10°  
39.52 42.08 45.00 48.79%  $\text{Cu}(\text{NO}_3)_2$ .

18° 20° 26.4° mpt.  
53.86 55.58 63.39%  $\text{Cu}(\text{NO}_3)_2$   
(Funk, *Z. anorg.* 1899, **20**, 413.)

Sat. solution of  $\text{Cu}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$   
at 20° contains 5.04 g. mol. per 1 Sp gr. of  
sat. solution = 1.688. (Fedotief, *Z. anorg.*  
1911, **73**, 78.)

Sat. solution of  $\text{Cu}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$   
contains 45.0 g.  $\text{Cu}(\text{NO}_3)_2$  in 100 g. solution  
at 0°, 53.9 g. at 18°. (Mylus, *Z. anorg.* 1912,  
**74**, 411)

+9 $\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$

Sat. solution contains at.

-23° -21° -20°  
36.08 37.38 40.92%  $\text{Cu}(\text{NO}_3)_2$ .

Cryohydrate is formed at -24° (Funk,  
*Z. anorg.* 1899, **20**, 414.)

Cupric nitrate ammonia (Cuprammonium  
nitrate),  $\text{Cu}(\text{NO}_3)_2 \cdot 4\text{NH}_3$

Easily sol. in  $\text{H}_2\text{O}$ , from which it can be  
recrystallized. Sol. in alcohol (Berzelius.)

Sol. in 1 pt liqnd  $\text{NH}_3$  (Horn, *Am. Ch.*  
*J.* 1908, **39**, 216.)

$\text{Cu}(\text{NO}_3)_2 \cdot 5\text{NH}_3$ . (Horn, *Am. Ch. J.*  
1907, **37**, 620.)

4 $\text{Cu}(\text{NO}_3)_2 \cdot 23\text{NH}_3$  (Horn)

Cupric nitrate hydrazine,  $\text{Cu}(\text{NO}_3)_2 \cdot \text{N}_2\text{H}_4$ .

Decomp by  $\text{H}_2\text{O}$ . (Hofmann and Marburg,  
*A.* 1899, **305**, 221.)

Cupric nitrate mercuric oxide,  $\text{Cu}(\text{NO}_3)_2$ ,  
 $\text{HgO} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Finzi,  
*Gazz. ch. it.* 1913, **43**, (2) 709.)

Didymium nitrate, basic,  $4\text{D}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 +$   
 $15\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  (Marignac.)

$2\text{D}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5$ . (Becquerel, *A. ch.* (6) **14**,  
257.)

Didymium nitrate,  $\text{Di}(\text{NO}_3)_2$

Anhydrous. Very sol in  $\text{H}_2\text{O}$ . As sol. in  
96% alcohol as in  $\text{H}_2\text{O}$ , and the solution is not  
precipitated by much ether. Insol. in pure  
ether (Marignac, *A. ch.* (3) **36**, 161.)

Moderately sol. in liqnd  $\text{NH}_3$ . (Franklin,  
*Am. Ch. J.* 1898, **20**, 827.)

Sol. in acetone. (Naumann, *B.* 1904, **37**,  
4328; Edmann, *C. C.* 1899, **11**, 1014.)

+6 $\text{H}_2\text{O}$ . Very deliquescent. (Cleve, *Bull.*  
*Soc.* (2) **43**, 361.)

- Didymium nickel nitrate**,  $2\text{Dy}(\text{NO}_3)_3 \cdot 3\text{Ni}(\text{NO}_3)_2 + 36\text{H}_2\text{O}$ .  
Very deliquescent. (Frerichs and Smith, A. 191. 355.)  
See Neodymium and praseodymium.
- Didymium zinc nitrate**,  $2\text{Dy}(\text{NO}_3)_3 \cdot 3\text{Zn}(\text{NO}_3)_2 + 69\text{H}_2\text{O}$ .  
Very deliquescent (F. and S.)  
See Neodymium and praseodymium.
- Dysprosium nitrate**,  $\text{Dy}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$ ; less sol. in  $\text{H}_2\text{O} + \text{HNO}_3$ .  
Sol. in alcohol (Urban, C. R. 1908, 146. 129.)
- Erbium nitrate, basic**,  $2\text{Er}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 + 9\text{H}_2\text{O}$ .  
Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3$ . (Bahr and Bunsen.)  
 $3\text{Er}_2\text{O}_3 \cdot 4\text{N}_2\text{O}_5 + 20\text{H}_2\text{O}$  (Cleve, Bull. Soc. (2) 21. 344.)
- Erbium nitrate**,  $\text{Er}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. (Häglund.)  
Sol. in acetone. (Naumann, B. 1904, 37. 4328.)
- Gadolinium nitrate**,  $\text{Gd}(\text{NO}_3)_3 \cdot 6\frac{1}{2}\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Benedicks, Z. anorg. 1900, 22. 406.)  
 $+5\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ . (B.)
- Gadolinium magnesium nitrate**,  $2\text{Gd}(\text{NO}_3)_3 \cdot 3\text{Mg}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .  
1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 352 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 303.)
- Gadolinium nickel nitrate**,  $2\text{Gd}(\text{NO}_3)_3 \cdot 3\text{Ni}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .  
1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 400 g. hydrous salt at  $16^\circ$ . (Jantsch.)
- Gadolinium zinc nitrate**,  $2\text{Gd}(\text{NO}_3)_3 \cdot 3\text{Zn}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .  
1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 472.7 g. hydrous salt at  $16^\circ$ . (Jantsch.)
- Gallium nitrate**,  $\text{Ga}(\text{NO}_3)_3$ .  
Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Dupré.)
- Glucinum nitrate, basic**,  $2\text{GlnO} \cdot \text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$  (?).  
Sol. in  $\text{H}_2\text{O}$ .  
 $3\text{GlnO} \cdot \text{N}_2\text{O}_5$ . Sol. in  $\text{H}_2\text{O}$  (Ordway, Sill. Am. J. (2) 26. 205.)  
Compounds more basic than this are insol. in  $\text{H}_2\text{O}$ . (Ordway.)
- Glucinum nitrate**,  $\text{Gl}(\text{NO}_3)_2 + 3\text{H}_2\text{O}$ .  
Very deliquescent. (Joy, Sill. Am. J. (2) 36. 90.)  
Easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Vauquelin.)  
Melts in its crystal  $\text{H}_2\text{O}$  at  $29.4^\circ$ . (Ordway.)  
Sat.  $\text{Gl}(\text{NO}_3)_2 + \text{Aq}$  boils at  $140.5^\circ$ . (Ordway.)
- Gold (auric) nitrate, basic**,  $\text{Au}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 + \frac{2}{3}\text{H}_2\text{O}$ , or Auryl nitrate,  $(\text{AuO})\text{NO}_3 + \frac{1}{3}\text{H}_2\text{O}$ .  
(Schottländer, A. 217. 364.)  
 $2\text{Au}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 + 2\text{H}_2\text{O} = \text{Au}_4\text{O}_6(\text{NO}_3)_2 + 2\text{H}_2\text{O}$ . Slowly sol. in  $\text{HNO}_3 + \text{Aq}$  at  $100^\circ$ . (Schottländer, A. 217. 356.)
- Gold (auric) nitrate**,  $\text{Au}(\text{NO}_3)_3 + x\text{H}_2\text{O}$ .  
Decomp. by  $\text{H}_2\text{O}$ . Sol. in acetone. (Hanriot and Raoult, C. R. 1912, 155. 1086.)
- Gold (auric) hydrogen nitrate**,  $\text{Au}(\text{NO}_3)_3 \cdot \text{HNO}_3 + 3\text{H}_2\text{O}$ .  
Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Schottländer, A. 217. 356.)
- Gold (auric) potassium nitrate**,  $\text{KAu}(\text{NO}_3)_4$ .  
Easily sol. in  $\text{H}_2\text{O}$ .  
 $\text{HK}_2\text{Au}(\text{NO}_3)_6$ . Decomp. immediately by  $\text{H}_2\text{O}$ .  
 $2\text{KAu}(\text{NO}_3)_4 \cdot \text{K}_2\text{HAu}(\text{NO}_3)_6$  (Schottländer, J. B. 1884. 453.)
- Gold (auric) rubidium nitrate**,  $\text{RbAu}(\text{NO}_3)_4$ .  
Easily sol. in  $\text{H}_2\text{O}$ .  
 $\text{HRb}_2\text{Au}(\text{NO}_3)_6$ . As above. (Schottländer.)
- Gold (auric) thallium nitrate**,  $\text{TlAu}(\text{NO}_3)_4$ .  
Easily sol. in  $\text{H}_2\text{O}$ .  
 $6\text{Au}_2\text{O}_3 \cdot 2\text{Tl}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 + 15\text{H}_2\text{O}$ . Ppt (Schottländer.)
- Indium nitrate**,  $\text{In}(\text{NO}_3)_3 + 4\frac{1}{2}\text{H}_2\text{O}$ .  
Very deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Winkler.)  
 $+1\frac{1}{2}\text{H}_2\text{O}$
- Iron (ferrous) nitrate**,  $\text{Fe}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$ .  
100 pts. of crystals dissolve in 50 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , sp. gr. of solution = 1.44, 40.8 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , sp. gr. of solution = 1.48, 33.3 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ , sp. gr. of solution = 1.50. (Ordway, Sill. Am. J. (2) 40. 325.)  
Sat. solution contains at:  

$-0^\circ$	$0^\circ$	$+18^\circ$	$24^\circ$	$60.5^\circ$	Mpt.
39.68	41.53	45.14	46.51	62.50%	$\text{Fe}(\text{NO}_3)_2$ .

(Funk, Z. anorg. 1899, 20. 406.)  
 Sat. solution of  $\text{Fe}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  contains 41.5%  $\text{Fe}(\text{NO}_3)_2$  at  $0^\circ$ ; 45.1% at  $18^\circ$ . (Mylus, Z. anorg. 1912, 74. 411.)

+9H<sub>2</sub>O. Solubility in H<sub>2</sub>O.  
Sat. solution contains at:  
-27° -21.5° -19° -15.5°  
35.66 30.10 36.54 37.17% Fe(NO<sub>3</sub>)<sub>2</sub>

Cryohydrate is formed at -28° (Funk, Z. anorg. 1899, 20, 497.)

Fe(NO<sub>3</sub>)<sub>2</sub>+Aq decomposes on heating, less rapidly when dil., more readily in presence of excess of acid. (Ordway)

**Iron (ferric) nitrate, basic, 36Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+48H<sub>2</sub>O (?).**

Easily sol. in H<sub>2</sub>O. Sl. sol. in dil. HNO<sub>3</sub>+Aq; very sl. sol. in alcohol. (Haussmann, A 89, 111.)

8Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+12H<sub>2</sub>O. Sl. sol in H<sub>2</sub>O; very sl. sol. in cold or warm dil. HNO<sub>3</sub>+Aq; more easily sol. in hot HCl+Aq. (Haussmann.)

+xH<sub>2</sub>O. Sol. in H<sub>2</sub>O; completely pptd from aqueous solution by NaCl, NH<sub>4</sub>Cl, KI, KClO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>, CaSO<sub>4</sub>, ZnSO<sub>4</sub>, CuSO<sub>4</sub>, KNO<sub>3</sub>, NaNO<sub>3</sub>, Ba(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>, or Zn(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+Aq. More slowly pptd. by NH<sub>4</sub>NO<sub>3</sub>, Mg(NO<sub>3</sub>)<sub>2</sub>, Ba(NO<sub>3</sub>)<sub>2</sub>, or Pb(NO<sub>3</sub>)<sub>2</sub>+Aq. Not pptd. by alcohol, Pb(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>, Cu(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>, Hg(CN)<sub>2</sub>, AgNO<sub>3</sub>, or As<sub>2</sub>O<sub>3</sub>+Aq. (Ordway, Silf. Am. J. (2) 9, 30.)

4Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+1½H<sub>2</sub>O. Easily sol in H<sub>2</sub>O, sl. sol. in dil. HNO<sub>3</sub>+Aq, and in alcohol. (Haussmann.)

+3H<sub>2</sub>O Insol. in H<sub>2</sub>O or HNO<sub>3</sub>+Aq; sol. in HCl+Aq. (Scheurer-Kestner, C. R. 87, 927.)

+9H<sub>2</sub>O. Not deliquescent, easily sol in H<sub>2</sub>O. (Ordway.)

3Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+2H<sub>2</sub>O. Insol in H<sub>2</sub>O (Scheurer-Kestner.)

2Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+H<sub>2</sub>O Decomp. by H<sub>2</sub>O. (Scheurer-Kestner.)

+8H<sub>2</sub>O. (S.-K.)

Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub> Decomp. by H<sub>2</sub>O. (S.-K.)

Fe<sub>2</sub>O<sub>3</sub>, 2N<sub>2</sub>O<sub>5</sub>. Sol. in H<sub>2</sub>O or alcohol in all proportions. Insol. in HNO<sub>3</sub>+Aq.

N<sub>2</sub>O<sub>5</sub> with 1, 2, 3, 4, 5, 6, and 8Fe<sub>2</sub>O<sub>3</sub> forms compounds, sol. in H<sub>2</sub>O. (Ordway.)

Solubility determinations show that there are no definite basic nitrates of iron formed from solutions at 25°, and that the solid phase under these conditions is a solid solution of Fe<sub>2</sub>O<sub>3</sub>, HNO<sub>3</sub>, and H<sub>2</sub>O. The normal salt, Fe<sub>2</sub>O<sub>3</sub>, 3N<sub>2</sub>O<sub>5</sub>, 18H<sub>2</sub>O is stable in solutions containing about 30-45% N<sub>2</sub>O<sub>5</sub>. In higher concentrations of nitric acid it appears to be metastable and a new salt, Fe<sub>2</sub>O<sub>3</sub>, 4N<sub>2</sub>O<sub>5</sub>, 18(?)H<sub>2</sub>O is the stable form. (Cameron, J. phys. Chem. 1909, 13, 262.)

**Iron (ferric) nitrate, Fe(NO<sub>3</sub>)<sub>3</sub>.**

+H<sub>2</sub>O. (Scheurer-Kestner, A. ch. (3) 65, 113.)

+6H<sub>2</sub>O Deliquescent, and sol. in any amount of H<sub>2</sub>O. (Schonben, Pogg. 39, 141.)

Sol. in acetone. (Naumann, B. 1904, 37, 4328.)

+9H<sub>2</sub>O. Deliquescent. Sol. in H<sub>2</sub>O and alcohol. Sl. sol. in HNO<sub>3</sub>+Aq. 2 pts. salt with 1 pt. H<sub>2</sub>O lower the temperature 18.5°. (Scheurer-Kestner.)

Sp. gr. of solution at 17.5° containing:  
5 10 15 20 25% Fe(NO<sub>3</sub>)<sub>3</sub>,  
1.0398 1.0770 1.1182 1.1612 1.2110

30 35 40 45 50% Fe(NO<sub>3</sub>)<sub>3</sub>,  
1.2622 1.3164 1.3746 1.4338 1.4972

55 60 65% Fe(NO<sub>3</sub>)<sub>3</sub>,  
1.5723 1.6572 1.7532

(Franz, J. pr. (2) 5, 274.)

Nearly insol. in conc. HNO<sub>3</sub>+Aq at temp. below 15.5°.

Easily sol in alcohol.

Melts in crystal H<sub>2</sub>O at 47.2°. (Ordway.)

Sat. Fe(NO<sub>3</sub>)<sub>3</sub>+Aq boils at 125°. (Ordway)

**Lanthanum nitrate, La(NO<sub>3</sub>)<sub>3</sub>+6H<sub>2</sub>O.**

Very deliquescent; easily sol. in H<sub>2</sub>O and alcohol. (Mosander.) Melts in its crystal H<sub>2</sub>O at 40°; boils at 124.5°. (Ordway.)

La(NO<sub>3</sub>)<sub>3</sub>+Aq sat at 25% contains 60.17% La(NO<sub>3</sub>)<sub>3</sub>, or 100 g H<sub>2</sub>O dissolve 151.1 g. La(NO<sub>3</sub>)<sub>3</sub> at 25°. (James and Whittemore, J. Am. Chem. Soc 1912, 34, 1169.)

Sol. in acetone. (Naumann, B 1904, 37, 4328; Eidmann, C. C. 1899, II, 1014.)

**Lanthanum magnesium nitrate, 2La(NO<sub>3</sub>)<sub>3</sub>, 3Mg(NO<sub>3</sub>)<sub>2</sub>+24H<sub>2</sub>O.**

Deliquescent in moist air. (Holzmann, J. pr. 75, 350.)

1 l. sat. solution in HNO<sub>3</sub>+Aq (sp. gr. 1.325) contains 63.8 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76, 321.)

**Lanthanum manganous nitrate, 2La(NO<sub>3</sub>)<sub>3</sub>, 3Mn(NO<sub>3</sub>)<sub>2</sub>+24H<sub>2</sub>O.**

Sol in H<sub>2</sub>O. (Dumour and Deville.)

1 l. sat. solution in HNO<sub>3</sub>+Aq (sp. gr. 1.325) contains 193.1 g. hydrous salt at 16°. (Jantsch.)

**Lanthanum nickel nitrate, 2La(NO<sub>3</sub>)<sub>3</sub>, 3Ni(NO<sub>3</sub>)<sub>2</sub>+36H<sub>2</sub>O.**

Very sol. in H<sub>2</sub>O. (Frerichs and Smith, A. 191, 355.)

+24H<sub>2</sub>O 1 l. sat. solution in HNO<sub>3</sub>+Aq (sp. gr. 1.325) contains 80.3 g. hydrous salt at 16°. (Jantsch)

**Lanthanum rubidium hydrogen nitrate, [La(NO<sub>3</sub>)<sub>2</sub>]Rb, HNO<sub>3</sub>+6H<sub>2</sub>O.**

Sol in H<sub>2</sub>O and HNO<sub>3</sub>. (Jantsch, Z. anorg. 1911, 69, 225.)

**Lanthanum thallous nitrate, [La(NO<sub>3</sub>)<sub>2</sub>]Tl<sub>2</sub>+4H<sub>2</sub>O**

Hydroscopic. (Jantsch, Z. anorg. 1911, 69, 228.)

Lanthanum zinc nitrate,  $2\text{La}(\text{NO}_3)_3$ ,  
 $3\text{Zn}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ . (Damour and Deville, J. B. 1858. 135.)

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 124.1 g. hydrous salt at  $16^\circ$ . (Jantech, Z. anorg. 1912, 76. 321.)  
 $+69\text{H}_2\text{O}$ . (Frerichs and Smith, A. 191. 355.)

Lead nitrate, basic,  $2\text{PbO}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ .

Sol. in 5.15 pts.  $\text{H}_2\text{O}$  at  $19.2^\circ$ . (Pohl, W. A. B. 6. 597.) Very al. sol. in cold, much more in hot  $\text{H}_2\text{O}$ . (Berzelius.) Sol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . (Guignot, C. R. 56. 358.)

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Athanasesco, Bull. Soc. 1895, (3) 13. 178.)

$+2\text{H}_2\text{O}$ . (André, C. R. 100. 639.)

$3\text{PbO}$ ,  $\text{N}_2\text{O}_5 + 1\frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in pure  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  containing  $\text{HCl}$ . (Berzelius.)

$+3\text{H}_2\text{O}$  Sol. in 119.2 pts. cold, and 10.5 pts. boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ , but al. sol. in  $\text{KNO}_3 + \text{Aq}$  (Vogel, jr. A. 94. 97.)

$= 10\text{PbO}$ ,  $3\text{N}_2\text{O}_5 + 5\text{H}_2\text{O}$ . (Wakemann and Wells, Am. Ch. J. 9. 299.)

$+4\text{H}_2\text{O}$ . (André, C. R. 100. 639.)

$6\text{PbO}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Löwe, J. pr. 98. 885.)

$10\text{PbO}$ ,  $3\text{N}_2\text{O}_5 + 4\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than  $\text{Pb}(\text{NO}_3)_2\text{OH}$ , and not decomp. by boiling  $\text{H}_2\text{O}$  (Wakemann and Wells, Am. Ch. J. 9. 299.)

Lead nitrate,  $\text{Pb}(\text{NO}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$  with absorption of much heat (Roe.)

1 pt.  $\text{Pb}(\text{NO}_3)_2$  dissolves in  $7\frac{1}{2}$  pts. cold  $\text{H}_2\text{O}$  (Mitscherlich.)

1 pt.  $\text{Pb}(\text{NO}_3)_2$  dissolves in 1.989 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  and forms a liquid of 1.3078 sp. gr. (Kureston.)

1 pt.  $\text{Pb}(\text{NO}_3)_2$  dissolves in 1.707 pts.  $\text{H}_2\text{O}$  at  $22.3^\circ$ , in 1.885 pts.  $\text{H}_2\text{O}$  at  $24.7^\circ$ . (Kopp.)

Sol. in 1.87 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$ . (Schiff, A. 109. 326.)

100 pts.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat. at  $102.2^\circ$  contain 62.5 pts.  $\text{Pb}(\text{NO}_3)_2$  or 100 pt.  $\text{H}_2\text{O}$  dissolve 110.620 pts.  $\text{Pb}(\text{NO}_3)_2$  at  $102.2^\circ$ . (Griffiths.)

Sol. in 7.5 pts. cold  $\text{H}_2\text{O}$  and much less hot  $\text{H}_2\text{O}$  (Wittmann.)

100 pts. boiling  $\text{H}_2\text{O}$  dissolve 13 pts.  $\text{Pb}(\text{NO}_3)_2$  (Ure's Dict.)

100 pts.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat. at  $19-20^\circ$  contain 35.80 pts. salt. (v. Hauer, W. A. B. 53. 2. 221.)

1 pt. dissolves:  
 at  $0^\circ$   $10^\circ$   $25^\circ$   $45^\circ$   $65^\circ$   $85^\circ$   $100^\circ$   
 in 2.58 2.07 1.65 1.25 0.99 0.83 0.72 pts.  $\text{H}_2\text{O}$ .

(Kremers, Pogg. 92. 497.)

1 l.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat. at  $15^\circ$  contains 461.49 g.  $\text{Pb}(\text{NO}_3)_2$  and 928.58 g.  $\text{H}_2\text{O}$ , and has sp. gr. 1.39. (Michel and Krafft, A. ch. (3) 41. 471.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{Pb}(\text{NO}_3)_2$	$t^\circ$	Pts $\text{Pb}(\text{NO}_3)_2$	$t^\circ$	Pts $\text{Pb}(\text{NO}_3)_2$
0	36.5	36	65.9	72	99.7
1	37.4	37	66.7	73	100.7
2	38.3	38	67.6	74	101.7
3	39.1	39	68.5	75	102.6
4	39.8	40	69.4	76	103.6
5	40.5	41	70.3	77	104.6
6	41.2	42	71.2	78	105.6
7	42.0	43	72.1	79	106.6
8	42.8	44	73.0	80	107.6
9	43.6	45	74.0	81	108.6
10	44.4	46	74.9	82	109.6
11	45.2	47	75.9	83	110.6
12	46.0	48	76.8	84	111.5
13	46.8	49	77.7	85	112.5
14	47.5	50	78.7	86	113.5
15	48.3	51	79.6	87	114.5
16	49.1	52	80.5	88	115.4
17	49.9	53	81.5	89	116.4
18	50.7	54	82.4	90	117.4
19	51.5	55	83.3	91	118.4
20	52.3	56	84.3	92	119.4
21	53.1	57	85.2	93	120.3
22	53.9	58	86.1	94	121.3
23	54.7	59	87.1	95	122.3
24	55.6	60	88.0	96	123.2
25	56.4	61	89.0	97	124.2
26	57.3	62	90.0	98	125.2
27	58.1	63	90.9	99	126.1
28	59.0	64	91.9	100	127.0
29	59.8	65	92.8	101	128.0
30	60.7	66	93.8	102	128.9
31	61.6	67	94.8	103	129.9
32	62.4	68	95.7	104	130.9
33	63.3	69	96.7	104.7	131.5
34	64.1	70	97.7	...	..
35	65.0	71	98.7	...	..

(Mulder, Schenk. Verhand. 1864. 66.)

100 g.  $\text{H}_2\text{O}$  dissolve 52.76 g.  $\text{Pb}(\text{NO}_3)_2$  at  $17^\circ$ . (Euler, Z. phys. Ch. 1904. 49. 315.)

Solubility of  $\text{Pb}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  at  $20^\circ = 1.62$  g. mol. per l. Sp. gr. of sat. solution = 1.419 (Fedotzeff, Z. anorg. 1911, 73. 178.)

Sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at  $0^\circ$  contains 26.7%  $\text{Pb}(\text{NO}_3)_2$ ; at  $18^\circ$ , 29.1%  $\text{Pb}(\text{NO}_3)_2$ . (Mylius, Z. anorg. 1912, 74. 411.)

Sp. gr. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at  $19.5^\circ$

$\text{Pb}(\text{NO}_3)_2$	Sp. gr.	$\text{Pb}(\text{NO}_3)_2$	Sp. gr.
5	1.045	25	1.266
10	1.093	30	1.334
15	1.144	35	1.414
20	1.203		.

(Kremers, calculated by Gerlach, Z. anal. 8. 286.)

Sp. gr. of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at $17.5^\circ$			
$\text{Pb}(\text{NO}_3)_2$	Sp. gr.	$\text{Pb}(\text{NO}_3)_2$	Sp. gr.
5	1.044	25	1.263
10	1.092	30	1.333
15	1.144	35	1.409
20	1.200	sat. sol.	1.433

(Gerlach, Z. anal. 27, 283.)

Sp. gr. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat. at  $8^\circ = 1.372$ . (Anthon.)

Sp. gr. of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at $17.5^\circ$			
$\text{Pb}(\text{NO}_3)_2$	Sp. gr.	$\text{Pb}(\text{NO}_3)_2$	Sp. gr.
1	1.0080	20	1.1902
2	1.0163	21	1.2016
3	1.0247	22	1.2132
4	1.0331	23	1.2251
5	1.0416	24	1.2372
6	1.0502	25	1.2495
7	1.0591	26	1.2620
8	1.0682	27	1.2747
9	1.0775	28	1.2876
10	1.0869	29	1.3007
11	1.0963	30	1.3140
12	1.1059	31	1.3276
13	1.1157	32	1.3416
14	1.1257	33	1.3558
15	1.1359	34	1.3702
16	1.1463	35	1.3848
17	1.1569	36	1.3996
18	1.1677	37	1.4146
19	1.1788		

(Schiff, calculated by Gerlach, Z. anal. 8, 286.)

Sp. gr. of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at $t^\circ$		
$t^\circ$	$\% \text{Pb}(\text{NO}_3)_2$	Sp. gr.
14	5	1.0451
14	10	1.0939
14.5	15	1.1468
14.3	20	1.2045
15	25	1.2678
15	32.28	1.3716

(Long, W. Ann. 1880, 11, 40.)

Sp. gr. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

17.93 32.22%  $\text{Pb}(\text{NO}_3)_2$ .  
1.1786 1.3619

(Wagner, W. Ann. 1883, 18, 267.)

Sp. gr. of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at $25^\circ$	
Concentration of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.1380
$\frac{1}{2}$ -normal	1.0690
$\frac{1}{4}$ -normal	1.0351
$\frac{1}{8}$ -normal	1.0175

(Wagner, Z. phys. Ch. 1890, 5, 36.)

$\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing 15.93%  $\text{Pb}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.1558$ .  
 $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing 30.57%  $\text{Pb}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.3436$ .  
 $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing 30.69%  $\text{Pb}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.3465$ .  
 (Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 279.)

Sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  boils at  $103.5^\circ$ . (Kremers.)Sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  boils at  $102.2^\circ$ , and contains 140 pts.  $\text{Pb}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$  (Griffiths.)Sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  boils at  $103.5^\circ$  (Gerlach, Z. anal. 26, 427.)B.-pt. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing pts.  $\text{Pb}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , according to Gerlach (Z. anal. 26, 449).

B-pt	Pts $\text{Pb}(\text{NO}_3)_2$	B-pt	Pts $\text{Pb}(\text{NO}_3)_2$
100 $5^\circ$	11	102 $5^\circ$	87
101	26	103	111
101.5	44	103.5	137
102	65		

Insol. in conc.  $\text{HNO}_3 + \text{Aq}$ .Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{Ba}(\text{NO}_3)_2$ .See under  $\text{Ba}(\text{NO}_3)_2$ .Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{Cu}(\text{NO}_3)_2$ .See under  $\text{Cu}(\text{NO}_3)_2$ .Sol in sat.  $\text{KNO}_3 + \text{Aq}$  without pptn., 100 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$  dissolving 114 pts. mixed salt, viz. 84.1 pts.  $\text{Pb}(\text{NO}_3)_2$  and 29.9 pts.  $\text{KNO}_3$ . (Karsten.)100 pts.  $\text{H}_2\text{O}$  dissolve 119.6 pts.  $\text{Pb}(\text{NO}_3)_2$  and 67.1 pts.  $\text{KNO}_3$  at  $21.2^\circ$ . (Rüdorff, B. 6, 481.)100 g.  $\text{H}_2\text{O}$  dissolve 95.39 g.  $\text{Pb}(\text{NO}_3)_2$  and 61.05 g.  $\text{KNO}_3$  at  $20^\circ$ . (Le Blanc and Noyes, Z. phys. Ch. 1890, 6, 386.)Sol in sat.  $\text{NaNO}_3 + \text{Aq}$  without pptn., 100 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$  dissolving 121.9 pts. mixed salt, viz. 87.8 pts.  $\text{Pb}(\text{NO}_3)_2$  and 34.1 pts.  $\text{NaNO}_3$ . (Karsten.)Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{NaNO}_3$ 

Solid phase = $\text{Pb}(\text{NO}_3)_2$		
$t^\circ$ of saturation	% $\text{NaNO}_3$	% $\text{Pb}(\text{NO}_3)_2$
32	34.42	19.69
35.5	34.15	20.33
39.5	33.71	21.35
44	33.35	22.19
49.1	32.94	23.15
55	32.60	23.93
58	32.47	24.24
62	32.33	24.57
65	32.14	24.89

Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{NaNO}_3$ —Continued.Solid phase =  $\text{NaNO}_3$ 

° of saturation	% $\text{NaNO}_3$	% $\text{Pb}(\text{NO}_3)_2$
21	40.97	13.62
26.5	42.04	13.38
31	43.18	12.88
38.8	44.63	12.78
41	45.11	12.94
44.25	46.03	12.45
51	47.28	12.50
58	49.03	11.76
64	49.92	11.56

(Isaac, Chem. Soc. 1908, 93, 398.)

Also sol in  $\text{KNO}_3 + \text{NaNO}_3 + \text{Aq}$   
 100 pts. sat  $\text{Pb}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2 + \text{Aq}$   
 contain 45.95 pts of the two salts at 19.20°.  
 (v. Hauer, J. pr. 98, 137.)

Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2$  at 25°.

G per 100 cc		Mol per cent in solid phase	
$\text{Pb}(\text{NO}_3)_2$	$\text{Sr}(\text{NO}_3)_2$	$\text{Pb}(\text{NO}_3)_2$	$\text{Sr}(\text{NO}_3)_2$
46.31	0	100	0
50.47	4.56	99.05	0.95
53.92	8.14	98.11	1.89
45.34	17.81	97.02	2.98
44.48	18.74	96.06	3.94
25.23	35.03	83.84	16.16
19.13	37.54	32.88	67.12
0	71.04	0	100

(Toek, Z. Kryst. Min. 1897, 28, 365.)

Very easily sol in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

100 pts alcohol of 0.9282 sp gr dissolve.

at 4° 8° 22° 40° 50°  
 4.96 5.82 8.77 12.8 14.9 pts  $\text{Pb}(\text{NO}_3)_2$ .  
 (Gerardin, A. ch. (4), 5, 129.)

100 pts. absolute methyl alcohol dissolve 1.37 pts at 20.5°.

100 pts absolute ethyl alcohol dissolve 0.04 pt. at 20.5°. (de Bruyn, Z. phys. Ch. 10, 783.)

Very sl sol in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)

Insol in cold, sl sol in hot  $\text{CS}_2$  (Arcetowski, Z. anorg. 1894, 6, 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790); ethyl acetate (Naumann, B. 1910, 43, 314.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, 15, 21.)

Solubility of  $\text{Pb}(\text{NO}_3)_2$  in pyridine at 1°.

t°	G $\text{Pb}(\text{NO}_3)_2$ per 100 g $\text{C}_5\text{H}_5\text{N}$	Solid phase
—19.4	2.93	$\text{Pb}(\text{NO}_3)_2, 4\text{C}_5\text{H}_5\text{N}$
—14.5	2.14	"
—10	1.90	"
0	3.54	"
5.4	3.93	"
8.7	5.39	"
14.72	6.13	"
19.97	6.78	"
24.75	8.56	"
30.03	10.98	"
34.97	13.20	"
40.03	16.94	"
45.	22.03	"
49.97	29.37	"
51 tr pt		" + $\text{Pb}(\text{NO}_3)_2, 3\text{C}_5\text{H}_5\text{N}$
59.52	36.70	$\text{Pb}(\text{NO}_3)_2, 3\text{C}_5\text{H}_5\text{N}$
70	47.29	"
80	61.60	"
89.93	90.21	"
94.94	128.06	"
96 tr pt.		" + $\text{Pb}(\text{NO}_3)_2, 2\text{C}_5\text{H}_5\text{N}$
99.89	143.36	$\text{Pb}(\text{NO}_3)_2, 2\text{C}_5\text{H}_5\text{N}$
104.90	152	"
109.90	163.80	"

(Walton and Judd, J. Am. Chem. Soc. 1911, 33, 1036.)

Lead mercurous nitrate,  $2\text{PbO}, 2\text{Hg}_2\text{O}, 3\text{N}_2\text{O}_5$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in warm dil.  $\text{HNO}_3$ , or  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$  without decomp. (Stadeler, A. 87, 129.)

Lead silver nitrate,  $\text{Pb}(\text{NO}_3)_2, 2\text{AgNO}_3$ .

Sol. in  $\text{H}_2\text{O}$  (Sturenberg, Pogg. 74, 115.)

Lead silver nitrate iodide,  $\text{Pb}(\text{NO}_3)_2, 8\text{AgNO}_3, 4\text{AgI}$ 

Decomp. by  $\text{H}_2\text{O}$  (Sturenberg.)

$\text{Pb}(\text{NO}_3)_2, 2\text{AgNO}_3, 2\text{AgI}$ . Decomp by  $\text{H}_2\text{O}$  (Sturenberg.)

Lead nitrate nitrite, basic,  $4\text{PbO}, \text{N}_2\text{O}_5, \text{N}_2\text{O}_2 + 2\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_2, \text{Pb}(\text{OH})\text{NO}_3$ .

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$ . Sol in 80 pts.  $\text{H}_2\text{O}$  at 23° (Chevreul), 85 pts. at ord. temp. (Bromeis, A. 72, 38), 106 pts. at 100° (Chevreul).

+  $2\text{H}_2\text{O}$ .

## Solubility in acetic acid.

Normality of acid	g $\text{PbO}$ per 100 cc sat. solution	Normality of acid	g $\text{PbO}$ per 100 cc sat. solution
0	0.601	0.25	5.450
0.05	1.323	0.50	9.690
0.10	2.185	0.75	15.874

(Chilesotti, Att. Acad. Linc. 1908, (5) 17, II, 475.)

Formula is  $3\text{Pb}(\text{OH})\text{NO}_3$ ,  $5\text{Pb}(\text{OH})\text{NO}_2 + \text{H}_2\text{O}$ . (v. Lorenz, W. A. B. 84, 2, 1133.)

+  $3\text{H}_2\text{O}$ . (v. Lorenz.)

$4\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_3 + 4\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Bromeis.)

$6\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $2\text{N}_2\text{O}_3 + 3\frac{1}{2}\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $2\text{Pb}(\text{OH})\text{NO}_2 + \frac{1}{2}\text{H}_2\text{O}$ . (v. Lorenz.)

$6\text{PbO}$ ,  $2\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_3 + 3\frac{1}{2}\text{H}_2\text{O} = 2\text{Pb}(\text{OH})\text{NO}_3$ ,  $\text{Pb}(\text{OH})\text{NO}_2 + \frac{1}{2}\text{H}_2\text{O}$ . (v. Lorenz.)

$7\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_3 + 3\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than  $4\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_3 + 2\text{H}_2\text{O}$ ; sol. in cold conc.  $\text{HNO}_3 + \text{Aq}$  (Pelzgot, A. 39, 338.)

$8\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_3 + 4\frac{1}{2}\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $3\text{Pb}(\text{OH})\text{NO}_2 + \frac{1}{2}\text{H}_2\text{O}$ . (v. Lorenz.)

$10\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $4\text{N}_2\text{O}_3 + 5\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $4\text{Pb}(\text{OH})\text{NO}_2$ . (v. Lorenz.)

$12\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $5\text{N}_2\text{O}_3 + 6\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $5\text{Pb}(\text{OH})\text{NO}_2$ . (v. Lorenz.)

$10\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $2\text{N}_2\text{O}_3 + 4\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $2\text{Pb}(\text{OH})\text{NO}_2$ ,  $2\text{PbO} + \frac{1}{2}\text{H}_2\text{O}$ . (v. Lorenz.)

$14\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_3 + 6\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $3\text{Pb}(\text{OH})\text{NO}_2$ ,  $3\text{PbO} + \text{H}_2\text{O}$ . (Bromeis.)

$14\text{PbO}$ ,  $3\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_3 + 6\text{H}_2\text{O} = 3\text{Pb}(\text{OH})\text{NO}_3$ ,  $\text{Pb}(\text{OH})\text{NO}_2$ ,  $3\text{PbO} + \text{H}_2\text{O}$ . (Bromeis.)

$16\text{PbO}$ ,  $2\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_3 + 6\text{H}_2\text{O} = 4\text{Pb}(\text{OH})\text{NO}_3$ ,  $6\text{Pb}(\text{OH})\text{NO}_2$ ,  $5\text{PbO}$ ,  $\text{Pb}(\text{OH})_2$ . (v. Lorenz.)

$16\text{PbO}$ ,  $3\text{N}_2\text{O}_5$ ,  $5\text{N}_2\text{O}_3 + 10\text{H}_2\text{O} = 3\text{Pb}(\text{OH})\text{NO}_3$ ,  $5\text{Pb}(\text{OH})\text{NO}_2 + \text{H}_2\text{O}$ . (v. Lorenz.)

$26\text{PbO}$ ,  $6\text{N}_2\text{O}_5$ ,  $7\text{N}_2\text{O}_3 + 21\text{H}_2\text{O} = 6\text{Pb}(\text{OH})\text{NO}_3$ ,  $7\text{Pb}(\text{OH})\text{NO}_2 + 4\text{H}_2\text{O}$ . (v. Lorenz.)

**Lead nitrate phosphate**,  $\text{Pb}(\text{NO}_3)_2$ ,  $\text{Pb}_3(\text{PO}_4)_2 + 2\text{H}_2\text{O}$ .

Completely insol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$  into its constituents. Sol. in a little conc.  $\text{HNO}_3 + \text{Aq}$  without decomp. (Gerhardt, A. 72, 83.)

**Lead nitrate phosphite**,  $\text{Pb}(\text{NO}_3)_2$ ,  $\text{PbHPO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ .  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  (33.3 g. per litre) dissolves 1 g. salt at  $15^\circ$ . If less than 31 g. per litre of  $\text{Pb}(\text{NO}_3)_2$  are present the salt is decomp. (Amat, A. ch. (6) 24, 317.)

**Lead nitrate potassium nitrite**,  $\text{Pb}(\text{NO}_3)_2$ ,  $2\text{KNO}_2 + \text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . (Lang, J. B. 1862, 102.)

$3\text{PbO}$ ,  $3\text{K}_2\text{O}$ ,  $4\text{N}_2\text{O}_3$ ,  $2\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Hayes, Sill. Am. J. (2) 31, 226.)

**Lithium nitrate**,  $\text{LiNO}_3$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve:

at  $0^\circ$   $20^\circ$   $40^\circ$   $70^\circ$   $100^\circ$   $110^\circ$

48.3 75.7 169.4 190.1 227.3 256.4 pts.  $\text{LiNO}_3$ . (Kremers, Pogg. 99, 47.)

Forms supersaturated solutions with ease, which crystallize when temp. is lowered to  $+1^\circ$ . (Kremers, Pogg. 92, 520.)

Sat. solution boils at over  $200^\circ$ . (Kremers, Pogg. 99, 43.)

1 pt.  $\text{LiNO}_3$  dissolves in 200 pts.  $\text{HNO}_3$ . (Schultz, Zeit. Ch. (2) 5, 531.)

100 pts. of the sat. solution contain at:

$64.2^\circ$  70.9°

64.9 66.1 pts. anhydrous salt.

(Donnan and Burt, Chem. Soc. 1903, 83, 339.)

See  $+ \frac{1}{2}\text{H}_2\text{O}$ , and  $3\text{H}_2\text{O}$ .

Sp. gr. of  $\text{LiNO}_3 + \text{Aq}$  at  $19.5^\circ$  containing pts.  $\text{LiNO}_3$  in 100 pts.  $\text{H}_2\text{O}$ .

12.7	14.2	26.4	41.8 pts. $\text{LiNO}_3$
1.069	1.077	1.134	1.197

54.8	57.5	77.4	79.4 pts. $\text{LiNO}_3$
1.245	1.255	1.315	1.319

(Kremers, Pogg. 114, 45.)

Sp. gr. of  $\text{LiNO}_3 + \text{Aq}$ .

g. $\text{LiNO}_3$ in 1000 g. of solution	Sp. gr. $18/18^\circ$
0	1.000000
4.8526	1.002469
10.9128	1.0055495
17.9016	1.009113

(Dijken, Z. phys. Ch. 1897, 24, 109.)

Sp. gr.  $20^\circ/4^\circ$  of a normal solution of  $\text{LiNO}_3 = 1.03303$ ; of a 0.5-normal solution = 1.01830. (Haigh, J. Am. Chem. Soc. 1912, 34, 1151.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1893, 20, 328.)

Sol. in strong alcohol.

Sol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37, 4328.)

Solubility in acetone = 0.343 g. mol. per l. at  $18^\circ$ . (Roshdestwensky and McBride, Chem. Soc. 1911, 99, 2140.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 pts. of the sat. solution contain at:

43.6°	50.5°	55.0°	60.0°
60.8	61.3	63.0	63.6 pts. anhydrous salt.

$61.1^\circ$  is the temp. at which  $\text{LiNO}_3 + \frac{1}{2}\text{H}_2\text{O}$  goes over into  $\text{LiNO}_2$ . (Donnan and Burt, Chem. Soc. 1903, 83, 339.)

+3H<sub>2</sub>O.Solubility in H<sub>2</sub>O

100 pts. of the sat solution contain pts. anhydrous salt at t°

t°	Pts anhydrous salt
0 10	34.8
10 50	37.9
12 10	38.2
13 75	39.3
19 05	40.4
22 10	42.9
27 55	47.3
29.47	53.67
29.78	55.09
29.87	56.42
29.86	56.68
29.64	57.48
29.55	58.03

Mpt. of LiNO<sub>3</sub>+3H<sub>2</sub>O is 29.88°.

(Donnan and Burt, Chem. Soc. 1903, 83. 337.)

Magnesium nitrate, basic, Mg<sub>2</sub>N<sub>2</sub>O<sub>5</sub>.Insol in H<sub>2</sub>O and alcohol. Sol. in acids. (Chodnew, A. 71. 241.)+5H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Didier, C. R. 1896, 122. 936.)Magnesium nitrate, Mg(NO<sub>3</sub>)<sub>2</sub>.

Anhydrous. Deliquescent.

Sol in 1 pt. H<sub>2</sub>O at 15.6° Sol in 4 pts abs alcohol at 16.6° and 2 pts at boiling temp. More sol in alcohol of 9.817 sp. gr. than in that of 0.900 (Kirwan).  
 Sol in 6.3458 pt strong alcohol at 82.5° (Wenzel).  
 Sol in 10 pts strong alcohol at 15° (Bergmann).  
 Sol. in 9 pts strong alcohol on heating (Bergmann).

Solubility in H<sub>2</sub>O in presence of the anhydrous salt.

Sat. solution contains at:

89° 77.5° 67°

63.14 65.67 67.55 % Mg(NO<sub>3</sub>)<sub>2</sub>.

(Funk, Z. anorg. 1899, 20. 396.)

See +6, and 9H<sub>2</sub>O.Sp. gr. of Mg(NO<sub>3</sub>)<sub>2</sub>+Aq at 14°.

% Mg(NO <sub>3</sub> ) <sub>2</sub> in H <sub>2</sub> O	Sp. gr	% Mg(NO <sub>3</sub> ) <sub>2</sub> in H <sub>2</sub> O	Sp. gr
1	1.0034	30	1.1347
5	1.0202	35	1.1649
10	1.0418	40	1.1909
15	1.0639	45	1.2176
20	1.0869	49	1.2397
25	1.1103	.	.

(Oudemans, Z anal. 7. 419.)

Sp. gr. of Mg(NO<sub>3</sub>)<sub>2</sub>+Aq at 21°.

% Mg(NO <sub>3</sub> ) <sub>2</sub> in H <sub>2</sub> O	Sp. gr	% Mg(NO <sub>3</sub> ) <sub>2</sub> in H <sub>2</sub> O	Sp. gr
2	1.0078	28	1.1216
4	1.0158	30	1.1312
6	1.0239	32	1.1410
8	1.0321	34	1.1508
10	1.0405	36	1.1608
12	1.0490	38	1.1709
14	1.0577	40	1.1811
16	1.0663	42	1.1914
18	1.0752	44	1.2019
20	1.0843	46	1.2124
22	1.0934	48	1.2231
24	1.1026	50	1.2340
26	1.1120	.	.

(Schiff, calculated by Gerlach, Z. anal. 8. 286.)

Sp. gr of Mg(NO<sub>3</sub>)<sub>2</sub>+Aq at 18°

% Mg(NO <sub>3</sub> ) <sub>2</sub>	Sp. gr	% Mg(NO <sub>3</sub> ) <sub>2</sub>	Sp. gr
5	1.0378	15	1.1181
10	1.0763	17	1.1372

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of Mg(NO<sub>3</sub>)<sub>2</sub>+Aq at room temp. containing:18.62 34.19 39.77% Mg(NO<sub>3</sub>)<sub>2</sub>.

1.1025 1.2000 1.4298

(Wagner, W. Ann 1883, 18. 273.)

Sp. gr. of Mg(NO<sub>3</sub>)<sub>2</sub>+Aq at 25°.

Concentration of Mg(NO <sub>3</sub> ) <sub>2</sub> +Aq	Sp. gr
1-normal	1.0512
1/2- "	1.0259
1/4- "	1.0130
1/8- "	1.0066

(Wagner, Z. phys. Ch 1890, 5. 38.)

Sp. gr. of solution sat. at 18°=1.384, containing 43.1% Mg(NO<sub>3</sub>)<sub>2</sub>. (Mylius, B. 1897, 80. 1718.)Sp. gr of Mg(NO<sub>3</sub>)<sub>2</sub>+Aq.

1/2 Mg(NO <sub>3</sub> ) <sub>2</sub> g. in 1000 g of solution	Sp. gr. 16°/16°
0	1.000000
0.8099	1.000660
1.5621	1.001253
3.3398	1.002539
7.4410	1.005523
15.161	1.011151
29.356	1.021580
58.353	1.043329
81.025	1.060773

(Dijkens, Z phys. Ch. 1897, 24. 107.)

Sp. gr. of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at 20°.   
 p = per cent strength of solution; d = observed density, w = volume concentration in grams per cc ( $\frac{\text{pd}}{100} = w$ .)

p	d	w
35.02	1.3110	0.46095
31.15	1.2655	0.39420
25.03	1.2057	0.30172
19.55	1.1551	0.22585
13.43	1.1028	0.14815
10.09	1.0753	0.10850
6.650	1.0480	0.06968
4.672	1.0330	0.04820
4.001	1.0276	0.04112
1.372	1.0085	0.01383

(Barnes, J. phys. Chem. 1898, 2 545)

Sp. gr. of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at 20° containing M g. mols. of salt per liter.

M	0.02	0.05	0.10	0.15
Sp. gr.	1.00224	1.005626	1.011118	1.016557

M	0.20	0.50	1.00	1.274
Sp. gr.	1.022026	1.054804	1.107865	1.136615

(Jones and Pearce, Am. Ch. J. 1907, 38. 707)

Less sol. in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Dijonval.)

Very easily sol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 828.)

+2 $\text{H}_2\text{O}$ . Mpt. 127°. (Wasiljew, C. C. 1909, II. 1966.)

+4 $\text{H}_2\text{O}$ . Mpt. 45.5° (W.)

+6 $\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. Sol. in 0.5 pt. cold  $\text{H}_2\text{O}$ , and 9 pts cold alcohol of 0.84 sp. gr.; very sl. sol. in abs. alcohol (Graham)

Melts in its crystal  $\text{H}_2\text{O}$  at 90°, and the resulting liquid boils at 143.4°. (Ordway, Ill. Am. J. (2) 27. 14.)

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-18°	-4.5°	0°	18°
38.03	39.50	39.96	42.33%

40° 80° 90° (mpt.).

45.87 53.69 57.81%  $\text{Mg}(\text{NO}_3)_2$

(Funk, Z. anorg. 1899, 20. 395.)

+9 $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-23°	-20.5°	-18°
35.44	36.19	38.03%

Cryohydrate is formed at -29°. (Funk, Z. anorg. 1899, 20. 398.)

**Magnesium neodymium nitrate,  $3\text{Mg}(\text{NO}_3)_2 \cdot 2\text{Nd}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .**

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 97.7 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76. 303.)

**Magnesium praseodymium nitrate,  $3\text{Mg}(\text{NO}_3)_2 \cdot 2\text{Pr}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$**

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 7.70 g. hydrous salt at 16°. (Jantsch)

**Magnesium samarium nitrate,  $3\text{Mg}(\text{NO}_3)_2 \cdot \text{Sm}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .**

(Dermaçay, C. R. 1900, 130. 1187.)

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 24.55 g. hydrous salt at 16°. (Jantsch)

**Magnesium thorium nitrate,  $\text{MgTh}(\text{NO}_3)_4 + \text{H}_2\text{O}$ .**

Hydroscopic, sol. in  $\text{HNO}_3$ . (Meyer, Z. anorg. 1901, 27. 385.)

**Magnesium nitrate ammonia,  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{NH}_3$ .**

Sl. sol. in liquid  $\text{NH}_3$  (Franklin, J. Am. Chem. Soc. 1913, 35. 1459.)

**Manganous nitrate, basic,  $2\text{MnO} \cdot \text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Gorgeu.)

**Manganous nitrate,  $\text{Mn}(\text{NO}_3)_2$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol

See +3, and 6 $\text{H}_2\text{O}$

Sp. gr. of  $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$  at 8°.

% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$	Sp. gr.	% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$	Sp. gr.
5	1.0253	45	1.2705
10	1.0517	50	1.3074
15	1.0792	55	1.3459
20	1.1078	60	1.3861
25	1.137	65	1.4281
30	1.1688	70	1.4721
35	1.2012	71	1.4811
40	1.2352		

(Oudemans, Z. anal. 7. 421.)

Sp. gr. of aqueous solutions containing:

10	20	30	% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$
6.237	12.474	18.711	% $\text{Mn}(\text{NO}_3)_2$
1.052	1.107	1.165	

40	50	60	% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$
24.948	31.185	37.422	% $\text{Mn}(\text{NO}_3)_2$
1.230	1.302	1.381	

70 80 %  $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$ .

43.059 49.896%  $\text{Mn}(\text{NO}_3)_2$ .

1.406. 1.553

(Gerlach, Z. anal. 28. 477.)

Sp. gr. of  $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

18.309	29.602	49.309%	% $\text{Mn}(\text{NO}_3)_2$
1.1482	1.3227	1.5056	

(Wagner, W. Ann. 1883, 18. 271.)

Sp. gr. of  $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$  at 25°

Concentration of $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0690
$\frac{1}{2}$ -normal	1.0349
$\frac{1}{3}$ -normal	1.0174
$\frac{1}{4}$ -normal	1.0093

(Wagner, Z. phys. Ch. 1890, 5. 39.)

Sol. in liquid  $\text{NH}_3$ . (Guntz, Bull. Soc. 1909, (4) 5. 1006.)Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)+ $\text{H}_2\text{O}$ . Deliquescent. (Guntz, Bull. Soc. 1909 (4) 5. 1005.)+ $3\text{H}_2\text{O}$ . From solution in  $\text{HNO}_3$ . (Schultz-Sellack, Zeit. Ch. 1870. 646.)Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at.

27° 29° 30° 34° 35 5° mpt.  
 65.66 66.99 67.38 71.31 76.82%  $\text{Mn}(\text{NO}_3)_2$ .  
 (Funk, Z. anorg. 1899, 20. 403.)

+ $6\text{H}_2\text{O}$ . Melts in its crystal  $\text{H}_2\text{O}$  at 25.8° and boils at 129.4° (Ordway.)Solubility in  $\text{H}_2\text{O}$ 

Sat. solution contains at:

-20° -20° -21° -16° -5°  
 42.29 43.15 44.30 45.52 48.88%  $\text{Mn}(\text{NO}_3)_2$ .

0° +11° 18° 25 8° mpt

50.40 54.50 57.33 62 37%  $\text{Mn}(\text{NO}_3)_2$ .

Cryohydrate is formed at -36° (Funk, Z. anorg. 1899, 20. 403.)

Manganous neodymium nitrate,  $3\text{Mn}(\text{NO}_3)_2$ ,  $2\text{Nd}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 296 g. hydrous salt at 16° (Jantsch, Z. anorg. 1912, 76. 303.)Manganous praseodymium nitrate,  $3\text{Mn}(\text{NO}_3)_2$ ,  $2\text{Pr}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 234 g. hydrous salt at 16° (Jantsch.)Manganous samarium nitrate,  $3\text{Mn}(\text{NO}_3)_2$ ,  $2\text{Sm}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 50.04 g. hydrous salt at 16° (Jantsch.)Manganous thorium nitrate,  $\text{MnTh}(\text{NO}_3)_6 + 8\text{H}_2\text{O}$ .

Ppt. (Meyer, Z. anorg. 1901, 27. 388.)

Manganous nitrate cupric oxide,  $\text{Mn}(\text{NO}_3)_2$ ,  $3\text{CuO} + 3\text{H}_2\text{O}$ .

Ppt. (Mailhe, C. R. 1902, 134. 234.)

Manganous nitrate hydrazine,  $\text{Mn}(\text{NO}_3)_2$ ,  $2\text{N}_2\text{H}_4$ .Not decomp. by  $\text{H}_2\text{O}$  (Franzen, Z. anorg. 1908, 60. 286.)Mercurous nitrate, basic,  $2\text{Hg}_2\text{O}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ .Ppt. Decomp. by boiling with  $\text{H}_2\text{O}$ . (Marignac, A. ch. (3) 27. 332.)Slowly sol. in cold, rapidly in hot  $\text{HCl} + \text{Aq}$ ; insol. in  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{NO}_3 + \text{Aq}$ .+ $10\text{H}_2\text{O}$  Slowly sol. in normal  $\text{HNO}_3$ . (Reuss, Dissert. 1886.)+ $4\text{H}_2\text{O}$ ,  $3\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . Sol. in a small quantity of  $\text{H}_2\text{O}$ ; decomp. by a large amt. of  $\text{H}_2\text{O}$  or by warm  $\text{H}_2\text{O}$  (Rose, Pogg. 83. 154.)Is  $3\text{Hg}_2\text{O}$ ,  $2\text{N}_2\text{O}_5 + \text{H}_2\text{O}$  according to Gerhardt+ $5\text{H}_2\text{O}$ . (Reuss, Dissert. 1886.)+ $5\text{Hg}_2\text{O}$ ,  $3\text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$ . (Marignac.) Is  $2\text{Hg}_2\text{O}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . (Lefort, A. 56. 247.)Sol. in boiling, less sol. in cold  $\text{H}_2\text{O}$ . (Marignac, l. c.)+ $4\text{H}_2\text{O}$ , and + $6\text{H}_2\text{O}$ . (Reuss, Dissert. 1886.)+ $8\text{Hg}_2\text{O}$ ,  $5\text{N}_2\text{O}_5 + 5\text{H}_2\text{O}$ , and + $11\text{H}_2\text{O}$ . (Reuss.)+ $11\text{Hg}_2\text{O}$ ,  $6\text{N}_2\text{O}_5 + 25\text{H}_2\text{O}$  (Reuss.)+ $16\text{Hg}_2\text{O}$ ,  $9\text{N}_2\text{O}_5 + 19\text{H}_2\text{O}$ , + $23\text{H}_2\text{O}$ , and + $31\text{H}_2\text{O}$ . (Reuss.)+ $3\text{Hg}_2\text{O}$ ,  $\text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$ . (Cox, Z. anorg. 1904, 40. 177.)Mercurous nitrate,  $\text{HgNO}_2$ .Very sol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 829.)Fairly sol. in boiling  $\text{CS}_2$ . (Aretowski, Z. anorg. 1894, 6. 257.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in methylamine (Franklin, J. Am. Chem. Soc. 1906, 28. 1419.)

+ $\text{H}_2\text{O}$ . Completely sol. in a little warm  $\text{H}_2\text{O}$ , but decomp. by more  $\text{H}_2\text{O}$ . Completely sol. as acid salt in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ .

(Marignac, A. ch. (3) 27. 332.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+ $1\frac{1}{2}\text{H}_2\text{O}$ , + $1\frac{1}{3}\text{H}_2\text{O}$ , + $1\frac{1}{2}\text{H}_2\text{O}$ , etc. (Reuss, Dissert. 1896.)Mercuric nitrate, basic,  $6\text{HgO}$ ,  $\text{N}_2\text{O}_5$  (?).Insol. in hot  $\text{H}_2\text{O}$  (Kane.)+ $3\text{HgO}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$  Decomp. to oxide by washing with cold  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Mullon, A. ch. (3) 18. 361.)+ $2\text{HgO}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . Sl. deliquescent. Decomp. by  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Mullon.)+ $2\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ . (Marignac.)+ $3\text{H}_2\text{O}$ . (Ditte, J. B. 1854. 366.)Mercuric nitrate,  $\text{Hg}(\text{NO}_3)_2$ .Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Neither dissolved nor attacked by liquid  $\text{NO}_2$  (Frankland, Chem. Soc. 1901, 79. 1361.)

Sol in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sol in methylal. (Eidmann, C. C. 1899. II, 1014.)

+ $\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent Very sol. in a little  $\text{H}_2\text{O}$ .  $\text{Hg}_2\text{O}$  precipitates basic salt from conc.  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  Insol. in alcohol. Decomp. by ether. (Millon.)

+ $\text{H}_2\text{O}$ . Extraordinarily sol. in  $\text{H}_2\text{O}$  (Cov. Z. anorg. 1904, 40. 159.)

+ $8\text{H}_2\text{O}$ . Melts at  $6^\circ$  in crystal  $\text{H}_2\text{O}$ . (Ditte.)

**Mercuriomercuric nitrate**,  $\text{Hg}_2\text{O}$ ,  $2\text{HgO}$ ,  $\text{N}_2\text{O}_5$ .

Boiling  $\text{H}_2\text{O}$  gradually dissolves out  $\text{Hg}_2(\text{NO}_3)_2$ , and leaves residue of  $\text{HgO}$  and  $\text{Hg}$ . (Brooks, Pogg. 66. 63.)

$2\text{Hg}_2\text{O}$ ,  $\text{Hg}_2\text{O}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . (Ráy, Chem Soc. 1905, 87. 175.)

$\text{Hg}_2\text{O}$ ,  $2\text{HgO}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . (Ráy.)

**Mercurous hydrogen nitrate**,  $4\text{HgNO}_3$ ,  $\text{HNO}_3$ , + $8\text{H}_2\text{O}$ .

(Reuss, Dissert 1886.)

$5\text{HgNO}_3$ ,  $3\text{HNO}_3 + 26\text{H}_2\text{O}$ . (Reuss.)

**Mercuric silver nitrate**,  $\text{Hg}(\text{NO}_3)_2$ ,  $2\text{AgNO}_3$ .

Easily sol. in  $\text{H}_2\text{O}$  without decomp. (Berzelius.)

**Mercurous strontium nitrate**,  $2\text{SrO}$ ,  $2\text{Hg}_2\text{O}$ ,  $3\text{N}_2\text{O}_5$ .

Decomp. by  $\text{H}_2\text{O}$ . Much more sol. in  $\text{H}_2\text{O}$  than the corresponding Ba compound.

Readily sol. in warm dil.  $\text{HNO}_3 + \text{Aq}$  or  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$  without decomposition. (Städeler, A. 87. 131.)

**Mercurous thalious nitrate**,  $\text{HgNO}_3$ ,  $\text{TiNO}_3$ .

Miscible with  $\text{H}_2\text{O}$ . (Retgers, N. Jahrb Miner, 1896. II, 183.)

**Mercuric nitrate bromide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{HgBr}_2$ . (Morse, Z. phys. Ch. 1902, 41. 733.)

**Mercuric nitrate cadmium oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{CdO} + 2\text{H}_2\text{O}$ .

Ppt. (Mailhe, Bull. Soc. 1901, (3) 25. 788.)

+ $3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mailhe.)

**Mercuric nitrate cobaltous oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{CoO} + 3\text{H}_2\text{O}$ .

Ppt. (Mailhe, C. R. 1901, 132. 1275.)

+ $4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 369.)

**Mercuric nitrate cupric oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{CuO} + 2\text{H}_2\text{O}$ , and + $4\text{H}_2\text{O}$ .

(Mailhe, Bull. Soc. 1901, (3) 25. 791.)

+ $5\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 365.)

**Mercuric nitrate cyanide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{Hg}(\text{CN})_2$ .

Very sol. in  $\text{H}_2\text{O}$  Very sol. in methyl alcohol and solution is not decomp. at bpt. Ethyl alcohol apparently decomp. it (Prussa, Gazz. ch. it 1898, 28. (2) 115.)

**Mercurous nitrate hydrazine**,  $2\text{HgNO}_3$ ,  $\text{N}_2\text{H}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . Stable in dil.  $\text{HNO}_3 + \text{Aq}$  solution (Hofmann and Marburg, A. 1899, 305. 215.)

Ppt.; very unstable. (Hofmann, B. 1897, 30. 2021.)

$\text{Hg}(\text{NO}_3)_2$ ,  $\text{N}_2\text{H}_4$  Sol in dil.  $\text{HCl}$  and  $\text{HNO}_3$ . (Hofmann and Marburg, A. 1899, 305. 215.)

Ppt.; sol in acids; decomp. by alkali. (Hofmann, B. 1897, 30. 2021.)

**Mercuric nitrate iodide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $2\text{HgI}_2$ .

Decomp. by long boiling with  $\text{H}_2\text{O}$ . (Riegel, Jahrb Pharm. 11. 396.)

$2\text{Hg}(\text{NO}_3)_2$ ,  $3\text{HgI}_2$ . Easily decomp. by  $\text{H}_2\text{O}$ ; less easily by alcohol or ether. (Riegel.)

$\text{Hg}(\text{NO}_3)_2$ ,  $\text{HgI}_2$ . Decomp. very quickly by  $\text{HNO}_3 + \text{Aq}$  or alcohol of 0.814 sp gr. (Souville, J Pharm. 26. 474.)

**Mercuric nitrate manganous oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{MnO} + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Mailhe, Bull. Soc. 1901, (3) 25. 790.)

+ $3\text{H}_2\text{O}$  (Mailhe.)

+ $4\text{H}_2\text{O}$  (Mailhe, A. ch. 1902, (7) 27. 370.)

**Mercuric nitrate nickel oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{NiO} + 2\text{H}_2\text{O}$

(Mailhe, Bull. Soc. 1901, (3) 25. 788.)

+ $4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 369.)

**Mercurous nitrate phosphate**,  $\text{HgNO}_3$ ,  $\text{Hg}_3\text{PO}_4 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling therewith. Insol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$  or alcohol. Completely sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ . Decomp. by cold  $\text{KOH} + \text{Aq}$ , and warm  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Wittstein.)

$2\text{HgNO}_3$ ,  $\text{Hg}_3\text{O}$ ,  $5\text{Hg}_3\text{PO}_4 + \text{H}_2\text{O}$ . (Haack, A. 262. 192.)

**Mercuric nitrate silver bromide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{AgBr}$ .

(Morse, Z. phys. Ch. 1902, 41. 733.)

Mercuric nitrate silver cyanide, basic,  
 $\text{Hg}(\text{OH})\text{NO}_3$ ,  $\text{AgCN} + 2\text{H}_2\text{O}$ .  
 (Schmidt, Z. anorg. 1895, 9, 431)  
 $\text{Hg}(\text{OH})\text{NO}_3$ ,  $5\text{Ag}_2\text{O}$ ,  $20\text{AgCN} + 7\text{H}_2\text{O}$ .  
 (Schmidt.)

Mercuric nitrate silver iodide,  $\text{Hg}(\text{NO}_3)_2$ ,  
 $2\text{AgI} + \frac{1}{2}\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Preuss, A. 29, 328.)

Mercuric nitrate sulphide,  $\text{Hg}(\text{NO}_3)_2$ ,  $2\text{HgS}$ .  
 Very sl. sol in hot  $\text{H}_2\text{O}$ . Insol. in  $\text{HNO}_3$  +  
 Aq. Decomp. by hot  $\text{H}_2\text{SO}_4$  or aqua regia,  
 also by hot  $\text{HCl}$  + Aq. (Barfoed, J. pr. 93,  
 230.)

Sol. in aqua regia. (Denigès, Bull. Soc.  
 1915, (4) 17, 355.)  
 $2\text{Hg}(\text{NO}_3)_2$ ,  $\text{HgO}$ ,  $6\text{HgS} + 12\text{H}_2\text{O}$ . Insol.  
 in  $\text{H}_2\text{O}$  and  $\text{HNO}_3$  + Aq of 1.2 sp. gr. (Gramp,  
 J. pr. (2) 14, 299.)

Mercuric nitrate zinc oxide,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{ZnO} +$   
 $\text{H}_2\text{O}$ .

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Mailhe, C. R.  
 1901, 132, 1274.)

Molybdenum nitrate,  $\text{Mo}_2\text{O}_5$ ,  $\text{N}_2\text{O}_5$  (?).

Sol. in dil.  $\text{HNO}_3$  + Aq. (Berzelius.)  
 $\text{MoO}_3$ ,  $2\text{N}_2\text{O}_5$  (?). Sol. in dil.  $\text{HNO}_3$  + Aq  
 (Berzelius)

Neodymium nickel nitrate,  $2\text{Nd}(\text{NO}_3)_3$ ,  
 $3\text{Ni}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3$  + Aq (sp. gr.  
 1.325) contains 116.6 g. hydrous salt at  $16^\circ$ .  
 (Jantsch, Z. anorg. 1912, 76, 303.)

Neodymium rubidium nitrate,  $[\text{Nd}(\text{NO}_3)_3\text{Rb}_2]$   
 $+ 4\text{H}_2\text{O}$ .

Hydrosopic. (Jantsch, Z. anorg. 1911,  
 69, 230.)

Neodymium zinc nitrate,  $2\text{Nd}(\text{NO}_3)_3$ ,  
 $3\text{Zn}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3$  + Aq (sp. gr.  
 1.325) contains 177 g. hydrous salt at  $16^\circ$ .  
 (Jantsch.)

Nickel nitrate, basic.

Insol. in  $\text{H}_2\text{O}$ . (Proust.)  
 $8\text{NiO}$ ,  $2\text{N}_2\text{O}_5$ ,  $+ 5\text{H}_2\text{O}$ . Insol. in cold or hot  
 $\text{H}_2\text{O}$ . (Habermann, M. 5, 432.)  
 $5\text{NiO}$ ,  $\text{N}_2\text{O}_5$ ,  $+ 4\text{H}_2\text{O}$ . Not decomp. by boil-  
 ing  $\text{H}_2\text{O}$ . (Rousseau and Tite, C. R. 114,  
 1184.)

Nickel nitrate,  $\text{Ni}(\text{NO}_3)_2$ .

Solubility in  $\text{H}_2\text{O}$ . See + 3, 6, and  $9\text{H}_2\text{O}$ .  
 Sp. gr. of aqueous solution at  $17.5^\circ$  contain-  
 ing:

5	10	15	20	% $\text{Ni}(\text{NO}_3)_2$
1.0463	1.0903	1.1375	1.1935	
25	30	35	40	% $\text{Ni}(\text{NO}_3)_2$
1.2534	1.3193	1.3896	1.4667	

(Franz, J. pr. (2) 5, 295.)

Sp. gr. of  $\text{Ni}(\text{NO}_3)_2$  + Aq containing g.  
 $\text{Ni}(\text{NO}_3)_2$  (anhydrous) in 1000 g.  $\text{H}_2\text{O}$  at  
 $24.4^\circ$ :

91.5 g. (= $\frac{1}{2}$ mol.)	183.274.5	369.460.5	549.1073
	1.141	1.205	1.266

(Gerlach, Z. anal. 28, 468.)

Sp. gr. of  $\text{Ni}(\text{NO}_3)_2$  + Aq at room temp.  
 containing:

16.493	30.006	40.953%	$\text{Ni}(\text{NO}_3)_2$ .
1.1363	1.2776	1.3879	

(Wagner, W. Ann. 1883, 18, 269.)

Sp. gr. of  $\text{Ni}(\text{NO}_3)_2$  + Aq at  $25^\circ$ .

Concentration of $\text{Ni}(\text{NO}_3)_2$ + Aq	Sp. gr.
1-normal	1.0755
$\frac{1}{2}$ " "	1.0381
$\frac{1}{3}$ " "	1.0192
$\frac{1}{4}$ " "	1.0096

(Wagner, Z. phys. Ch. 1890, 5, 39.)

Sp. gr. at  $20^\circ$  of  $\text{Ni}(\text{NO}_3)_2$  + Aq containing  
 M g. mols. of salt per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.001521	1.003882	1.007792	1.011541
M	0.1	0.25	0.5	0.75
Sp. gr.	1.015307	1.03837	1.07611	1.11310
M	1.0	1.5	2.0	
Sp. gr.	1.14562	1.22134	1.29459	

(Jones and Pearce, Am. Ch. J. 1907, 38, 720.)

Sol in liquid  $\text{NH}_3$ . (Guntz, Bull. Soc.  
 1909, (4) 5, 1008.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin,  
 Am. Ch. J. 1898, 20, 828.)

Solubility in glycol = 7.5%. (de Coninck,  
 C. C. 1905, II 1234.)

Insol. in benzonitrile. (Naumann, B. 1914,  
 47, 1370.)

+  $3\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

58°	60°	64°	70°
61.61	61.99	62.76	63.95%
			$\text{Ni}(\text{NO}_3)_2$
90°	95°	mpt.	
70.16	77.12%	$\text{Ni}(\text{NO}_3)_2$	

(Funk, Z. anorg. 1899, 20, 411.)

+  $6\text{H}_2\text{O}$ . Not deliquescent in dry air. Sol.  
 in 2 pts cold  $\text{H}_2\text{O}$  and in alcohol. (Tupputi.)

Mpt. of  $\text{Ni}(\text{NO}_3)_2 + 6\text{H}_2\text{O} = 56.7^\circ$ . (Ord-  
 way; Tilden, Chem. Soc. 45, 409.)

Sat. solution boils at  $136.7^\circ$ . (Ordway.)

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-21°	-12.5°	-10°	-6°
39.94	41.59	42.11	43.00%
			$\text{Ni}(\text{NO}_3)_2$
0°	+20°	41°	56.7°
44.32	49.06	55.22	62.76%
			$\text{Ni}(\text{NO}_3)_2$

(Funk, Z. anorg. 1899, 20, 410.)

Sat. solution of  $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  contains 44.3%  $\text{Ni}(\text{NO}_3)_2$  at  $0^\circ$ , and 48.7%  $\text{Ni}(\text{NO}_3)_2$  at  $18^\circ$  (Mylius, Z. anorg. 1912, 74. 411.)

Sp. gr. of  $\text{Ni}(\text{NO}_3)_2 \cdot \text{Aq}$  containing in 1000 g.  $\text{H}_2\text{O}$  at  $24.4^\circ$ , g.  $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ .

145.5 g. (= 1/2 mol.) 291 436.5 583  
1.069 1.128 1.179 1.224

727.5 873 1018.5 1164

1.264 1.299 1.329 1.357

(Gerlach, Z. anal. 28. 468.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Insol. in absolute alcohol.

Sl. sol. in acetone. (Krug and M'Elroy.)

Difficultly sol. in methyl acetate (Naumann, B. 1909, 42. 3790)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

+  $9\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at.

$-23^\circ$   $-21^\circ$   $-10.5^\circ$   
39.02 39.48 44.13%  $\text{Ni}(\text{NO}_3)_2$ .

Cryohydrate is formed at  $-27^\circ$ . (Funk, Z. anorg. 1899, 20. 411.)

Nickel praseodymium nitrate,  $3\text{Ni}(\text{NO}_3)_2 \cdot 2\text{Pr}(\text{NO}_3)_3 + 2\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.825) contains 9.28 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 303)

Nickel samarium nitrate,  $3\text{Ni}(\text{NO}_3)_2 \cdot 2\text{Sm}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.825) contains 29.11 g. hydrous salt at  $16^\circ$ . (Jantsch.)

Nickel thorium nitrate,  $\text{NiTh}(\text{NO}_3)_6 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Meyer, Z. anorg. 1901, 27. 387.)

Nickel uranyl nitrate,  $10\text{Ni}(\text{NO}_3)_2 \cdot 3(\text{UO}_2)_3(\text{NO}_3)_3$ .

Sol. in  $\text{H}_2\text{O}$  and acids; insol. in aq. alkali. (Lancien, C. C. 1912, I. 208.)

Nickel nitrate ammonia,  $\text{Ni}(\text{NO}_3)_2 \cdot 4\text{NH}_3 + 2\text{H}_2\text{O}$ .

Efflorescent. Easily sol. in cold  $\text{H}_2\text{O}$ ; decomp. by boiling. Insol. in alcohol. (Erdmann, J. pr. 97. 395; Ephraïm, B. 1913, 48. 3106.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . (André, C. R. 106. 936.)

Nickel nitrate chloride ammonia,  $6\text{Ni}(\text{NO}_3)_2 \cdot \text{NiCl}_2 \cdot 30\text{NH}_3 + 16\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Schwarz, W. A. B. 1860. 272.)

Nickel nitrate cupric oxide,  $\text{Ni}(\text{NO}_3)_2 \cdot 3\text{CuO} + 3\text{H}_2\text{O}$ .

Ppt. (Maihle, C. R. 1902, 134. 234.)

Nickel nitrate hydrazine,  $\text{Ni}(\text{NO}_3)_2 \cdot 3\text{N}_2\text{H}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Franzen, Z. anorg. 1908, 60. 267.)

Palladium nitrate, basic,  $\text{Pd}(\text{NO}_3)_2 \cdot 3\text{PdO} + 4\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$  (Kane.)

Palladium nitrate,  $\text{Pd}(\text{NO}_3)_2 + x\text{H}_2\text{O}$

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$  or alcohol (Kane.)

Decomp. by cold or hot  $\text{H}_2\text{O}$  (Rose, A. 83. 143)

Platinic nitrate,  $\text{Pt}(\text{NO}_3)_4$  (?)

Known only in solution, which is decomp. on evaporating (Berzelius.)

$\text{Pt}(\text{NO}_3)_2 \cdot 3\text{PtO}_2 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Preuss, Bull. Soc. (2) 46. 156)

Platinum nitrate sulphocarbamide,  $\text{Pt}(\text{NO}_3)_2 \cdot 4\text{CS}(\text{NH}_2)_2$ .

Very sol. in  $\text{H}_2\text{O}$ . Unstable (Kunokow, J. pr. 1894, (2) 50. 490.)

Potassium nitrate,  $\text{KNO}_3$ .

Not deliquescent, but, according to Mulder, 100 pts.  $\text{KNO}_3$  under a bell jar with  $\text{H}_2\text{O}$  take up 339 pts.  $\text{H}_2\text{O}$  in 22 days, and small amounts finally deliquesce completely

Sol. in  $\text{H}_2\text{O}$  with absorption of heat.

16 pts.  $\text{KNO}_3 + 100$  pts.  $\text{H}_2\text{O}$  at  $13.2^\circ$  lower the temperature  $10.2^\circ$ . If the initial temp. is  $23^\circ$  it falls to  $12.8^\circ$ , if  $0^\circ$  it does not fall below  $-2.7^\circ$ , which is the freezing-point of the mixture. (Rudorff, Pogg. 136. 276)

$\text{KNO}_3 + \text{Aq}$  sat. at  $18.1^\circ$  has 1.601 sp. gr. and contains 22.72%  $\text{KNO}_3$ , or 100 pts.  $\text{H}_2\text{O}$  at  $18.1^\circ$  dissolve 29.45 pts.  $\text{KNO}_3$ . (Kerston, 1840)

Sol. in 3.743 pts.  $\text{H}_2\text{O}$  at  $18^\circ$  (Gerlach.)

Sol. in 3 pts.  $\text{H}_2\text{O}$  at  $21^\circ$  (Schiff, A. 109. 326), and solution has 1.683 sp. gr.

Sol. in 3 pts. cold, and 0.6 pt. boiling  $\text{H}_2\text{O}$ . (Fourcroy)

$\text{KNO}_3 + \text{Aq}$  sat. at  $18^\circ$  has sp. gr. 1.151, and contains 21.03%  $\text{KNO}_3$ , or 100 pts.  $\text{H}_2\text{O}$  dissolve 27.60 pts.  $\text{KNO}_3$  at  $18^\circ$  (Longchamp)

Sol. in 1 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and 0.25 pt. at b.-pt. (Rafault)

100 pts.  $\text{H}_2\text{O}$  at  $114.5^\circ$  dissolve 281.01 pts. (Griffiths)

Sol. in 7 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$  (Bergmann)

Sol. in 6.15 pts. cold  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl)

100 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 26.6 pts. at  $100^\circ$ , 100 pts. (Tre's Dictionary)

$\text{KNO}_3 + \text{Aq}$  sat. at  $10^\circ$  contains 33.3% (Eller)

$\text{KNO}_3 + \text{Aq}$  sat. in the cold contains 26% (Fourcroy)

$\text{KNO}_3 + \text{Aq}$  sat. at  $12.6^\circ$  contains 24.8% (Hansson)

Solubility of  $\text{KNO}_3$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{KNO}_3$	$t^\circ$	Pts. $\text{KNO}_3$
0	13.2	45.10	74.7
5	16.7	54.72	97.1
11.67	22.2	65.45	125.5
17.91	29.3	79.72	169.2
24.94	38.4	97.66	236.4

(Gay-Lussac, A. ch. 11. 314.)

Solubility of  $\text{KNO}_3$  in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{KNO}_3$
16 0	26 7
29	43 5
44 2	71 4

(Nordenskjöld, Pogg. 136 312.)

100 pts  $\text{H}_2\text{O}$  dissolve at:  
 $10^\circ$  18° 27° 41° 53°  
 21.2 27.9 40.1 66.3 93.3 pts  $\text{KNO}_3$ .  
 (Gerardin, A. ch. (4) 5. 150)

100 pts.  $\text{KNO}_3 + \text{Aq}$  sat at  $14^\circ$  contain  
 16.34 pts  $\text{KNO}_3$ ; at  $15^\circ$ , 18.81 pts  $\text{KNO}_3$ .  
 (v. Hauer, J. pr. 98. 177.)

100 pts  $\text{H}_2\text{O}$  dissolve at  
 $4^\circ$  16.3° 68.3°  
 10 27.2 132.1 pts.  $\text{KNO}_3$   
 (Andreae, J. pr. (2) 29. 456)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{KNO}_3$	$t^\circ$	Pts $\text{KNO}_3$	$t^\circ$	Pts $\text{KNO}_3$
0	13.3	39	62	78	165
1	13.8	40	64	79	168
2	14.6	41	66	80	172
3	15.5	42	68	81	175
4	16.4	43	70	82	179
5	17.1	44	72	83	182
6	17.8	45	74	84	185
7	18.5	46	76	85	189
8	19.3	47	78	86	192
9	20.2	48	81	87	196
10	21.1	49	83	88	199
11	22.0	50	86	89	203
12	23.0	51	88	90	206
13	24.0	52	91	91	210
14	25.0	53	93	92	214
15	26.0	54	96	93	218
16	27.0	55	98	94	222
17	28.1	56	101	95	226
18	29.1	57	103	96	230
19	30.2	58	106	97	234
20	31.2	59	108	98	238
21	32.3	60	111	99	243
22	33.5	61	113	100	247
23	34.7	62	116	101	252
24	36.0	63	119	102	256
25	37.3	64	121	103	261
26	38.6	65	124	104	266
27	40.0	66	127	105	272
28	41.4	67	130	106	278
29	42.9	68	133	107	284
30	44.5	69	136	108	289
31	46.0	70	139	109	295
32	48	71	142	110	301
33	50	72	146	111	307
34	52	73	149	112	313
35	54	74	152	113	319
36	56	75	155	114	326
37	58	76	159	114.1	327 4
38	60	77	162	.	..

(Mulder, Scheik. Verhandel 1864. 89.)

100 pts  $\text{H}_2\text{O}$  dissolve 493 pts.  $\text{KNO}_3$  at  $125^\circ$ . (Tilden and Shenstone, Phil. Trans. 1884. 23.)

Rhombohedral  $\text{KNO}_3$  is more easily soluble than the prismatic, and easily forms super-saturated solutions. (Frankenheim)

Sat.  $\text{KNO}_3 + \text{Aq}$  contains at.

$139^\circ$   $158^\circ$   $160^\circ$   $175^\circ$   $180^\circ$   
 79.8 83.7 83.9 84.0 84.2%  $\text{KNO}_3$

$190^\circ$   $215^\circ$   $225^\circ$   $258^\circ$   $283^\circ$   
 86.0 89.0 90.4 91.6 96.5%  $\text{KNO}_3$ .

(Étaud, A. ch. 1894, (7) 2. 526.)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	G $\text{KNO}_3$	Sp gr $t^\circ/4^\circ$
0 40	13 43	1 0817
14 90	25 78	1 1389
30 80	47 52	1 2218
44 75	74 50	1 3043
60 05	111 18	1.3903
76	156 61	1 4700
91 65	210 20	1 5394
114*	311.64	1 6269

\* B.-pt. of sat. solution.

(Berkeley, Phil. Trans. 1904, 203, A 189)

100 g.  $\text{H}_2\text{O}$  dissolve 37.79 g.  $\text{KNO}_3$  at  $25^\circ$   
 100 g.  $\text{H}_2\text{O}$  dissolve 3.08 g. equiv.  $\text{KNO}_3$   
 at  $20^\circ$ ; 3.27 at  $21.5^\circ$ . (Euler, Z. phys. Ch. 1904, 49. 312)

1 l.  $\text{H}_2\text{O}$  dissolves 384.48 g.  $\text{KNO}_3$  at  $25^\circ$ .  
 (Armstrong and Eyre, Proc Roy. Soc 1910, A, 84. 123.)

1 l. sat.  $\text{KNO}_3 + \text{Aq}$  contains 2.8 g. mols.  $\text{KNO}_3$ .  
 (Rosenheim and Weinheber, Z. anorg. 1911, 69. 263.)

100 g  $\text{H}_2\text{O}$  dissolve 38.485 g.  $\text{KNO}_3$  at  $25^\circ$ .  
 (Haugh, J. Am. Chem. Soc 1912, 34. 1148)

Sat.  $\text{KNO}_3 + \text{Aq}$  contains at:

$50^\circ$   $58^\circ$   $62^\circ$   $68^\circ$   
 46.39 51.55 53.64 57.04%  $\text{KNO}_3$   
 (Tschugaeff, Z. anorg. 1914, 86. 160)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at.

$9.1^\circ$   $21.1^\circ$   $35^\circ$   
 16.76 24.77 35.01 g  $\text{KNO}_3$ .

(Findlay, Chem. Soc. 1914, 105. 780.)

Sp. gr. of solution sat. at  $15^\circ = 1.134$   
 (Michel and Kraft.)

Sp. gr. of solution sat at  $16^\circ = 1.138$ .  
 (Stolba, J. pr. 97. 503.)

Sp. gr. of solution sat. at  $18^\circ = 1.1601$ , and  
 contains 29.45%  $\text{KNO}_3$ . (Karsten.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $19.5^\circ$ .

% $\text{KNO}_3$	Sp gr	% $\text{KNO}_3$	Sp gr.
4 871	1.0307	17 965	1 1198
9 618	1 0618	21.488	1 1457
14 044	1 0920	..	..

(Kremers, Pogg 95. 120.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $21^\circ$ .

$\% \text{KNO}_3$	Sp. gr.	$\% \text{KNO}_3$	Sp. gr.
1	1.0058	13	1.0819
2	1.0118	14	1.0887
3	1.0178	15	1.0956
4	1.0239	16	1.1026
5	1.0300	17	1.1097
6	1.0363	18	1.1169
7	1.0425	19	1.1242
8	1.0490	20	1.1316
9	1.0555	21	1.1390
10	1.0621	22	1.1464
11	1.0686	23	1.1538
12	1.0752	24	1.1613

(Schuff, A 110 75.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $15^\circ$ .

$\% \text{KNO}_3$	Sp. gr.	$\% \text{KNO}_3$	Sp. gr.
1	1.00041	12	1.07905
2	1.01283	13	1.08598
3	1.01924	14	1.09286
4	1.02566	15	1.09977
5	1.03207	16	1.10701
6	1.03870	17	1.11426
7	1.04534	18	1.12150
8	1.05197	19	1.12875
9	1.05861	20	1.13599
10	1.06524	21	1.14361
11	1.07215		

(Gerlach, Z. anal. 8. 286.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $17^\circ 5'$ .

$\% \text{KNO}_3$	Sp. gr.	$\% \text{KNO}_3$	Sp. gr.	$\% \text{KNO}_3$	Sp. gr.
1	1.006	8	1.051	15	1.099
2	1.012	9	1.058	16	1.106
3	1.019	10	1.065	17	1.113
4	1.025	11	1.072	18	1.120
5	1.032	12	1.078	19	1.127
6	1.038	13	1.085	20	1.134
7	1.045	14	1.092		

(Hager, Comm. 1883.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $18^\circ$ .

$\% \text{KNO}_3$	Sp. gr.	$\% \text{KNO}_3$	Sp. gr.
5	1.0305	20	1.133
10	1.0632	22	1.148
15	1.097		

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $20^\circ$ , containing mols.  $\text{KNO}_3$  in 100 mols.  $\text{H}_2\text{O}$ .

Mols. $\text{KNO}_3$	Sp. gr.	Mols. $\text{KNO}_3$	Sp. gr.
0.5	1.01780	4	1.12264
1	1.03373	5	1.14888
2	1.05524		

(Nicol, Phil. Mag. (5) 16, 122.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{KNO}_3 + \text{Aq}$	Sp. gr.
1-normal	1.0605
$\frac{1}{2}$ -normal	1.0305
$\frac{1}{4}$ -normal	1.0161
$\frac{1}{8}$ -normal	1.0075

(Wagner, Z. phys. Ch. 1890, 5. 37.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $20^\circ 1'$ .

p = per cent strength of solution; d = observed density; w = volume conc. in grams per cc.  $\left(\frac{pd}{100} = w\right)$

p	d	w
25.54	1.1783	0.30095
21.95	1.1510	0.25270
17.88	1.1200	0.20083
13.93	1.0913	0.16203
8.706	1.0553	0.09186
5.393	1.0331	0.05671
4.389	1.0264	0.04506
2.848	1.0165	0.02895
2.030	1.0113	0.02053
0.741	1.0030	0.00743

(Barnes, J Phys. Chem. 1898, 2. 544.)

Sp. gr.  $20^\circ/4^\circ$  of a normal solution of  $\text{KNO}_3$  = 1.05954; of a 0.5 normal solution = 1.029325. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

Sp. gr. of sat.  $\text{KNO}_3 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	G $\text{KNO}_3$ sol in 100 g $\text{H}_2\text{O}$	Sp. gr.
0	13.27	1.034
10	20.89	1.120
20	31.59	1.161
30	45.85	1.212
40	63.90	1.282
50	85.51	1.339
60	109.00	1.403
70	138.00	1.446

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, 44. 1565.)

The saturated solution boils at  $114.1^\circ$  (Muller);  $114.5^\circ$  (Griffiths);  $115.9^\circ$  (Legrand, Gerardin);  $117^\circ$  (Magnus);  $118^\circ$  (Kremers);  $126^\circ$  (Le Page).

The saturated solution forms a crust at  $111^\circ$ , and boils at  $115^\circ$ ; highest temp. observed,  $115.3^\circ$ . (Gerlach, Z. anal. 28. 426.)

B.-pt of  $\text{KNO}_3 + \text{Aq}$  containing pts.  $\text{KNO}_3$  to 100 pts.  $\text{H}_2\text{O}$  G=according to Gerlach (Z. anal. 26. 444); L=according to Legend (A. ch. (2) 62. 426).

B.-pt.	G	L	B.-pt.	G	L
100.5°	7 5	..	107°	120.5	119 0
101	15.2	12 2	108	141 5	140 6
101 5	23	..	109	164	163 0
102	31	26.4	110	188 5	185.9
102 5	39	..	111	215	209 2
103	47 5	42 2	112	243	233 0
103 5	56	..	113	274	257.6
104	64 5	59 6	114	306	283.3
104.5	73	..	115	338 5	310 2
105	82	78 3	115.9		335 1
106	101	98.2			

1 pt.  $\text{KNO}_3$  dissolves in 1.4 pts  $\text{HNO}_3$ ; at 20° in 3.8 pts., and at 123° in 1 pt.  $\text{HNO}_3 + \text{Aq}$  of 1.423 sp gr. (Composition  $2\text{HNO}_3, 3\text{H}_2\text{O}$ .) (Schultz, Zeit. Ch. (2) 5. 531.)

Solubility of  $\text{KNO}_3$  in  $\text{HNO}_3$  at 0°.

G. per 100 cc solution		Sp gr
$\text{KNO}_3$	$\text{HNO}_3$	
12.65	0 00	1 079
10.02	3 71	
8.38	8.38	1 093
7.49	13 58	1.117
7.49	19 47	1.144
7 68	30.04	1 202
10 42	42.86	1 289
28 64	75 95	1 498

(Engel, C. R., 1887, 104 913.)

Solubility in  $\text{HNO}_3 + \text{Aq}$

Solution temp	% by wt. $\text{KNO}_3$	Solid phase
-6°	24 4	$\text{KNO}_3, 2\text{HNO}_3$ (solution in $\text{HNO}_3$ ) (stable)
+14 0	32 6	"
17 0	34 8	"
19 5	37 2	"
22.0	44 5	(mpt.)
21 5	47 8	(Solution in $\text{KNO}_3$ ) (labile)
21.5	48 6	"
20.0	50.9	"
-4.0	37.2	$\text{KNO}_3, \text{HNO}_3$ (labile)
+16.5	44.5	"
22.5	47.2	(stable)
23.5	47 8	"
25.5	48 6	"
27.0	49.4	"
29 0	50 1	(labile)
30.5	50.9	"
21 0	49.4	$\text{KNO}_3$ (labile)
39 0	50 6	(stable)
50.0	51 7	"

(Groschuff, Z. anorg. 1904, 40. 10.)

Sol in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  Solution thus obtained contains 43.07 pts. mixed salts, or 100 pts.  $\text{H}_2\text{O}$  dissolve 75.66 pts. mixed salts, viz. 38.82 pts.  $\text{KNO}_3$  and 39.84 pts.  $\text{NH}_4\text{Cl}$ . (Karsten.) See also under  $\text{NH}_4\text{Cl}$ .

Solubility of  $\text{KNO}_3 + \text{K}_2\text{CO}_3$  and  $\text{KHCO}_3$  in  $\text{H}_2\text{O}$ , see under  $\text{K}_2\text{CO}_3$  and  $\text{KHCO}_3$ .

Sol. in sat.  $\text{BaCl}_2 + \text{Aq}$  with pptn. of  $\text{Ba(NO}_3)_2$ .

Sol. in sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$ , at first without pptn., but afterwards  $\text{NH}_4\text{NO}_3$  is pptd. (Karsten.)

Sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  with pptn. of  $\text{NH}_4\text{NO}_3$ . (Rüdorff, B. 6. 485)

See also under  $\text{NH}_4\text{NO}_3$ .

Sol in sat.  $\text{Ba(NO}_3)_2 + \text{Aq}$ , but soon a double salt separates. (Karsten.)

See also under  $\text{Ba(NO}_3)_2$ .

Sol in  $\text{Ca(NO}_3)_2 + \text{Aq}$ . (Longchamp)

See also under  $\text{Ca(NO}_3)_2$ .

Sol. in sat.  $\text{Pb(NO}_3)_2 + \text{Aq}$  without pptn.

100 pts.  $\text{H}_2\text{O}$  dissolve 119.6 pts.  $\text{Pb(NO}_3)_2$  and 87 1 pts.  $\text{KNO}_3$  at 21.2°. (Rüdorff, B. 6. 484.) See also under  $\text{Pb(NO}_3)_2$ .

Solubility in  $\text{AgNO}_3 + \text{Aq}$  at t°.

t°	Sat. solution contains		
	% $\text{KNO}_3$	% $\text{AgNO}_3$	% total salt
-7	10.5	39 4	49.9
-7 5	10 5	40 5	51 0
-4	11 3	42 5	53.8
+20	23 6	46 4	70 0
33	26 3	50 9	77.2
34	27 3	51 1	78.4
36	29 4	52.0	81.4
38		...	81.7
46		...	82 3
54	33 1	55 0	88 1
54	..	55 8	
61		...	80.5
68	34.3	54 6	88.9
96	37 8	55 4	93 2
105	38 5	55 6	94 1
142	41 5	55 8	97 3

(Etard, A. ch. 1894, (7) 3. 286.)

Solubility of mixed crystals of  $\text{KNO}_3$  and  $\text{AgNO}_3$  in  $\text{H}_2\text{O}$  at 25°.

G per l		Mg mols per l		Mol % $\text{AgNO}_3$ in solution	Mol % $\text{AgNO}_3$ in solid phase
$\text{AgNO}_3$	$\text{KNO}_3$	$\text{AgNO}_3$	$\text{KNO}_3$		
45 9	321 8	270	3180	7.83	0.2896
110 7	322 6	6513	3184	16 96	0.6006
176 8	333 7	1040	3298	23 97	0.9040
269 6	364.0	1258	3597	29 81	1.054
365 6	456 4	2151	4511	32 23	1.604
507 9	387 2	2988	3816	43 85	2.439
745 9	398.6	4388	3900	57 70	8.294

(Hers, Z. Kryst. Min. 1897, 28. 405.)

Solubility of  $\text{KNO}_3 + \text{AgNO}_3$  at  $30^\circ$ .

Composition of the solution		Solid phase
% $\text{KNO}_3$	% $\text{AgNO}_3$	
0	73.0	$\text{AgNO}_3$
5 53	71.65	"
11 22	69 01	$\text{AgNO}_3 + \text{AgNO}_3, \text{KNO}_3$
13 44	65 08	$\text{AgNO}_3$
17 38	57 85	"
25 05	46 32	$\text{KNO}_3 + \text{AgNO}_3, \text{KNO}_3$
25 00	46 45	"
26 58	39 09	$\text{KNO}_3$
29 22	23 59	"
30 45	11 51	"
31 30	0	"

(Schreinemakers, Z. phys. Ch. 1909, 65, 576.)

 $\text{KNO}_3 + \text{NaNO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 34.53 pts.  $\text{KNO}_3$  and 91.16 pts.  $\text{NaNO}_3$  at  $15.6^\circ$ , and solution has sp. gr. = 1.478 (Page and Keightley)

100 pts.  $\text{KNO}_3 + \text{NaNO}_3 + \text{Aq}$  sat. at  $11^\circ$  contain 52.17 pts. of the two salts, sat. at  $13^\circ$  contain 53.15 pts. of the two salts (v. Hauer.)

100 pts.  $\text{H}_2\text{O}$  dissolve at  $18.75^\circ$  29.45 pts.  $\text{KNO}_3$  and 89.53 pts.  $\text{NaNO}_3$ , if sat.  $\text{KNO}_3 + \text{Aq}$  is treated with  $\text{NaNO}_3$  and 35.79 pts.  $\text{KNO}_3$  and 88.00 pts.  $\text{NaNO}_3$  by the opposite process 134.38 pts. of the two salts are dissolved if a mixture of the salts is treated with  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Karsten)

100 pts.  $\text{H}_2\text{O}$  dissolve 39.34 pts.  $\text{KNO}_3$  and 94.60 pts.  $\text{NaNO}_3$ , or 133.91 pts. of the two salts at  $20^\circ$  (Nicol, Phil. Mag. (5) 13, 385)

Solubility of mixtures of  $\text{KNO}_3$  and  $\text{NaNO}_3$ .

% $\text{NaNO}_3$ in mixture before solution	Total amt mixed salts dissolved in 100 pts. $\text{H}_2\text{O}$ at $20^\circ$	% $\text{NaNO}_3$ dissolved	% $\text{KNO}_3$ dissolved	% $\text{NaNO}_3$ in mixture after solution and evap. to dryness
100	88 8	88 8	0	100
90	109 6	96 4	13 2	88
80	136 5	98 0	38 5	71.8
70	130 3			
60	137 6	90 0	47 6	65 4
50	106 1	96 0	40 1	62.2
45 7*	88 0	53 3	34 7	60.6
40	81 1	45 6	35 6	56 2
30	73 5			
20	54 1	20 8	33.3	38 5
10	40 9	9 4	31.5	22 9
0	33 6	0	33.6	0

\*  $\text{NaNO}_3 + \text{KNO}_3$ .

(Carnelley and Thomson, Chem. Soc. 53 752.)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $10^\circ$ .

In 1000 ccm $\text{H}_2\text{O}$		Solid phase
$\text{NaNO}_3$	$\text{KNO}_3$	
805 0		$\text{NaNO}_3$
848 3	301 9	$\text{NaNO}_3, \text{KNO}_3$
	208 9	$\text{KNO}_3$

(Kremann and Zitek, M. 1909, 30, 325.)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $24.2^\circ$ .

In 1000 ccm $\text{H}_2\text{O}$		Solid phase
$\text{NaNO}_3$	$\text{KNO}_3$	
913 58		$\text{NaNO}_3$
910 60	123 00	"
1019 65	435 85	$\text{NaNO}_3, \text{KNO}_3$
1018 40	437 70	"
931 30	422 00	$\text{KNO}_3$
346 70	390 00	"
..	377 35	"

(Kremann and Zitek)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

% $\text{KNO}_3$	% $\text{NaNO}_3$	Solid phase
38 70	39 62	
41 60	66 31	$\text{KNO}_3$
46 35	100 10	"
39 08	98 99	$\text{KNO}_3 + \text{NaNO}_3$
20 98	94 44	$\text{NaNO}_3$

(Uyeda, Mem. Col. Sc. Kioto, 1910, 2, 245)

Solubility in  $\text{NaNO}_3 + \text{Aq}$  at  $20^\circ$ ,  $30^\circ$ ,  $40^\circ$  and  $91^\circ$ . Data, given in the original, show that each salt increases the solubility of the other. (Leather, Mem. Dept. Agric. India, 1914, 3, 177; Chem. Soc. 1915, 108, (2), 13.)

100 pts.  $\text{H}_2\text{O}$  dissolve 28.92 pts.  $\text{KNO}_3$ , 53.68 pts.  $\text{NaNO}_3$ , and 26.44 pts.  $\text{NaCl}$  at  $15.6^\circ$ , and solution has sp. gr. = 1.44. (Page and Keightley, Chem. Soc. (2) 10, 566.)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

% $\text{KNO}_3$	% $\text{NaNO}_3$	% $\text{NaCl}$	Solid phase
38.44	22 87	32 58	
38 57	44 40	27 07	$\text{NaCl} + \text{KNO}_3$
42 55	63 26	33 50	"
17 77	61 13	23 94	$\text{NaNO}_3, \text{KNO}_3 + \text{NaCl}$
28 08	62 92	23 70	"
44 72	82 82	9 56	"

(Uyeda, Mem. Col. Sc. Kioto, 1910, 2, 245.)

 $\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2$ .

1 l.  $\text{H}_2\text{O}$  sat. with both salts at  $25^\circ$  contains 553 g.  $\text{KNO}_3 + 1074$  g.  $\text{Sr}(\text{NO}_3)_2$ . (Le Blanc and Noyes, Z. phys. Ch. 1890, 6, 386.)

Solubility of  $\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2$  at  $t^\circ$ 

$t^\circ$	% $\text{KNO}_3$	% $\text{Sr}(\text{NO}_3)_2$	Solid phase
20	22.90	5.49	$\text{KNO}_3$
	21.70	9.17	"
	21.01	17.10	"
	19.60	31.24	"
	19.49	34.91	"
	19.69	39.56	$\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	17.56	40.37	$\text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	12.65	41.12	"
	10	40.70	"
40	30.26	23.70	$\text{KNO}_3$
	26.90	38.52	$\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	22.50	40.22	$\text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	11.19	44.19	"
	0	47.7	"

(Findlay, Morgan and Morris, Chem. Soc. 1914, 106, 779.)

 $\text{KNO}_3 + \text{TiNO}_3$ 

100 g.  $\text{H}_2\text{O}$  dissolve 43.5 g.  $\text{TiNO}_3 + 104$  g.  $\text{KNO}_3$  at  $58^\circ$ . (Rabe, Z. anorg. 1902, 31, 156.)

Solubility of mixed crystals of  $\text{KNO}_3 + \text{TiNO}_3$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

G per l		Sp gr
$\text{TiNO}_3$	$\text{KNO}_3$	
0.00	351.0	1.2632
2.37	329.0	1.1903
6.15	332.4	1.1956
17.64	333.7	1.2050
49.74	333.3	1.2196
63.60	321.0	1.2436
86.18	330.5	1.2617
123.8	428.3	1.2950
101.3	245.1	1.2050
116.1	0.0	1.0964

(Herz, Z. Kryst. Min. 1897, 28 405.)

 $\text{KNO}_3 + \text{KBr}$ Solubility in  $\text{KBr} + \text{Aq.}$ 

1 litre of the solution contains

at $14.5^\circ$		at $25.2^\circ$	
Mol KBr	Mol. $\text{KNO}_3$	Mol KBr	Mol $\text{KNO}_3$
0.0	2.228	0.0	3.217
0.356	2.026	0.38	3.026
0.784	1.835	0.93	2.689
1.092	1.730	1.37	2.492
1.577	1.589	2.08	2.216
2.542	1.406	2.87	1.958
3.536	1.308	3.55	1.807

(Touren, C. R. 1900, 130. 910.)

 $\text{KNO}_3 + \text{KCl}$ 

100 pts.  $\text{H}_2\text{O}$  dissolve pts. of the two salts:

	At $12.0^\circ$	At $15.3^\circ$
	18.8	18.9
$\text{KNO}_3$	28.5	29.8
$\text{KCl}$		

(Kopp.)

100 pts.  $\text{H}_2\text{O}$  dissolve 315.2 pts.  $\text{KCl}$  and 19.1 pts.  $\text{KNO}_3$  at  $20.0^\circ$ . (Radorff, B. 6. 484.)

100 pts.  $\text{H}_2\text{O}$  dissolve 18.95 pts.  $\text{KNO}_3 + 32.84$  pts.  $\text{KCl}$ , or 51.79 pts. of the mixed salts at  $20^\circ$ . (Nicol, Phil. Mag. (5) 31. 385.)

Solubility of  $\text{KCl}$  with addition of  $\text{KNO}_3$  at  $17.5^\circ$ .

Sp gr.	100 ccm. of solution contain g.		
	$\text{KCl}$	$\text{H}_2\text{O}$	$\text{KNO}_3$
1.1730	29.39	87.85	0
1.1980	27.50	85.68	6.58
1.2100	27.34	84.76	8.83
1.2250	26.53	83.58	12.48
1.2360	25.98	82.84	14.83
1.2390	25.96	82.65	15.22
1.2388	25.95	82.43	15.49
1.2410	26.24	82.63	15.33

$\text{KNO}_3$  separated out in last four solutions.

Solubility of  $\text{KNO}_3$  with addition of  $\text{KCl}$  at  $20.5^\circ$ .

Sp gr	100 ccm. of solution contain g		
	$\text{KNO}_3$	$\text{H}_2\text{O}$	$\text{KCl}$
1.1625	27.68	88.51	0
1.1700	24.39	87.89	4.72
1.1765	22.44	87.47	7.74
1.1895	20.23	86.48	12.23
1.1983	18.96	85.69	15.15
1.2150	17.67	84.23	19.61
1.2265	17.11	83.40	22.17
1.2400	16.79	82.24	24.96

(Bodlander, Z. phys. Ch. 7 359.)

## Solubility in KCl+Aq at t°.

t°	Sat solution contains		
	% KNO <sub>3</sub>	% KCl	% total salt
-11.4	4.0	18.4	22.4
-11	3.9	18.1	22.0
-10	3.8	18.6	22.5
-4		19.7	
+2.5	6.3	19.9	26.2
4.5	7.3	20.7	28.0
4.5	7.8	19.8	27.6
8.5	7.9	20.9	28.8
10.5	8.4	21.0	29.4
13.5	8.9	21.8	30.7
14	10.2	21.3	31.5
17	9.7	22.6	32.3
23	12.5	21.8	34.3
27	14.9	21.3	36.2
29	16.1	21.0	37.1
34	18.9	21.2	39.3
36	18.9	21.6	40.5
37.5	19.2	21.6	40.8
39	21.0	21.0	42.0
42.5	21.8	20.9	42.7
48	25.3	20.3	45.6
50	28.3	20.8	49.1
52		20.2	
53			48.7
56	29.5	19.5	49.0
61	34.5	18.3	52.8
62	35.4		
71	40.5	17.3	57.8
81	47.1	15.4	62.5
85	48.2	15.3	63.5
90	52.8	13.3	66.1
96	54.1	12.6	66.7
97	56.6	12.4	69.0
104	59.9	10.8	70.7
105		10.9	
120	69.6	7.7	77.3
120	69.1	7.6	76.7

(Étard, A. ch. 1894, (7) 3 285.)

## Solubility in KCl+Aq

1 litre of the solution contains at			
14.5°		at 25.2°	
Mol KCl	Mol KNO <sub>3</sub>	Mol KCl	Mol KNO <sub>3</sub>
0.0	2.228	0.0	3.217
0.182	2.172	0.20	3.086
0.424	2.057	0.66	2.853
0.880	1.830	1.35	2.510
1.778	1.576	2.08	2.218
2.204	1.515	2.78	2.015
2.635	1.423	3.04	1.946
3.172	1.355		

(Touren, C. R. 1900, 130, 909.)

Solubility of KCl in KNO<sub>3</sub>+Aq

t°	Concentration of KNO <sub>3</sub> % mol. per l	G salt dissolved in 1 l H <sub>2</sub> O	Molecular solubility
0°	0	283.55	3.81
"	1/4	284.25	3.81
"	1/2	283.60	3.81
"	1	287.60	3.86
25°	0	304.15	4.89
"	1/4	365.00	4.90
"	1/2	361.65	4.86
"	1	358.80	4.81
"	1 1/2	355.20	4.77

(Armstrong and Eyre, Proc. R. Soc. (A) 1910, 84, 127.)

Solubility in KCl+Aq at 20°, 30°, 40° and 91°. Data, given in the original, show that each salt diminishes the solubility in H<sub>2</sub>O of the other. (Leather, Mem. Dept. Agric. India, 1914, 3, 177, Chem. Soc. 1915, 108, (2) 13.)

KNO<sub>3</sub>+NaCl

NaCl is sol in sat. KNO<sub>3</sub>+Aq, and the mixed solution is capable of dissolving more KNO<sub>3</sub>. An amount of H<sub>2</sub>O, which, when pure, could only dissolve 100 pts KNO<sub>3</sub>, can in this way be made to take up 152.64 pts. (Longchamp, A. ch. (2) 9, 8.)

Sol. in sat NaCl+Aq.

100 pts. H<sub>2</sub>O dissolve:

	Longchamp 4° (1)	Rüdorff		Page and Keightley 15.6° (4)
		14° (2)	18° (3)	
NaCl	35.96	38.5	38.0	39.57
KNO <sub>3</sub>	26.01	28.7	36.1	32.32
	61.97	67.2	75.0	71.89

	Karsten 18.75°			Muker At b-pt. (8)
	(5)	(6)	(7)	
NaCl	36.53	38.25	39.19	37.9
KNO <sub>3</sub>	33.12	29.45	38.53	306.7
	69.65	67.70	77.72	344.6

1, 2, 3, 4, and 8. Both salts in excess.

5. Sat. NaCl+Aq treated with KNO<sub>3</sub>.6. Sat. KNO<sub>3</sub>+Aq treated with NaCl7. The two salts simultaneously treated with H<sub>2</sub>O.

100 pts. H<sub>2</sub>O dissolve 31.44 pts KNO<sub>3</sub>, 139 pts. KCl, and 38.58 pts. NaCl at 15.6°, and solution has sp. gr.=1.33. (Page and Keightley.)

## Solubility in NaCl + Aq at t°.

t°	Sat. solution contains		
	% KNO <sub>3</sub>	% NaCl	% total salt
-22	7.3	22.5	29.8
-19.5	7.9	22.6	30.5
-15.5	8.7	22.1	31.8
-7	10.1	22.5	32.6
-6	10.9	23.0	33.9
-1	12.7	23.3	36.0
+1	12.9	23.8	36.7
+11	16.6	22.8	39.4
17	19.0	22.8	41.8
18	19.8	22.0	41.8
18.	18.9	22.5	41.5
20.5	20.4	22.3	42.7
22	...	21.2	...
22	21.8	20.7	42.5
26	20.7	22.3	43.0
27	...	...	45.0
30.5	24.7	20.7	45.4
32.5	25.0	20.2	45.2
32.5	25.9	20.2	46.1
33	26.7	20.7	47.4
35	27.9	20.2	48.1
39	29.8	19.5	49.3
42.2	31.1	20.0	51.1
50	38.5	16.5	55.0
54	39.4	17.1	56.5
58.5	40.9	15.3	56.2
70	49.7	14.0	63.7
76	53.9	13.6	67.5
79	54.8	12.9	67.7
84	57.4	12.6	70.0
90	61.4	10.4	71.8
96	64.7	9.5	74.2
105	70.0	9.0	79.0
106	69.9	9.3	79.2
107	71.3	8.4	79.7
115	72.2	9.0	81.2
122	73.8	8.0	81.8
127	73.6	7.9	81.5
127	72.9	8.8	81.7
127	73.0	7.6	80.6
128	74.2	7.9	82.1
132	75.7	7.6	83.3
145	77.7	7.6	85.3
170	80.7	5.8	86.5
171	79.1	5.9	85.0

(Étard, A. ch. 1894, (7) 3. 283.)

100 g. H<sub>2</sub>O dissolve 41.14 g. KNO<sub>3</sub> and 38.25 g. NaCl at 25°; 168.8 g. KNO<sub>3</sub> and 39.31 g. NaCl at 80°. (Soch, J. phys. Ch. 1898, 2. 46.)

See also under NaCl.

\* Sol. in sat. CuSO<sub>4</sub> + Aq, forming a double salt, which soon separates out.

Very slowly and slightly sol. in MgSO<sub>4</sub> + Aq with pptn. of MgSO<sub>4</sub>. (Karsten.)

KNO<sub>3</sub> + K<sub>2</sub>SO<sub>4</sub>.

Sat. KNO<sub>3</sub> + Aq dissolves some K<sub>2</sub>SO<sub>4</sub>, and sat. K<sub>2</sub>SO<sub>4</sub> + Aq slowly dissolves some KNO<sub>3</sub>.

without pptn., but K<sub>2</sub>SO<sub>4</sub> is afterwards pptd. (Karsten.)

100 pts. H<sub>2</sub>O dissolve:

	Mulder 18 76° (1)	Karsten 18 76° (2)	Kopp		Mulder 18.75° (5)
			20° (3)	40° (4)	
KNO <sub>3</sub>	29.90	29.42	26.9	59.35	...
K <sub>2</sub> SO <sub>4</sub>	.	4.0	6.6	5.75	10.8

2 H<sub>2</sub>O sat. with KNO<sub>3</sub> and K<sub>2</sub>SO<sub>4</sub> simultaneously, or to a sat. solution of one salt the other was added.

3 and 4. H<sub>2</sub>O sat. with both salts simultaneously.

Mulder doubts the results of 3 and 4.

Solubility in K<sub>2</sub>SO<sub>4</sub> + Aq at t°.

t°	In 100 ccm of the solution		Sp. gr. of solution
	G KNO <sub>3</sub>	G K <sub>2</sub> SO <sub>4</sub>	
15	216.5	50.7	1.165
25	308.5	47.66	1.210

(Euler, Z. phys. Ch. 1914, 40. 313.)

Slowly sol. in sat. Na<sub>2</sub>SO<sub>4</sub> at first without pptn., but afterwards K<sub>2</sub>SO<sub>4</sub> or NaSO<sub>4</sub> separates out.

Sol. in sat. ZnSO<sub>4</sub> + Aq with pptn. of double salt (Karsten.)

Sol. in sat. KClO<sub>4</sub> + Aq, from which solution it is not pptd. by salts which would ppt. it from aqueous solution. (Karsten.)

Hydrazine dissolves 21.7 pts. KNO<sub>3</sub> at 12.5-13°. (de Bruyn, R. t. c. 1899, 18. 297.)

Neither dissolved nor attacked by liquid NO<sub>2</sub>. (Frankland, Chem. Soc. 1901, 79. 1361.)

Very sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1893, 20. 829.)

Insol. in absolute alcohol; in dilute alcohol it dissolves proportional to the amount of H<sub>2</sub>O present, but always less is dissolved than the H<sub>2</sub>O would dissolve by itself. (Gerardin.)

100 pts. alcohol containing % by weight of alcohol dissolve pts. KNO<sub>3</sub> at 15°.

10	20	30	40	50	60	80%	alcohol
13.2	8.5	5.6	4.3	2.8	1.7	0.4	pts. KNO <sub>3</sub> .

(Schiff, A. 118. 365.)

Solubility in 100 pts. alcohol at  $t^{\circ}$  D = sp. gr.  
of alcohol; S = solubility

D = 0.9904		D = 0.9848		D = 0.9793		D = 0.9726	
$t^{\circ}$	S	$t^{\circ}$	S	$t^{\circ}$	S	$t^{\circ}$	S
12	18 1	12	14 6	10	10 20	14	8 8
21	25 0	21	21 7	10	10 19	25	13 6
33	40.4	36	37 8	13	11.74	34	20 3
43	58.0	41	46 0	18	14 52	44	31 3
53	79 1	56	72 9	20	16 35	47	34 2
61	94 5	.	.	31	25 81	60	52 3
62	95 7	.	.	34	28 63	.	.
.	.	.	.	40	36 66	.	.
.	.	.	.	41	37 20	.	.
.	.	.	.	50	50 14	.	.
.	.	.	.	53	56 01	.	.
.	.	.	.	61	72 24	.	.
.	.	.	.	62	73 36	.	.

D = 0.9673		D = 0.9690		D = 0.9667		D = 0.9429	
$t^{\circ}$	S	$t^{\circ}$	S	$t^{\circ}$	S	$t^{\circ}$	S
14	5 4	16	4 13	12	1 61	15	0 29
25	9 0	24	6 00	33	3 62	23	0 39
33	13 2	40	10 94	47	5 77	40	0 62
44	19 1	51	16.51	57	6 97	54	0 78
57	29 1	60	21.51	..	.	60	1.10
65	36.2	64	24.22	.	.	..	.

(Gerardin, A. ch. (4) 5. 151)

Solubility of  $\text{KNO}_3$  in alcohol at  $18^{\circ}$ .

Sp. gr.	100 ccm. contain g		
	Alcohol	Water	$\text{KNO}_3$
1.1475	.	89 63	25 12
1.1085	3 30	87 44	20.11
1.1010	5 24	86 26	18 60
1.0805	8 69	83 18	16.18
1.0655	14 08	77 93	14 54
1.0490	16 27	76.36	12.27
1.0375	19 97	72 93	10 85
0.9935	28 11	64 74	6 50
0.9585	37 53	54 21	4 11
0.9456	42 98	48.15	3 37
0.9050	51 23	27.32	1 95
0.8723	61.65	24.74	0 83
0.8375	69 60	13 95	0 20

(Bodlander, Z. phys. Ch. 7. 316.)

Solubility in alcohol.

Wt % alcohol	G $\text{KNO}_3$ per 100 g alcohol	
	at $30^{\circ}$	at $10^{\circ}$
0	45 6	64 5
8 25	32 3	47 1
17 0	22 4	33 3
25 7	15 1	24 1
35 0	11 4 (34.5°)	16 7
44 9	7 0	11 6 (44°)
54 3	4 5	7 2 (55°)
65 0	2 7	4.4
75.6	1.3	2.0 (76 3°)
88.0	0.4	0.6 (88 5°)

(Bathrick, J. phys. Ch. 1896, 1. 160)

Solubility of  $\text{KNO}_3$  in ethyl alcohol + Aq at  $30^{\circ}$ .

$t^{\circ}$ by wt. $\text{H}_2\text{O}$	$t^{\circ}$ by wt alcohol	$t^{\circ}$ by wt. $\text{KNO}_3$
68 7	0	31 3
69.2	10 1	20.7
67 3	17 0	15 7
61 1	23 8	12.1
58 8	32 2	9.0
50 8	43 1	6.1
39 8	56 9	3 3
33 9	63 8	2.3
22 3	76 8	0 88
7.5	92 3	0 15

(Schreinemakers, Z. phys. Ch. 1909, 65. 556.)

Solubility in ethyl alcohol at  $25^{\circ}$ .

Concentration of alcohol in g. mol per l. $\text{H}_2\text{O}$	Solubility in 1 l $\text{H}_2\text{O}$	Mol solubility
0	384.48	3.80
$\frac{1}{2}$	368.30	3 64
$\frac{1}{3}$	354.40	3 50
1	327.00	3 22

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) 84. 127.)

Solubility of  $\text{KNO}_3$  in methyl alcohol + Aq at  $30^{\circ}$ .

$t^{\circ}$ by wt $\text{H}_2\text{O}$	$t^{\circ}$ by wt alcohol	$t^{\circ}$ by wt. $\text{KNO}_3$
68 7	0	31 3
68 9	7 8	23.3
66.4	17 3	16 3
61.0	27 8	11 2
53 9	38.4	7 7
39 2	57.0	3.8
0.99	98.58	0.43

(Schreinemakers, Z. phys. Ch. 1909, 65. 556.)

Solubility of  $\text{KNO}_3 + \text{AgNO}_3$  in 51.6%  $\text{C}_2\text{H}_5\text{OH} + \text{Aq}$  at  $30^\circ$ .

$\text{KNO}_3$	$\text{AgNO}_3$	Solnd phase
4 8	0	$\text{KNO}_3$
4 55	5 15	"
4 11	16 47	"
4 26	21 28	$\text{KNO}_3 + \text{AgNO}_3$
2 62	36 94	$\text{AgNO}_3, \text{KNO}_3 + \text{AgNO}_3$
0	37	$\text{AgNO}_3$

(Schrenemakers, Z. phys. Ch. 1909, 65, 556.)

100 g 40% ethyl alcohol sat. with  $\text{KNO}_3 + \text{NaCl}$  at  $25^\circ$  contain 13.74 g.  $\text{KNO}_3 + 15.78$  g  $\text{NaCl}$ . (Soch, J. phys. Ch 1898, 2, 43.)  
Insol. in propyl alcohol. (Schlamp, Z. phys. Ch. 1894, 14, 277.)

Almost insol. in ether. (Braconnot.)  
Very sl. sol in acetone. (Krug and M'Elroy.)

Sol. in acetone. (Eidmann, C. C. 1899, II, 1014)

Solubility in acetone + Aq at  $40^\circ$ .

Wt % acetone	G $\text{KNO}_3$ per 100 g. solvent
0	64 5
8 5	51 3
16 8	38 9
25 2	22 8
34 3	24 7
44 1	17 0
53 9	11 9
64.8	7 2
76 0	3 0
87 6	0 7

(Bathrick, J. phys. Ch. 1896, 1, 160)

100 pts. glycerine (sp. gr. 1.225) dissolve 10 pts.  $\text{KNO}_3$ . (Vogel, N. Rep. Ph. 16, 557)

100 g. trichlorethylene dissolve 0.01 g.  $\text{KNO}_3$  at  $15^\circ$ . (Wester and Bruins, Pharm. Weekbl. 1914, 51, 1443.)

Insol. in  $\text{CS}_2$ . (Arcetowski, Z. anorg. 1894, 6, 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1910, 43, 314.)

100 g.  $\text{H}_2\text{O}$  sat. with sugar and  $\text{KNO}_3$  dissolve 224.7 g. sugar + 41.9 g.  $\text{KNO}_3$ , or sat solution contains 61.36 g. sugar + 11.45 g.  $\text{KNO}_3$  at  $31.25^\circ$ . (Kohler, Z. Ver. Zuckerind. 1897, 47, 447.)

Potassium hydrogen nitrate,  $\text{KNO}_3, \text{HNO}_3$ .

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$  (Groschuff, B. 1904, 37, 1489.)

Potassium dihydrogen nitrate,  $\text{KNO}_3, 2\text{HNO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Ditte, A. ch. (5) 18, 320.)

Solubility in  $\text{H}_2\text{O}$

Solution temp.	% by wt $\text{KNO}_3$	% by wt $\text{HNO}_3$	% by wt $\text{H}_2\text{O}$
mp. $+23^\circ$	44 5	55 5	0
20 5	41 1	55 0	0 9
18 0	43 8	54 5	1 7
12 0	43 0	53 6	3 4
6 0	42 3	52 7	5 0
0	41 6	51 8	6 6

(Groschuff, Z. anorg. 1904, 40, 11.)

Potassium silver nitrate,  $\text{KNO}_3, \text{AgNO}_3$ .

Sol in  $\text{H}_2\text{O}$ . (Russell and Maskelyne, Roy. Soc. Proc. 26, 357)

$3\text{KNO}_3, \text{AgNO}_3$ . Sol in  $\text{H}_2\text{O}$ . (Rose, Pogg. 106, 320.)

Potassium thallic nitrate,  $2\text{KNO}_3, \text{Ti}(\text{NO}_3)_3 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Meyer, Z. anorg. 1900, 24, 361.)

Potassium thorium nitrate,  $4\text{KNO}_3, \text{Th}(\text{NO}_3)_4$ .

Very sol in  $\text{H}_2\text{O}$  and alcohol. (Berzelius.)  
Hygroscopic, very unstable. (Meyer, Z. anorg. 1901, 27, 379)

Hydroscopic; sol in dil.  $\text{HNO}_3 + \text{Aq}$ . (Meyer, Z. anorg. 1901, 27, 378)

Potassium thorium hydrogen nitrate,  $3\text{KNO}_3, \text{Th}(\text{NO}_3)_4, 3\text{HNO}_3$ .

Decomp. in the air. (Meyer, B. 1900, 33, 2140.)

$+4\text{H}_2\text{O}$ . Sol in  $\text{HNO}_3$  of 1.2 sp. gr. Effloresces in the air. (Meyer, Z. anorg. 1901, 27, 380)

Potassium uranyl nitrate,  $\text{K}(\text{UO}_2)(\text{NO}_3)_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HNO}_3$ . (Meyer, B. 1903, 36, 4057.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	In 100 pts. of the solution			Solid phase
	Pts by wt $\text{UO}_2$	Pts by wt K	Pts by wt $\text{NO}_3$	
0.5	31 98	1 72	..	Double salt + $\text{KNO}_3$
13 0	33 40	2 74		"
25 0 a)	37 08	4.05	23 49	"
b)	37 06	3.98	23 46	"
45 0	42 18	5 16		"
59 0	41 65	6 03		"
80.6 a)	43 72	6 42		Double salt
b)	43.70	6 34	.	"

Potassium uranyl nitrate is decomp by  $\text{H}_2\text{O}$  at temp. below  $60^\circ$ ; above  $60^\circ$  it is sol. in  $\text{H}_2\text{O}$  without decomp.

(Rumbach, B. 1904, 37, 473.)

Potassium nitrate barium sulphate,  $\text{KNO}_3$ ,  $2\text{BaSO}_4$ .

Easily decomp. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Silberberger, M. 1904, 25. 251.)

Potassium nitrate phosphomolybdate.

See Phosphomolybdate nitrate, potassium.

Potassium nitrate sulphate,  $\text{KNO}_3$ ,  $\text{KHSO}_4$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol. (Jacquelin.)

Potassium nitrate sulphotungstate,  $2\text{KNO}_3$ ,  $\text{K}_2\text{WS}_4$  (?).

Very sol. in hot or cold  $\text{H}_2\text{O}$ . Insol. in alcohol. (Berzelius.)

Potassium nitrate tungstate (?).

100 pts. boiling  $\text{H}_2\text{O}$  dissolve 5 pts salt. (Storer's Diet., p. 393.)

Potassium nitrate zinc iodide.

Permanent. Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Anthon.)

Praseodymium nitrate,  $\text{Pr}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (von Schule, Z. anorg. 1898, 18. 355.)

Praseodymium rubidium nitrate,

$[\text{Pr}(\text{NO}_3)_3]_2\text{Rb}_2 \cdot 4\text{H}_2\text{O}$

Hydroscopic (Jantsch, Z. anorg. 1911, 69. 230.)

Praseodymium sodium nitrate,  $\text{Pr}(\text{NO}_3)_3$ ,  $2\text{NaNO}_3 \cdot \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (von Schule, Z. anorg. 1898, 18. 356.)

Praseodymium zinc nitrate,  $2\text{Pr}(\text{NO}_3)_3$ ,  $3\text{Zn}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 14.69 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 321.)

Radium nitrate.

Has apparently the same solubility in  $\text{H}_2\text{O}$  as the corresponding Ba comp. (Curie, Dissert. 1903.)

Rhodium nitrate,  $\text{Rh}(\text{NO}_3)_3 \cdot 2\text{H}_2\text{O}$  (?).

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Claus.)

Rhodium uranyl nitrate,

$2(\text{UO}_2)(\text{NO}_3)_2 \cdot \text{Rh}_2(\text{NO}_3)_4 \cdot 10\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and acids; insol. in aq. alkalis. (Lancien, C. C. 1912, I. 208.)

Rubidium nitrate,  $\text{RbNO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 20.1 pts. at  $0^\circ$ ; 43.5 pts. at  $10^\circ$ . (Bunsen.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{PbNO}_3$ per 100 g.		$t^\circ$	G. $\text{RbNO}_3$ per 100 g.	
	$\text{H}_2\text{O}$	Solu- tion		$\text{H}_2\text{O}$	Solu- tion
0	19.5	16.3	60	200	66 7
10	33 0	24 8	70	251	71 5
20	53.3	34 6	80	309	75 6
30	81.3	44.8	90	375	78 9
40	116.7	53 0	100	452	81 9
50	155.6	60.9	118 3	617	86 1

(Berkeley, Trans. Roy. Soc. 1904, 203. A. 207.)

100 g.  $\text{H}_2\text{O}$  dissolve 66.855 g.  $\text{RbNO}_3$  at  $25^\circ$ . (Haigh, J. Am. Chem. Soc. 1912, 34. 1148.)

Sp. gr.  $20^\circ/4^\circ$  of a normal solution of  $\text{RbNO}_3 = 1.100835$ ; of a 0.5 normal solution = 1.04989. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

Sp. gr. of  $\text{RbNO}_3 + \text{Aq}$

G.-equiv.  $\text{RbNO}_3$  per l.

at $18^\circ =$	0.5035	1.008
Sp. gr. at $0^\circ/6^\circ$	1.05342	1.10566
Sp. gr. at $18^\circ/18^\circ$	1.05226	1.10361
Sp. gr. at $30^\circ/30^\circ$	1.05156	1.10222

G.-equiv.  $\text{RbNO}_3$  per l.

at $18^\circ =$	2.000	2.685
Sp. gr. at $0^\circ/6^\circ$	1.20655	
Sp. gr. at $18^\circ/18^\circ$	1.20302	1.27066
Sp. gr. at $30^\circ/30^\circ$	1.20036	1.26717

(Clausen, W. Ann. 1914, (4) 44. 1069.)

Easily sol. in  $\text{HNO}_3$  (Schultz, Zeit. Ch. (2) 5. 531.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Rubidium hydrogen nitrate,  $\text{RbNO}_3$ ,  $\text{HNO}_3$ .

Fairly stable in air. (Wells, Am. Ch. J. 1901, 26. 273.)

Rubidium dihydrogen nitrate,  $\text{RbNO}_3$ ,  $2\text{HNO}_3$ .

Decomp. rapidly in air. (Wells, Am. Ch. J. 1901, 26. 273.)

$2\text{RbNO}_3$ ,  $5\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Known only in solution in  $\text{HNO}_3 + \text{Aq}$ . (Ditte, A. ch. (5) 18. 320.)

Rubidium silver nitrate,  $\text{RbNO}_3$ ,  $\text{AgNO}_3$ .

Sol. in  $\text{H}_2\text{O}$  (Russell and Maskelyne, Roy. Soc. Proc. 26. 357.)

Rubidium thorium nitrate,  $\text{Rb}_2\text{Th}(\text{NO}_3)_4$ .

Sl. sol. in  $\text{HNO}_3$ ; decomp. by  $\text{H}_2\text{O}$ . (Meyer, Z. anorg. 1901, 27. 384.)

Rubidium uranyl nitrate,  $\text{Rb}(\text{UO}_2)(\text{NO}_3)_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HNO}_3$ .  
(Meyer, B. 1903, 36. 4057.)

Solubility of  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	In 100 pts. of the solution				Solid phase
	Pts. by wt. $\text{UO}_2$	Pts. by wt. $\text{NO}_3$	Pts. by wt. $\text{Rb}$	Pts. by wt. total salt	
25	a) 35.42	19.72	4.63	59.67	Double salt + $\text{RbNO}_3$
"	b) 35.40	19.76	4.67	59.64	"
80	a) 34.84	11.01	69.46	Double salt	
"	b) 34.68	11.01	69.62	"	

Rubidium uranyl nitrate is decomp. by  $\text{H}_2\text{O}$  at low temp.; at  $80^\circ$  it is sol. in  $\text{H}_2\text{O}$  without decomp.

(Rumbach, B. 1904, 37. 476.)

Samarium nitrate,  $8\text{Sm}(\text{NO}_3)_3 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve, C. N. 48. 74.)

Very hygroscopic. (Demarçay, C. R. 1900, 130. 1187.)

Samarium zinc nitrate,  $2\text{Sm}(\text{NO}_3)_3$ ,

$3\text{Zn}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 36.47 g. hydrous salt at  $16^\circ$ .  
(Jantsch, Z. anorg. 1912, 76. 321.)

Scandium nitrate, basic.

Sol. in  $\text{H}_2\text{O}$ . (Nilson, B. 13. 1444.)

$\text{ScOH}(\text{NO}_3)_2 + \text{H}_2\text{O}$  (Crookes, Roy. Soc. Proc. 1908, 80. A. 518.)

$\text{Sc}_2\text{O}(\text{NO}_3)_4$ . (Crookes.)

Scandium nitrate,  $\text{Sc}(\text{NO}_3)_3$

(Crookes, Roy. Soc. Proc. 1908, 80. A. 518.)  
 $+4\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Crookes.)

Silver nitrate,  $\text{AgNO}_3$ .

100 pts.  $\text{H}_2\text{O}$  at  $11^\circ$  dissolve 127.7 pts  
(Schnauss, Arch. Pharm. (2) 82. 260.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$  19.5° 54° 85° 110°  
121.9 227.3 500 714 1111 pts.  $\text{AgNO}_3$ .

(Kremers, Pogg. 92. 497.)

100 pts.  $\text{H}_2\text{O}$  dissolve 1622.5 pts at  $125^\circ$ ,  
and 1941.4 pts. at  $133^\circ$ . (Tilden and Shennstone, Phil. Trans. 1884. 23.)

Sat. solution boils at  $125^\circ$ . (Kremers.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$   
Sat.  $\text{AgNO}_3 + \text{Aq}$  contains %  $\text{AgNO}_3$  at  $t^\circ$ .

$t^\circ$	% $\text{AgNO}_3$	$t^\circ$	% $\text{AgNO}_3$
-7	46.2	36.5	75.7
-7	46.0	40.5	76.8
-5	47.6	45	77.1
-1	52.4	48	78.5
-1	51.9	73	84.0
+5	56.3	122	88.7
10	61.2	134	92.1
15.5	66.1	135	92.8
20	67.8	135	92.7
26	71.1	148	93.3
29	73.0	160	95.2
31	73.8	182	96.9

(Étard, A. ch. 1894, (7) 2. 526.)

100 g. sat.  $\text{AgNO}_3 + \text{Aq}$  at  $15.5^\circ$  contain 65.5 g.  $\text{AgNO}_3$ . (Greenish and Smith, Pharm. Jour. 1903, 71. 881.)

Solubility of  $\text{AgNO}_3$  in  $\text{H}_2\text{O}$  at  $30^\circ = 10.31$  mol.-litre. (Masson, Chem. Soc. 1911, 99. 1138.)

100 g.  $\text{AgNO}_3 + \text{Aq}$  sat at  $30^\circ$  contain 73.0 g.  $\text{AgNO}_3$ . (Schreinemakers and de Baat, Arch. Néer. Sc. 1911, (2) 15. 415.)

100 g. sat.  $\text{AgNO}_3 + \text{Aq}$  contain 53.5 g.  $\text{AgNO}_3$  at  $0^\circ$ ; 66.7 g. at  $18^\circ$  (Mylius, Z. anorg. 1912, 74. 411.)

Sp. gr. of aqueous solution, according to C. K. = Chemiker Kalender; K. M. = Kohlrausch by Mendelejeff (Z. anal. 27. 284); and K. = Kohlrausch (W. Ann. 1879. 1), containing:

	5	10	15	20% $\text{AgNO}_3$
C. K.	1.041	1.080	1.125	1.160
K. M.	1.0440	1.0901		1.1969
K.	1.0422	1.0893	1.1404	1.1958

	25	30	35	40% $\text{AgNO}_3$
C. K.	1.206	1.251	..	1.4761
K. M.				1.4791
K.	1.2555	1.3213	1.3945	1.4773

45 50%  $\text{AgNO}_3$ .  
K. 1.5705 1.6745

Sp. gr. of  $\text{AgNO}_3 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{AgNO}_3$	Sp. gr.
1-normal	1.1386
$\frac{1}{2}$ -"	1.0692
$\frac{1}{4}$ -"	1.0348
$\frac{1}{8}$ -"	1.0173

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Sol. in 500 pts.  $\text{HNO}_3$ ; 30 pts.  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at  $20^\circ$ , and 6 pts.  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at  $100^\circ$ . (Schultz, Zeit. Ch. 1869. 531.)

Insol. in conc.  $\text{HNO}_3$ . (Warren, C. C. 1897. I, 438.)

Solubility of  $\text{AgNO}_3$  in  $\text{HNO}_3$  + Aq at 25°.

G mol per l		G. $\text{AgNO}_3$ per l	sp gr 25°
$\text{HNO}_3$	$\text{AgNO}_3$		
0	10.31	1752	2.3021
0.404	9.36	1501	2.2754
0.962	8.08	1373	2.1213
1.698	6.54	1111	1.9402
2.834	4.526	769.1	1.7052
4.497	2.590	440.1	1.4980
5.992	1.698	288.6	1.4195
8.84	0.843	143.2	1.3818
12.53	0.347	58.90	1.3976

(Masson, Chem. Soc. 1911, 99, 1132.)

 $\text{AgNO}_3 + \text{NH}_4\text{NO}_3$  Solubility of  $\text{AgNO}_3$  in  $\text{NH}_4\text{NO}_3$  + Aq. See under  $\text{NH}_4\text{NO}_3$ . $\text{AgNO}_3 + \text{KNO}_3$  Solubility of  $\text{AgNO}_3$  +  $\text{KNO}_3$  in  $\text{H}_2\text{O}$ . See under  $\text{KNO}_3$ . $\text{AgNO}_3 + \text{AgNO}_3$ Solubility of  $\text{AgNO}_3 + \text{AgNO}_3$  at 18°.

G per l		G per l	
$\text{AgNO}_3$	$\text{AgNO}_3$	$\text{AgNO}_3$	$\text{AgNO}_3$
0.000	3.184	3.512	2.201
0.439	3.042	7.024	1.799
0.878	2.926	14.048	1.480
1.756	2.601		

(Naumann and Rucker, B. 1905, 38, 2293.)

See also under  $\text{AgNO}_3$ .Insol. in liquid  $\text{CO}_2$ . (Buchner, Z. phys. Ch. 1906, 54, 674.)Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 829.)

Sol. in 4 pts. boiling alcohol

Sol. in 10 pts. alcohol. (Dumas.)

Sol. in 11 pts. alcohol of 90% (Hager.)

Solubility in 100 pts. alcohol of given vol. % at 18°.

t°	95%	80%	70%	60%
15	3.8	10.3	22.1	30.5
50	7.3			58.1
75	18.3	42.0		89.0

t°	50%	40%	30%	20%	10%
15	35.8	56.4	73.7	107	158
50		98.3		214	
75		180		340	

(Eder, J. pr. (2) 17, 44.)

100 pts. absolute methyl alcohol dissolve 3.72 pts. at 18°; 100 pts. absolute ethyl alcohol dissolve 3.1 pts. at 18°. (de Bruyn, Z. phys. Ch. 10, 783.)

Only traces are sol. in absolute alcohol or ether. 100 pts. of a mixture of 1 vol. alcohol (95 vol. %) + 1 vol. pure ether dissolve 1.6 pts.  $\text{AgNO}_3$  at 15°. 100 pts. of 2 vols. alcohol + 1 vol. ether dissolve 2.3 pts.  $\text{AgNO}_3$ . (Eder, J. pr. 1878, (2) 17, 45.)Solubility of  $\text{AgNO}_3$  in ethyl alcohol + Aq at 30°.

% by wt $\text{H}_2\text{O}$	% by wt alcohol	% by wt $\text{AgNO}_3$
27.0		73.0
27.71	2.8	69.49
30.80	13.67	55.53
32.10	20.13	47.77
31.40	25.85	42.75
28.95	37.26	33.79
27.91	44.54	27.55
20.92	64.42	14.66
6.83	86.54	6.63

(Schreinemakers, Z. phys. Ch. 1909, 65, 571.)

Solubility of  $\text{AgNO}_3 + \text{KNO}_3$  in alcohol. See under  $\text{KNO}_3$ .Sol. in methyl, ethyl, and isobutyl alcohols,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ , acetone and pyridine. (Wilcox, J. phys. Chem. 1910, 14, 587.)100 pts.  $\text{H}_2\text{O}$  sat. with ether dissolve 88.4 pts.  $\text{AgNO}_3$  at 15° (Eder, l. c.)

Sol. in glycerine.

Sol. in benzonitrile. 100 g. benzonitrile dissolve about 105 g.  $\text{AgNO}_3$  at 18°. (Naumann and Selner, B. 1914, 47, 1369.)1 pt. acetone dissolves about 15 pts.  $\text{AgNO}_3$ . (Scholl and Steinkopf, B. 1906, 39, 4398.)

Easily sol. in methyl, ethyl, and amyl amine. (Shunn, J. phys. Chem. 1907, 11, 538.)

Sol. in acetone (Krug and McEroy, J. Anal. Ch. 6, 184.)

0.35 pts. are sol. in 100 pts. acetone at 14°.

0.35 " " " " 100 " " " 59°.

(Laszyzanski, B. 1894, 27, 2287.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II, 1014.)

1 g.  $\text{AgNO}_3$  is sol. in 227 g. acetone at 18°. Sp. gr. of sat. solution  $18^\circ/4^\circ = 0.798$ . (Naumann, B. 1904, 37, 4339.)Insol. in  $\text{CS}_2$ . (Aretowski, Z. anorg. 1894, 6, 257.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790); ethyl acetate (Naumann, B. 1904, 37, 3601.)

Sol. in urethane. (Castoro, Z. anorg. 1899, 20, 61.)

100 g.  $\text{C}_2\text{H}_5$  dissolve 0.022 g.  $\text{AgNO}_3$  at 35°; 0.044 g. at 40.5°. (Linebarger, Am. J. Sci. 1895, 49, 48.)

Mol. weight determined in piperidine, pyridine and benzonitrile. (Werner, Z. anorg. 1897, 15, pp. 17, 23 and 32.)

Solubility of $\text{AgNO}_3$ in pyridine at $t^\circ$ .		
$t^\circ$	G $\text{AgNO}_3$ per 100 g $\text{C}_5\text{H}_5\text{N}$	Solid phase
-48.5*	0	$\text{C}_5\text{H}_5\text{N}$
-50.5	3	"
-53	6	"
-59	9	"
-65		$\text{C}_5\text{H}_5\text{N} + \text{AgNO}_3, 6\text{C}_5\text{H}_5\text{N}$
-51.25	11.1	$\text{AgNO}_3, 6\text{C}_5\text{H}_5\text{N}$
-44	11.7	"
-40	12.2	"
-35	12.6	"
-30	13.9	"
-25	17.6	"
-24		" + $\text{AgNO}_3, 3\text{C}_5\text{H}_5\text{N}$
-22	18.8	$\text{AgNO}_3, 3\text{C}_5\text{H}_5\text{N}$
-10	20.03	"
0	22.34	"
+10	27.21	"
20	33.64	"
30	40.86	"
40	53.52	"
45	62.26	"
46	63.06	"
47	66.35	"
48	70.85	"
48.5		" + $\text{AgNO}_3, 2\text{C}_5\text{H}_5\text{N}$
45	69.85	$\text{AgNO}_3, 2\text{C}_5\text{H}_5\text{N}$
50	72.25	"
60	78.60	"
70	89.10	"
80	121.21	"
87	215.02	"
80	228.5	"
74	230.6	"
74	235.4	"
80	230.4	"
87	237.1	"
90	241.9	"
100	253.8	"
110	271.4	"

\* M. pt.

(Kahlenberg and Brewer, J. phys. Ch. 1908, 12. 283.)

Silver nitrate acetylde,  $\text{AgNO}_3, \text{AgHC}_2$ .

(Willgerodt, B. 1895, 28. 2108.)

 $\text{AgNO}_3, \text{Ag}_2\text{C}_2$ . Ppt. (Chavastelon, C. R. 1897, 124. 1365.) $2\text{AgNO}_3, \text{Ag}_2\text{C}_2$  (Chavastelon.)Silver nitrate ammonia,  $\text{AgNO}_3, \text{NH}_3$ .Partly sol. in  $\text{H}_2\text{O}$ , rather sol. in alcohol. Sl. sol. in ether. (Reychler, B. 16. 990.)Very sol. in liquid ammonia below  $-10^\circ$ . (Joannis, C. R. 1894, 118. 1151.) $\text{AgNO}_3, 2\text{NH}_3$ . Easily sol. in  $\text{H}_2\text{O}$ . (Mitscherlich.)

11. alcohol dissolves 0.0383 g. mols. (Kurilow, C. C. 1903. II, 97.)

 $\text{AgNO}_3, 3\text{NH}_3$ . Completely sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 20. 153.)Silver nitrate antimonide,  $\text{AgNO}_3, \text{Ag}_3\text{Sb}$ .Decomp. at once by  $\text{H}_2\text{O}$ . (Poleck and Thummel, B. 16. 2435.)Silver nitrate arsenide,  $\text{AgNO}_3, \text{Ag}_3\text{As}$ Decomp. at once by  $\text{H}_2\text{O}$ . (Poleck and Thummel.)Silver nitrate bromide,  $\text{AgNO}_3, \text{AgBr}$ .Decomp. immediately by  $\text{H}_2\text{O}$  or alcohol, with separation of  $\text{AgBr}$ . (Risse, A. 111. 39.)Silver nitrate chloride,  $\text{AgNO}_3, \text{AgCl}$ .Quickly decomp. with  $\text{H}_2\text{O}$ ; more slowly with absolute alcohol; not decomp. by ether-alcohol. (Reichert, J. pr. 92. 237.)Silver nitrate cyanide,  $2\text{AgNO}_3, \text{AgCN}$ .Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Hellwig, Z. anorg. 1900, 25. 177.)Silver nitrate iodide,  $\text{AgNO}_3, \text{AgI}$ .Cold  $\text{H}_2\text{O}$  separates  $\text{AgI}$ , which redissolves on heating (Stilrenberg, Arch. Pharm. (2) 143. 12.) Sol. in little  $\text{H}_2\text{O}$  without decomp.; more  $\text{H}_2\text{O}$  separates  $\text{AgI}$ . (Kremers, J. pr. 71. 54.) Insol in absolute alcohol. Sol. in conc.  $\text{AgNO}_3 + \text{Aq}$ . $2\text{AgNO}_3, \text{AgI}$ . Sol. in little but decomp. by more boiling  $\text{H}_2\text{O}$ . (Risse, A. 111. 39.)Silver nitrate mercuric oxide,  $\text{AgNO}_3, 2\text{HgO}$ .Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Finca, Gazz. ch. it. 1910, 41. (2) 548.)Silver nitrate phosphide,  $3\text{AgNO}_3, \text{Ag}_3\text{P}$ 

(Warren, C. N. 56. 113.)

Silver nitrate silicide,  $4\text{AgNO}_3, \text{Ag}_4\text{Si}$ 

(Büchner, Ch. Ztg. 9. 484.)

Silver nitrate silicate,  $2\text{AgNO}_3, 3\text{Ag}_2\text{SiO}_4$ .Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ , but  $\text{SiO}_2$  separates out after heating. (Rousseau and Tite, C. R. 114. 294.)Silver nitrate sulphide,  $\text{AgNO}_3, \text{Ag}_2\text{S}$ .Decomp. by  $\text{H}_2\text{O}$  (Poleck and Thummel, B. 16. 2435.)Silver nitrate sulphocyanide,  $2\text{AgNO}_3,$  $\text{AgSCN}$ .Decomp. by  $\text{H}_2\text{O}$ , not by alcohol (Hellwig, Z. anorg. 1900, 25. 178.)Sodium nitrate,  $\text{NaNO}_3$ .Deliquescent in moist air. Sol. in  $\text{H}_2\text{O}$  with absorption of heat. 75 pts  $\text{NaNO}_3$  mixed with 100 pts.  $\text{H}_2\text{O}$  at  $13.2^\circ$  lower the temperature  $18.5^\circ$ . (Rüdorff, B. 2. 68.)

Sol in 1	58 pts	$\text{H}_2\text{O}$ at $-0^\circ$ .	
"	0.46	"	+119° (Marx)
"	2.89	"	3°
"	1.12	"	28° (Osann)
"	0.79	"	47°
"	1.14	"	18.5° (Kopp)
"	1.130	"	18.75° (Karsten)
"	1.16	"	29° (Schiff, A. 109. 320)
"	2	"	18.75° (Abl)

100 pts. H<sub>2</sub>O at t° dissolve pts. NaNO<sub>3</sub>.

t°	Pts NaNO <sub>3</sub>	t°	Pts NaNO <sub>3</sub>
-6	68.80	50	111.13
0	79.75	60	119.04
10	84.30	70	129.63
16	87.63	80	140.72
20	89.55	90	153.63
30	95.37	100	168.20
40	102.31	120	225.30

(Poggiale, A. ch. (3) 8. 400.)

100 pts H<sub>2</sub>O at 110° dissolve 150 pts NaNO<sub>3</sub> (Griffiths)NaNO<sub>3</sub> + Aq sat at 18.75° has 1.4769 sp. gr. and 100 pts H<sub>2</sub>O have dissolved 88.001 pts NaNO<sub>3</sub> (Karsten)NaNO<sub>3</sub> + Aq sat in cold contains 33.3% NaNO<sub>3</sub> (Fourcroy)NaNO<sub>3</sub> + Aq sat at 12.5° contains 34% NaNO<sub>3</sub> (Rosenkrantz)100 pts H<sub>2</sub>O at 15.5° dissolve 33 pts. at 32°, 100 pts NaNO<sub>3</sub> (Ure's Diet)100 pts. H<sub>2</sub>O dissolve pts. NaNO<sub>3</sub> at t°.

t°	Pts NaNO <sub>3</sub>	t°	Pts NaNO <sub>3</sub>
0	73.0	60.65	125.5
13.9	81.6	99.0	173.6
44.65	110.5	119.7	211.4

(Nordenskjöld, Pogg. 136. 312.)

100 pts H<sub>2</sub>O dissolve pts. NaNO<sub>3</sub> at t°.

t°	Pts NaNO <sub>3</sub>	t°	Pts NaNO <sub>3</sub>
0	70.94	70	142.31
10	78.57	80	153.72
20	87.97	90	165.55
30	98.26	100	178.18
40	109.01	110	194.26
50	120.00	119.4	213.43
60	131.11		

(Maumené, C. R. 58. 81.)

100 pts. NaNO<sub>3</sub> + Aq sat. at 14° contain 43.88 pts. NaNO<sub>3</sub>; at 15°, 44.53 pts. NaNO<sub>3</sub>. (v. Hauer, J. pr. 98. 137.)100 pts. H<sub>2</sub>O dissolve 84.21-84.69 pts NaNO<sub>3</sub> at 15.6°, and sat. solution has sp. gr. 1.337-1.378. (Page and Keightley, Chem. Soc. (2) 10. 556.)100 pts. H<sub>2</sub>O dissolve pts. NaNO<sub>3</sub> at t°.

t°	Pts NaNO <sub>3</sub>	t°	Pts NaNO <sub>3</sub>
0	66.69	18	83.62
2	70.97	21	85.73
4	71.04	26	90.33
8	75.65	29	92.93
10	76.31	36	99.39
13	79.00	51	113.63
15	80.60	68	125.07

Solubility is constant from 0° to -15.7°, when NaNO<sub>3</sub> + 7H<sub>2</sub>O separates out. (Ditté, C. R. 80. 1164.)Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts NaNO <sub>3</sub>	t°	Pts NaNO <sub>3</sub>
0	72.9	60	122
1	74.7	61	124
2	75.4	62	125
3	76.0	63	126
4	76.7	64	127
5	77.4	65	128
6	78.1	66	130
7	78.7	67	131
8	79.4	68	132
9	80.1	69	133
10	80.8	70	134
11	81.4	71	136
12	82.0	72	137
13	82.7	73	138
14	83.4	74	139
15	84.0	75	140
16	84.7	76	142
17	85.4	77	143
18	86.1	78	145
19	86.8	79	146
20	87.5	80	148
21	88.3	81	149
22	89.0	82	151
23	89.7	83	152
24	90.3	84	153
25	91.0	85	155
26	91.8	86	156
27	92.5	87	158
28	93.2	88	159
29	94.0	89	161
30	94.9	90	162
31	96.0	91	164
32	96	92	166
33	97	93	168
34	98	94	169
35	99	95	171
36	100	96	173
37	100	97	175
38	101	98	177
39	102	99	178
40	103	100	180
41	103	101	182
42	104	102	184
43	105	103	186
44	106	104	188
45	107	105	190
46	108	106	192
47	109	107	194
48	110	108	196
49	111	109	198
50	112	110	200
51	113	111	202
52	114	112	204
53	115	113	207
54	116	114	209
55	117	115	211
56	118	116	213
57	119	117	215
58	120	117.5	216.4
59	211		

(Mulder, Scheik. Verhandel. 1864. 83.)

Sat. solution at b-pt. contains 218.4 pts.  $\text{NaNO}_3$  (Mulder), 218.5 pts.  $\text{NaNO}_3$  (Marc), 213.4 pts.  $\text{NaNO}_3$  (Mauméné), 211.4 pts.  $\text{NaNO}_3$  (Nordenfjeld), 224.8 pts.  $\text{NaNO}_3$  (Legrand), 190 pts.  $\text{NaNO}_3$  (Griffiths)

Sat.  $\text{NaNO}_3 + \text{Aq}$  contains at:  
 120° 130° 172° 180° 199°  
 66.8 67.5 77.1 78.1 82.0%  $\text{NaNO}_3$ ,

220° 250° 255° 290° 313° (mpt.).  
 83.5 89.5 91.5 97.5 100%  $\text{NaNO}_3$ .  
 (Étard, A. ch. 1894, (7) 2. 527.)

100 g. sat.  $\text{NaNO}_3 + \text{Aq}$  contain 42.47 g.  $\text{NaNO}_3$  at 0°. (Coppadoro, Rass. Min. 1911, XVII, 35. 123.)

100 g. sat.  $\text{NaNO}_3 + \text{Aq}$  contain 49.16 g.  $\text{NaNO}_3$  at 30°. (Coppadoro, Rass. Min. 1912, 37. 7.)

100 g.  $\text{H}_2\text{O}$  dissolve 92.14 g.  $\text{NaNO}_3$  at 25°.

(Haugh, J. Am. Chem. Soc. 1912, 34. 1148.)  
 The solubility of crystals on different faces has been determined by Lebrun. (Belg. Acad. Bull. 1913. 953)

#### Sp. gr. of $\text{NaNO}_3 + \text{Aq}$ at 19.5°.

% $\text{NaNO}_3$	Sp. gr.	% $\text{NaNO}_3$	Sp. gr.
12.057	1.0844	39.860	1.3176
22.726	1.1667	46.251	1.3805
31.987	1.2450	...	...

(Kremers, Pogg. 95. 120.)

#### Sp. gr. of $\text{NaNO}_3 + \text{Aq}$ at 20.2°.

% $\text{NaNO}_3$	Sp. gr.	% $\text{NaNO}_3$	Sp. gr.
1	1.0065	26	1.1904
2	1.0131	27	1.1987
3	1.0197	28	1.2070
4	1.0264	29	1.2154
5	1.0332	30	1.2230
6	1.0399	31	1.2325
7	1.0468	32	1.2412
8	1.0537	33	1.2500
9	1.0606	34	1.2589
10	1.0676	35	1.2679
11	1.0746	36	1.2770
12	1.0817	37	1.2863
13	1.0889	38	1.2958
14	1.0962	39	1.3055
15	1.1035	40	1.3155
16	1.1109	41	1.3255
17	1.1184	42	1.3355
18	1.1260	43	1.3456
19	1.1338	44	1.3557
20	1.1418	45	1.3659
21	1.1498	46	1.3761
22	1.1578	47	1.3864
23	1.1659	48	1.3968
24	1.1740	49	1.4074
25	1.1822	50	1.4180

(Schiff, calculated by Gerlach, Z. anal. 8. 280.)

#### Sp. gr. of $\text{NaNO}_3 + \text{Aq}$ at 18°.

% $\text{NaNO}_3$	Sp. gr.	% $\text{NaNO}_3$	Sp. gr.
5	1.0327	20	1.1435
10	1.0681	30	1.2278

(Kohlrausch, W. Ann. 1879. 1)

Sp. gr. of  $\text{NaNO}_3 + \text{Aq}$  at 20°, containing mols.  $\text{NaNO}_3$  in 100 mols.  $\text{H}_2\text{O}$ .

Mols. $\text{NaNO}_3$	Sp. gr.
2	1.05980
5	1.13813

(Nicol, Phil. Mag. (5) 18. 122.)

The saturated solution boils at 117.5° (Mulder)  
 " " " 118° (Griffiths)  
 " " " 119° (Marc)  
 " " " 119.4° (Mauméné)  
 " " " 119.7° (Nordenfjeld)  
 " " " 121° (Legrand)  
 " " " 122-123° (Kremers.)

$\text{NaNO}_3 + \text{Aq}$  forms a crust at 118°, and contains 194 pts.  $\text{NaNO}_3$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp. observed, 120.5°. (Gerlach, Z. anal. 28. 427.)

B-pt. of  $\text{NaNO}_3 + \text{Aq}$  containing pts.  $\text{NaNO}_3$  to 100 pts.  $\text{H}_2\text{O}$ . G=according to Gerlach (Z. anal. 28. 433); L=according to Legrand (A. ch. (2) 59. 431).

B-pt.	G	L	B-pt.	G	L
101°	9	9.3	112°	121.5	120.8
102	18.5	18.7	113	133	131.3
103	28	28.2	114	144.5	142.4
104	38	37.9	115	156	153.7
105	48	47.7	116	168.5	165.2
106	58	57.6	117	181	176.8
107	68	67.7	118	194	188.6
108	78.5	77.9	119	207.5	200.5
109	89	88.3	120	222	212.6
110	99.5	98.8	121	..	224.8
111	110.5	109.5	..	..	...

50 pts.  $\text{NaNO}_3$  mixed with 100 pts. snow at -1° give a temp. of -17.5°. (Rüdorff, Pogg. 122. 337.)

#### Sp. gr. of $\text{NaNO}_3 + \text{Aq}$ at t°.

G. $\text{NaNO}_3$ dissolved in 100 g. $\text{H}_2\text{O}$	G. $\text{NaNO}_3$ in 100 g. of the solution	t°	Sp. gr.
4.166	4	17.5°	1.0276
11.111	10	13.9°	1.0704
25.000	20	12°	1.1441

(de Lannoy, Z. phys. Ch. 1895, 18. 405.)

Sp. gr. of  $\text{NaNO}_2 + \text{Aq}$  at 20  $^{\circ}$ , when  $p$  = per cent strength of sol.;  $d$  = observed density;  $w$  = volume conc. in grams per cc. ( $\frac{pd}{100} = w$ )

$p$	$d$	$w$
42.05	1.3380	0.56267
35.65	1.2765	0.45510
31.72	1.2407	0.39365
23.24	1.1696	0.27180
17.370	1.1228	0.19505
11.015	1.0819	0.12888
9.665	1.0656	0.10300
7.039	1.0468	0.07360
4.241	1.0273	0.04357
1.589	1.0096	0.01601

(Barnes, J. phys. Chem. 1898, 2, 545.)

Sp. gr. 20 $^{\circ}$ /4 $^{\circ}$  of a normal solution of  $\text{NaNO}_2$  = 1.05386; of a 0.5 normal solution = 1.02646 (Haigh, J. Am. Chem. Soc. 1912, 34, 1151.)

Sp. gr. of sat.  $\text{NaNO}_2 + \text{Aq}$  at  $t^{\circ}$ .

$t^{\circ}$	G $\text{NaNO}_2$ sol in 100 g $\text{H}_2\text{O}$	Sp gr
-10	68 0	1.342
0	43 0	1.358
10	80 5	1.377
20	88 0	1.387
30	96 2	1.406
40	104 0	1.418
50	114 0	1.437
60	124.6	1.456
70	136 0	1.467

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, 44, 1565.)

Sol. in 66 pts.  $\text{HNO}_3$ ; in 32 pts.  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at 32 $^{\circ}$ ; in 4 pts  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at 123 $^{\circ}$ . (Schultz, Zeit. Ch. (2) 5, 531.)

Solubility in  $\text{HNO}_3 + \text{Aq}$  at 0 $^{\circ}$ .

G per 100 cc of solution		Sp gr
$\text{NaNO}_2$	$\text{HNO}_3$	
56 5	0 00	1.341
54 2	1.67	1.338
51.48	3 59	1.331
48 42	5.55	1.324
44.88	7 92	1.312
41.44	10 65	1.308
33 61	17 02	1.291
29.86	20.33	1.285
26.46	23 48	1.282
20.00	30 26	1.276
15 32	36 09	1.276
10 97	44.76	1.291

(Engel, C. R. 1887, 104, 911.)

Solubility of  $\text{NaNO}_2$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at 15 $^{\circ}$ .

G. per 100 g. $\text{H}_2\text{O}$		Sp. gr.
$\text{NH}_4$	$\text{NaNO}_2$	
13 87	75 03	1.253
17.28	73 99	1.233
20 38	73 18	1.212

(Fedotieff and Koltunoff, Z. anorg. 1914, 85, 251.)

$\text{NaNO}_2 + \text{Na}_2\text{CO}_3$ . (See  $\text{Na}_2\text{CO}_3$ .)

Sol in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Very rapidly sol in sat.  $\text{BaCl}_2 + \text{Aq}$  with pptn. of  $\text{Ba}(\text{NO}_3)_2$ .

Sol in sat.  $\text{KCl} + \text{Aq}$ , with formation of  $\text{KNO}_3$ .

Sol. in sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (See  $\text{NH}_4\text{NO}_3$ .)

Sol. in sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$ , with partial pptn. of  $\text{Ba}(\text{NO}_3)_2$ . (See  $\text{Ba}(\text{NO}_3)_2$ .)

Sol. in sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ , with subsequent pptn. of  $\text{Pb}(\text{NO}_3)_2$ . (See  $\text{Pb}(\text{NO}_3)_2$ .)

$\text{NaNO}_2 + \text{KNO}_3$ .

Sol. in sat.  $\text{KNO}_3 + \text{Aq}$ ; solution thus made at 18 $^{\circ}$  contains 54.43% mixed salt, or 100 pts  $\text{H}_2\text{O}$  dissolve 118.98 pts. mixed salt, viz 89.53 pts.  $\text{NaNO}_2$  and 29.45 pts.  $\text{KNO}_3$ . (See  $\text{KNO}_3$ .)

$\text{NaNO}_2 + \text{Sr}(\text{NO}_3)_2$ .

If  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  sat. at 14.5 $^{\circ}$  is sat. with  $\text{NaNO}_2$ , 100 pts.  $\text{H}_2\text{O}$  dissolve:

$\text{NaNO}_2$	83.7	66.4	62.0
$\text{Sr}(\text{NO}_3)_2$	.	51.0	
		117.4	

(Mulder.)

$\text{NaNO}_2 + \text{NaNO}_3$ . See under  $\text{NaNO}_3$ .

$\text{NaNO}_2 + \text{NaCl}$ .

100 pts  $\text{H}_2\text{O}$  dissolve 24.91 pts.  $\text{NaCl} + 54.55$  pts.  $\text{NaNO}_2$  = 79.46 pts. of the two salts at 20 $^{\circ}$ . (Nicol, Phil. Mag. (5) 31, 386.)

100 pts  $\text{H}_2\text{O}$  dissolve at 18.75 $^{\circ}$ .

	1	2	3	4	5	6
$\text{NaCl}$	36	25 22	24 96	24 98	..	24 6
$\text{NaNO}_2$	.	52.89	52 84	52 82	86 6	53.8

2. Sat.  $\text{NaCl} + \text{Aq}$  treated with  $\text{NaNO}_2$ .

3. Sat.  $\text{NaNO}_2 + \text{Aq}$  treated with  $\text{NaCl}$ .

4. Simultaneous treatment of the two salts by  $\text{H}_2\text{O}$  (Karsten.)

5. Excess of both salts +  $\text{Aq}$  warmed and cooled to 20 $^{\circ}$ . (Rudorff, B 6, 484.)

Solubility of NaCl with addition of  $\text{NaNO}_3$  at  $15.5^\circ$ .

Sp gr	100 ccm contain in g		
	NaCl	$\text{H}_2\text{O}$	$\text{NaNO}_3$
1 2025	31 78	88 47	0 00
1 2305	27 89	87.63	7 53
1 2580	26.31	86 25	13 24
1 2810	23 98	82 66	21 58
1 3090	22 30	80 42	28.18
1 3345	20 40	79 25	33.80
1 3465	19 40	77 37	37 88
1 3485	19 67	77 34	37 64

$\text{NaNO}_3$  separated in last two solutions

Solubility of  $\text{NaNO}_3$  with addition of NaCl at  $15^\circ$ 

Sp. gr.	100 ccm contain in g		
	$\text{NaNO}_3$	$\text{H}_2\text{O}$	NaCl
1.3720	62 38	74 82	0
1 3645	56.56	75.69	4 00
1.3585	52 09	75.71	7 24
1.3530	47 08	76 86	11 36
1.3495	42 66	76 96	15 33
1 3485	39 90	77 14	17.81
1 3485	38 73	77 15	18.97
1 3485	38.02	77.49	19 34

NaCl separated in last two solutions.  
(Bodlander, Z. phys. Ch. 7. 360.)

Solubility of  $\text{NaNO}_3$  in NaCl + Aq at  $15^\circ$ .

Sp. gr	G per 100 cc sat solution		
	NaCl	$\text{NaNO}_3$	$\text{H}_2\text{O}$
1 3720	0	62 38	74.82
1 3645	4 0	56 76	75.69
1.3585	7.24	52 09	75.71
1.3530	11.36	47 08	76.86
1 3495	15 33	42 66	76 96
1 3485	17 81	39 90	77 14
1 3485	18 97*	38.73*	77 15
1.3485	19 34*	38.02*	77 49

\* Solutions sat. with both salts.

(Bodlander, Z. phys. Ch. 1891, 7. 361.)

Solubility of  $\text{NaNO}_3 + \text{NaCl}$  (g. in 100 g.  $\text{H}_2\text{O}$ ) at  $25^\circ$ .

$\text{NaNO}_3$	NaCl	Solid phase
79 20	8 39	$\text{NaNO}_3$
68 38	16 32	"
56 56	23 74	$\text{NaNO}_3 + \text{NaCl}$
39 20	27 58	NaCl
20 17	31 48	"

(Uyeda, Mem. Col. Sc. Kyoto, 1910, 2. 245.)

Solubility in NaCl + Aq at  $20^\circ$ ,  $30^\circ$ ,  $40^\circ$  and  $91^\circ$  Tables given in the original show that each salt diminishes the solubility of the other. (Leather, Mem. Dept. Agric. India, 1914, 3. 177, Chem. Soc. 1915, 108. (2) 13)  
See also under NaCl.

$\text{NaNO}_3 + \text{NaOH}$ .

Solubility in  $\text{NaOH} + \text{Aq}$  at  $0^\circ$ .  $\text{NaNO}_3 =$  mols.  $\text{NaNO}_3$  (in mg.) in 10 ccm. of solution,  $\text{Na}_2\text{O} =$  mols.  $\text{Na}_2\text{O}$  (in mg.) in 10 ccm. of solution

$\text{NaNO}_3$	$\text{Na}_2\text{O}$	$\text{NaNO}_3 + \text{Na}_2\text{O}$	Sp gr
66 4	0	66.4	1 341
62 5	2 875	65.375	1.338
57 15	6 1	63.25	1 333
47 5	12 75	60.25	1 327
29 5	26	55 5	1 326
17 5	39	56 5	1.332
13 19	45 875	59 065	1.356
6 05	60.875	66 925	1 401

(Engel, Bull. Soc. (3) 6. 16.)

Solubility in  $\text{NaOH} + \text{Aq}$  at  $0^\circ$ 

G per 100 cc solution		Sp gr
NaOH	$\text{NaNO}_3$	
0 0	56 50	1 341
2 30	53 19	1 338
4 89	48 63	1 333
10 21	40 42	1 327
20 83	25 10	1 326
31 25	14 89	1 332
36 76	11 22	1.356
48 75	5 15	1.401

(Engel, l. c.)

Easily sol. in  $\text{K}_2\text{SO}_4 + \text{Aq}$  without pptn.  
Easily sol. in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  without pptn.  
Sol. in  $\text{MgSO}_4 + \text{Aq}$ , at first to a clear solution, but afterwards  $\text{NaNO}_3$  is pptd.

Very sol in sat  $\text{CuSO}_4 + \text{Aq}$ , but double sulphate separates out

Very sol in  $\text{ZnSO}_4 + \text{Aq}$  with pptn. of double sulphate. (Karsten.)

Solubility of  $\text{NaNO}_3$  in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  at  $5^\circ$ .

$t^\circ$	% $\text{NaNO}_3$	% $\text{Na}_2\text{S}_2\text{O}_3$	Solid phase
9	33.31	12 26	$\text{NaNO}_3$
	22.57	23 41	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
	4.22	34 77	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
25	35 42	12.72	$\text{NaNO}_3$
	25 40	24.25	"
	19 90	31 81	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
	18 02	32 83	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
	4.33	40 50	"

(Kremann and Rothmund, Z. anorg. 1914, 86. 373.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am Ch. J. 1898, 20, 829.)

Easily sol. in liquid  $\text{HF}$ . (Franklin, Z anorg. 1905, 48, 2.)

Hydrazine dissolves 26.6 pts.  $\text{NaNO}_2$  at  $12.5-13^\circ$  (de Bruyn, R. t. c. 1890, 18, 297.)

100 pts. alcohol of 0.9 sp. gr. dissolve 10.5 pts.  $\text{NaNO}_2$ , 0.872 sp. gr., 6 pts., 0.831 sp. gr., 0.88 pt. insol in alcohol of 0.817 sp. gr. (Kraus.)

100 pts. alcohol of 0.814 sp. gr. by weight dissolve 21.2 pts.  $\text{NaNO}_2$  at  $20^\circ$  (Pohl W. A. B. 6, 600.)

100 pts. alcohol of 0.82 Tr. dissolve 7.4 pts.  $\text{NaNO}_2$  at  $19.5^\circ$

100 pts. alcohol of 0.8 Tr. dissolve 0.93 pt.  $\text{NaNO}_2$  at  $19.5^\circ$ . (Wittstein.)

100 pts. alcohol containing % alcohol by weight dissolve pts.  $\text{NaNO}_2$  at  $15^\circ$ , or 100 pts. solution contain %  $\text{NaNO}_2$ :

10	20	30	40	60	80%	alcohol.
65.3	48.8	35.5	25.8	11.4	2.8	pts. $\text{NaNO}_2$ .
39.5	32.8	26.2	20.5	10.2	2.7%	$\text{NaNO}_2$ .

(Schiff.)

100 pts. wood-spirit of 40% dissolve 32.3 pts.  $\text{NaNO}_2$ . (Schiff, A. 118, 365.)

#### Solubility in alcohol at $16.5^\circ$ .

Sp. gr.	100 ccm. contain in g.		
	Alcohol	Water	$\text{NaNO}_2$
1.3745	0	75.25	62.20
1.3102	6.16	70.82	54.64
1.2570	11.60	68.10	46.06
1.2140	16.49	65.04	39.87
1.1615	22.17	61.67	32.31
1.0855	32.22	52.92	23.41
1.0558	37.23	48.50	19.85
1.0050	43.98	42.78	13.74
0.9420	52.60	32.13	9.47
0.9030	60.00	25.65	4.65
0.8610	68.16	21.31	1.63

(Bodländer, Z. phys. Ch. 7, 317.)

100 pts. absolute methyl alcohol dissolve 0.41 pt. at  $25^\circ$ .

100 pts. absolute ethyl alcohol dissolve 0.036 pt. at  $25^\circ$ . (de Bruyn, Z. phys. Ch. 10, 783.)

#### Solubility in alcohol at $40^\circ$ .

Wt. % alcohol	G. $\text{NaNO}_2$ per 100 g. alcohol + liq.
0	104.5
8.22	90.8
17.4	73.3
26.0	61.6
36.0	48.4
42.8	40.6
55.3	27.1
65.1	18.1
77.0	9.4
87.2	4.2

(Bathrick, J. phys. Ch. 1896, 1, 162.)

#### Solubility in alcohol at $30^\circ$ .

Wt. % alcohol in solvent	G. $\text{NaNO}_2$ per 100 g.	
	Solution	Water
0	40.10	96.45
5	46.41	91.15
10	43.50	85.55
20	37.42	74.75
30	31.31	65.10
40	25.14	55.95
50	18.94	46.75
60	12.97	37.25
70	7.81	28.25
90	1.21	12.25

(Taylor, J. phys. Ch. 1897, 1, 723.)

#### Solubility in ethyl alcohol at $25^\circ$ .

(Concentration of alcohol in g. mol. per 1000 g.  $\text{H}_2\text{O}$ .)

Normality	Solubility in 1000 g. $\text{H}_2\text{O}$	Mol. solubility
	920.30	10.83
$\frac{1}{2}$	908.80	10.70
$\frac{1}{3}$	890.60	10.54
1	870.95	10.24
2	825.35	9.70

(Armstrong and Eyre, Proc. R. Soc. 1910 (A), 84, 127.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)

#### Solubility of $\text{NaNO}_2$ in acetone at $40^\circ$ .

Wt. % acetone	G. $\text{NaNO}_2$ per 100 g. acetone + liq.
0.0	105
8.47	91.2
16.8	78.3
25.2	66.4
34.3	57.9
44.1	46.2
53.9	32.8
64.8	23.0
76.0	10.8
87.6	3.2

(Bathrick, J. phys. Ch. 1896, 1, 162.)

Solubility of  $\text{NaNO}_3$  in acetone at  $30^\circ$ .

Wt % acetone in solvent	G $\text{NaNO}_3$ per 100 g	
	Solution	Water
0	49 10	96 45
5	46 96	93 20
9 00	45 11	90 40
20	40 10	83 70
30	35 08	77 20
40	29 80	70 75
50	24 34	64 40
60	18 55	59 95
70	13 15	50 50
80	7 10	38 20
90	1 98	20 20

(Taylor, Z. phys. Ch. 1897, 2. 723.)

Sol. in glycerine.

Insol. in ethylamine. (Shinn, J. phys. Chem. 1907, 11. 538.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1870.)

Sodium thorium nitrate,  $\text{NaTh}(\text{NO}_3)_4 + 9\text{H}_2\text{O}$ .Hydroscopic; sol. in dil.  $\text{HNO}_3$  and Aq (Meyer, Z. anorg. 1901, 27. 351.)Sodium nitrate sulphate,  $\text{NaNO}_3, \text{Na}_2\text{SO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 12. 44.)  
+  $\text{H}_2\text{O}$ . Min. Darapskite.Sodium nitrate tungstosilicate,  $3\text{Na}_2\text{W}_{12}\text{SiO}_{40} \cdot 4\text{NaNO}_3 + 45\text{H}_2\text{O}$ .

(Wyruboff, Chem. Soc. 1897, 72. (2) 174.)

Strontium nitrate,  $\text{Sr}(\text{NO}_3)_2$ .Sol. in 5 pts cold, and 0.5 pt boiling  $\text{H}_2\text{O}$ . (Dumas) 2 " " 0.5 " " (Wittmann)100 pts sat.  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $19-20^\circ$  contain 45.49 pts.  $\text{Sr}(\text{NO}_3)_2$ . (v. Hauer, J. pr. 98. 137.)1 pt.  $\text{Sr}(\text{NO}_3)_2$  dissolves in pts.  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$
0	2 32	25	1 10	75	0 90
10	1 73	50	1 02	100	0 94

(Kremers, Pogg. 92. 490)

100 pts.  $\text{H}_2\text{O}$  dissolve at  $0^\circ$ , 39.5 pts.  $\text{Sr}(\text{NO}_3)_2$  (Mulder); at  $0^\circ$ , 40.16 pts.  $\text{Sr}(\text{NO}_3)_2$  (Poggiale); at  $0^\circ$ , 43.1 pts.  $\text{Sr}(\text{NO}_3)_2$  (Kremers); at  $100^\circ$ , 101.1 pts.  $\text{Sr}(\text{NO}_3)_2$  (Mulder), at  $100^\circ$ , 106.5 pts.  $\text{Sr}(\text{NO}_3)_2$  (Kremers, Pogg. 92. 499); at  $100^\circ$ , 119.25 pts.  $\text{Sr}(\text{NO}_3)_2$  (Poggiale)Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{Sr}(\text{NO}_3)_2$	$t^\circ$	Pts $\text{Sr}(\text{NO}_3)_2$	$t^\circ$	Pts $\text{Sr}(\text{NO}_3)_2$
0	39 5	36	90 7	73	96 0
1	41.2	37	90 8	74	96 2
2	42.8	38	91 0	75	96 4
3	44 3	39	91 1	76	96 5
4	45 8	40	91 3	77	96 7
5	47 3	41	91 4	78	96 8
6	48 8	42	91 5	79	97 0
7	50 3	43	91 6	80	97 2
8	51 8	44	91 8	81	97 4
9	53.4	45	91 9	82	97 5
10	54.9	46	92 1	83	97 7
11	56 5	47	92 2	84	97 9
12	58 0	48	92 3	85	98 0
13	59 6	49	92 5	86	98 2
14	61.2	50	92 6	87	98 4
15	62 8	51	92 8	88	98 6
16	64 4	52	92 9	89	98 8
17	66 0	53	93 1	90	99 0
18	67 6	54	93 2	91	99 2
19	69 2	55	93 4	92	99 4
20	70 8	56	93 5	93	99 6
21	72.5	57	93 6	94	99 8
22	74.1	58	93 8	95	100 0
23	75.8	59	93 9	96	100 2
24	77.4	60	94 0	97	100 4
25	79 0	61	94 2	98	100 6
26	80 7	62	94 3	99	100 9
27	82.4	63	94 5	100	101 1
28	84.1	64	94 6	101	101 3
29	85 8	65	94 8	102	101 6
30	87 6	66	94 9	103	101 8
31	89 5	67	95 1	104	102 0
31.3	90 0	68	95 2	105	102 3
32	90 2	69	95 4	106	102 5
33	90 3	70	95 6	107	102 7
34	90 5	71	95 7	107.9	102 9
35	90 6	72	95 9	..	..

(Mulder, Scheik. Verhandel. 1864. 114.)

Sat.  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  contains at:

$-6^\circ$	$+14^\circ$	$20^\circ$	$32^\circ$
24.5	35.9	39.8	46.9% $\text{SrNO}_3$

$53^\circ$	$56^\circ$	$76^\circ$	$94^\circ$	$110^\circ$
47.2	47.8	49.1	50.4	50.2% $\text{SrNO}_3$

(Etard, A. ch. 1894, (7) 2. 528.)

79.27 g. anhydrous  $\text{Sr}(\text{NO}_3)_2$  are sol. in 100 g.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Parsons and Carson, J. Am. Chem. Soc. 1910, 32. 1385.)

Solubility of  $\text{Sr}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{Sr}(\text{NO}_3)_2$ in 100 g. $\text{H}_2\text{O}$	Sp. gr.
0.58	40.124	1.2856
14.71	60.867	1.3038
26.40	82.052	1.3883
29.06	87.648	1.5110
30.28	88.577	1.5144
32.58	88.943	1.5141
39.71	90.086	1.5128
47.73	91.446	1.5115
61.34	93.856	1.5105
68.96	95.576	1.5106
78.98	97.865	1.5109
88.91	100.136	1.5117

(Berkeley and Appleby, Proc. R. Soc. 1911, (A) 85, 503.)

100 g. of the sat. solution contain at  $20^\circ$ , 41.43 g.  $\text{Sr}(\text{NO}_3)_2$ . (Findlay, Chem. Soc 1914, 105, 782.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $19.5^\circ$ .

$\text{Sr}(\text{NO}_3)_2$	Sp. gr.	$\text{Sr}(\text{NO}_3)_2$	Sp. gr.
1	1.009	21	1.192
2	1.017	22	1.202
3	1.025	23	1.213
4	1.034	24	1.223
5	1.041	25	1.233
6	1.049	26	1.246
7	1.059	27	1.257
8	1.068	28	1.268
9	1.076	29	1.280
10	1.085	30	1.292
11	1.095	31	1.304
12	1.103	32	1.316
13	1.113	33	1.330
14	1.122	34	1.340
15	1.131	35	1.354
16	1.140	36	1.367
17	1.150	37	1.381
18	1.160	38	1.395
19	1.170	39	1.410
20	1.181	40	1.422

(Kremers, calculated by Gerlach, Z. anal. 8, 286.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $23.4^\circ$ . a=no. of grms.  $\times 1/2$  mol wt dissolved in 1000 grms.  $\text{H}_2\text{O}$ ; b=sp gr if a is  $\text{Sr}(\text{NO}_3)_2$ ,  $4\text{H}_2\text{O}$ ,  $1/2$  mol wt = 112; c=sp gr. if a is  $\text{Sr}(\text{NO}_3)_2$ ,  $1/2$  mol. wt = 106

a	b	c	a	b	c
1	1.078	1.081	5	1.303	1.350
2	1.146	1.155	6	1.345	1.407
3	1.205	1.224	7	1.383	.
4	1.257	1.281	.	.	...

(Favre and Valson, C. R. 79, 968.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $17.5^\circ$ .

$\text{Sr}(\text{NO}_3)_2$	Sp. gr.	$\text{Sr}(\text{NO}_3)_2$	Sp. gr.
10	1.083	40	1.422
20	1.180	Sat. sol.	1.52
30	1.294	.	..

(Gerlach, Z. anal. 27, 283.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	$\text{Sr}(\text{NO}_3)_2$	Sp. gr.
14.0°	5	1.0420
14.3°	10	1.0859
14.5°	15	1.1319
14.5°	20	1.1816
14.5°	25	1.2364
14.4°	34 33	1.3470

(Long, W. Ann 1880, 11, 39.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

10.29 21.19 32.61%  $\text{Sr}(\text{NO}_3)_2$ .  
1.0885 1.124 1.3067

(Wagner, W. Ann. 1883, 18, 266.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0822
$1/x$ "	1.0119
$1/c$ "	1.0208
$1/c$ "	1.0104

(Wagner, Z. phys. Ch. 1890, 5, 40.)

$\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  containing 10.50%  $\text{Sr}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.0905$

$\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  containing 25.51%  $\text{Sr}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.2440$ .

(Le Blanc and Rohland, Z. phys. Ch. 1890, 19, 279.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $20^\circ$  containing M g. mols. of salt per liter.

M 0.91 0.025 0.05 0.075  
Sp. gr. 1.001525 1.004207 1.008391 1.012646

M 0.10 0.25 0.50 0.75  
Sp. gr. 1.016834 1.04201 1.08312 1.12886

M 1.00  
Sp. gr. 1.16354

(Jones and Pearce, Am. Ch. J. 1907, 38, 705.)

B-pt. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$ , containing pts.  $\text{Sr}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ .

B-pt	Pts $\text{Sr}(\text{NO}_3)_2$	B-pt	Pts $\text{Sr}(\text{NO}_3)_2$
100 5°	12	104°	81 4
101	24	104 5	89 6
101 5	34 8	105	97 6
102	45	105 5	105
102 5	54.4	106	112 2
103	63 6	106 3	116.5
103 5	72 6		

(Gerlach, Z. anal. 26. 448.)

Sat.  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  boils at 106.8°, and contains 112.9 pts salt to 100 pts.  $\text{H}_2\text{O}$ . (Griffiths.)

Sat.  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  boils at 107.5–108° (Krems); 107 9° (Mulder).

Sat.  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  forms a crust at 106.3°, and contains 116.5 pts.  $\text{Sr}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , highest temp observed was 107° (Gerlach, Z. anal. 26. 427.)

Very sl sol. in conc.  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ . (Wuntz.)

Insol. in  $\text{HNO}_3 + \text{Aq}$  (Schultz, Zeit. Ch. (2) 5. 537.)

Solubility in  $\text{Sr}(\text{OH})_2, 8\text{H}_2\text{O} + \text{Aq}$  at 25°.

Sp. gr. 25°/25°	G. $\text{Sr}(\text{OH})_2$ in 100 g $\text{H}_2\text{O}$	G. $\text{Sr}(\text{NO}_3)_2$ in 100 g $\text{H}_2\text{O}$
1.492	0.38	79.47
1.494	0.78	80.83

(Parsons, J. Am. Chem. Soc. 1910, 32. 1388.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sol. in 8500 pts. absolute alcohol. Sol. in 60,000 pts. of a mixture of 1 pt. ether and 1 pt. alcohol. (Rose, Pogg. 110. 296.)

Sol. in 4189 pts. abs alcohol and in 199.87 pts. ordinary rectified spirits. (Hull, Pharm. J. 1888 (3) 19. 420.)

Solubility in ethyl alcohol + Aq at 25°.

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Sr}(\text{NO}_3)_2$ in the solution
99.4	99.38	0.02
79.2	77.15	2.60
59.9	53.6	10.5
40.65	32.35	20.5
20.6	13.8	33.2
18.8	12.35	34.3
16.25	10.45	35.7
15.05	9.5	36.7
10.0	6.0	40.05
6.0	3.45	42.7
0	0	46.6

$\text{Sr}(\text{NO}_3)_2$  is the solid phase in the solutions which are rich in alcohol;  $\text{Sr}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$  in

the solutions which contain small amounts of alcohol

(D'Ans and Siegler, Z. phys. Ch. 1913, 82. 39.)

Not completely insol. in boiling amyl alcohol, 30 cc. dissolving about 1 mg. (Browning, Sill. Am. J. 143. 52.)

Perfectly anhydrous  $\text{Sr}(\text{NO}_3)_2$  is sol. in 83044 pts. absolute ether-alcohol (1:1). (Presentius, Z. anal. 32. 190.)

Solubility in organic solvents.

Solvent	% $\text{Sr}(\text{NO}_3)_2$ in the solution at 25°
Methyl alcohol	1.26
Ethyl alcohol	0.02
Propyl alcohol	0.02
Isobutyl alcohol	0.01
Amyl alcohol	0.003
Acetone	0.02

(D'Ans and Siegler, Z. phys. Ch. 1913, 82. 44.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Sol. in acetone. (Eidmann, C. C. 1899. II, 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

The composition of the hydrates formed by  $\text{Sr}(\text{NO}_3)_2$  at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by  $\text{Sr}(\text{NO}_3)_2$ , and of the conductivity and sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$ . (Jones, Am. Ch. J. 1905, 34. 305.)

$+4\text{H}_2\text{O}$ . Efflorescent.

Solubility in ethyl alcohol + Aq at 25°

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Sr}(\text{NO}_3)_2$ in the solution
0	0	44.25
4	1.7	42.8
6	2.6	42.1
10.8	4.95	40.4
16.0	7.95	37.6
20	12.35	34.3

(D'Ans and Siegler, Z. phys. Ch. 1913, 82. 39.)

Tellurium nitrate, basic,  $4\text{TeO}_2, \text{N}_2\text{O}_5 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Very hygroscopic. Easily decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ , but more sol. when dil. than conc. (Klein and Morel, Bull. Soc. (2) 43. 205.)

Tellurium nitrate,  $\text{TeNO}_3$ .

Sol. in acetone. (Eidmann, C. C. 1899. II, 1014.)

**Terbium nitrate,  $Tb(NO_3)_3 \cdot 6H_2O$ .**

Sol. in  $H_2O$ . Sol. in alcohol. (Urbain, C R. 1908, 146. 128.)

**Thallous nitrate,  $TlNO_3$ .**

1 pt.  $TlNO_3$  dissolves, according to C=Crookes;  $L=Lamy$ :

at 15°	18°	32°	58°	107°
in 9.4	10.3	2.3	0.17	pts. $H_2O$ .
C	L	L	L	

Sat.  $TlNO_3 + Aq$  contains at:

3.5°	18°	32°	58°	95°
4.2	8.8	13.2	30.4	74.5% $TlNO_3$

107°	135°	145°	150°	155°
85	95	95.2	96.5	97% $TlNO_3$

(Étard, A. ch. 1894, (7) 2. 527.)

Solubility in  $H_2O$  at t°.

t°	g $TlNO_3$ in 100 g $H_2O$	g mol $TlNO_3$ in 1 l
0	3.91	0.149
10	6.22	0.230
20	9.55	0.357
25	...	0.433
30	14.3	0.522
40	20.9	0.755
50	30.4	1.07
60	46.2	1.68
70	69.5	2.29
80	111	3.40
90	200	5.32
100	414	8.29
105	594	10.25

(Berkeley, Trans. Roy. Soc. 1904, 203. A, 211.)

Sp. gr. of  $TlNO_3 + Aq$  at 25°.

Concentration of $TlNO_3 + Aq$	Sp. gr.
$\frac{1}{2}$ normal	1.0562
$\frac{1}{5}$ " "	1.0283

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Solubility of  $TlNO_3 + KNO_3$ . (See  $KNO_3$ .)

Insol. in alcohol. (Lamy.)

Sol. in acetone. (Eidmann, Dissert. 1899; Naumann, B. 1904, 37. 4328.)

**Thallous hydrogen nitrate,  $TlNO_3, 2HNO_3$ .**

(Wells, Am. Ch. J. 1901, 26. 273.)

$TlNO_3, 3HNO_3$ . (Ditte.)

**Thallic nitrate,  $Tl(NO_3)_3 \cdot 3H_2O$ .**

Effloresces in the air. (Meyer, Z. anorg. 1900, 24. 361.)

+6 $H_2O$ , or 3 $H_2O$ . Deliquescent. Sol. in  $H_2O$ .

**Thallic thallic nitrate,  $2TlNO_3, Tl(NO_3)_3$ .**

Decomp. by  $H_2O$ . (Wells, Am. Ch. J. 1901, 26. 278.)

**Thallic uranyl nitrate,  $Tl(UO_2)(NO_3)_3$ .**

Decomp. in moist air. Decomp. by  $H_2O$ . (Meyer, B. 1903, 36. 4058.)

**Thorium nitrate,  $ThQ_2, 2N_2O_5 + 6H_2O$ .**

Crystallized. Sl. hygroscopic. (Fukae, Zeit. angew. Ch. 1897, 10. 116.)

+12 $H_2O$ . Very deliquescent, and sol. in  $H_2O$  and alcohol.

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Thorium zinc nitrate,  $ZnTh(NO_3)_6 \cdot 8H_2O$ .**

Sol. in  $HNO_3$ ; very hygroscopic. (Meyer, Z. anorg. 1901, 27. 386.)

**Thulium nitrate,  $Tm_2(NO_3)_6 \cdot 8H_2O$ .**

Deliquescent. Can readily be cryst. from  $HNO_3$ . (James, J. Am. Chem. Soc. 1911, 33. 1344.)

**Tin (stannous) nitrate, basic,  $2SnO, N_2O_5$ .**

Difficultly sol. with partial decomp. in  $H_2O$ . (Weber, J. pr. (2), 26. 121.)

**Tin (stannous) nitrate,  $Sn(NO_3)_2 \cdot 20H_2O$ .**

Deliquescent, and easily decomp. (Weber, J. pr. (2) 26. 121.)

**Tin (stannic) nitrate, basic,  $4SnO_2, N_2O_5 + 4H_2O$ .**

(Thomas, Bull. Soc. 1896 (3) 15. 312.)

**Tin (stannic) nitrate,  $Sn(NO_3)_4$ .**

Sol. in  $H_2O$ , but decomp. very soon on standing. Stable in presence of conc.  $HNO_3 + Aq$  at 90°, but decomp. at 100° (Montemartini, Gazz. ch. it. 22. 384.)

Insol. in moderately conc.  $HNO_3$ ; readily decomp. by  $H_2O$ . (Engel, C R. 1897, 125. 710.)

**Titanium nitrate,  $5TiO_2, N_2O_5 + 6H_2O$ .**

Sol. to a slight milkiness in cold  $H_2O$ . Decomp. on boiling. (Merz, J. pr. 99. 157.)

**Uranyl nitrate, basic.**

Sol. in  $H_2O$ . (Ordway, Sil. Am. J. (2) 26. 209.)

**Uranyl nitrate,  $UO_2(NO_3)_2$ .**

+ $H_2O$ . (de Forcrand, C. R. 1913, 156. 1046.)

Sol. in fuming  $HNO_3$  from which it can be cryst.

+2 $H_2O$ . 52.39% is sol. in dry ether at 7°.

54.25% " " " " " " 10°.

(Lebeau, Bull. Soc. 1911, (4) 9. 300.)

+2H<sub>2</sub>O. (Vasheff, C. C. 1910, II. 1527.)  
 +3H<sub>2</sub>O. Mpt. 121.5°. (Vasheff.)  
 Cryst. out of hot HNO<sub>3</sub>+Aq. (Ditte.)  
 100 pts. HNO<sub>3</sub> dissolve 39 pts at 14°. (Ditte, A. ch. 1879, (5) 18. 337.)  
 +4H<sub>2</sub>O. (de Coninck, C. C. 1901, I. 1854.)  
 +6H<sub>2</sub>O. Deliquescent in moist, and efflorescent in dry air. Sol. in 0.5 pt. cold H<sub>2</sub>O, in 0.3 pt. absolute alcohol, and in 4.0 pts. ether. (Bucholz.)  
 Melts in crystal H<sub>2</sub>O at 59.4°. (Ordway.)  
 1 pt. is sol. in 2 pts. H<sub>2</sub>O at 12.9°-14.2°. (de Coninck, C. R. 1900, 131. 1220.)

Solubility in H<sub>2</sub>O at t°.

t°	% by wt UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> ·6H <sub>2</sub> O
-18.1	54.90
-12.1	58.00
-2.2	62.13
0	63.01
+12.3	67.36
25.6	72.83
36.7	78.05
45.2	82.96
71.8	86.32

(Vasheff, J. Russ. Phys. Chem. Soc. 1910, 42. 570.)

Sp. gr. of (UO<sub>2</sub>)(NO<sub>3</sub>)<sub>2</sub>+Aq at t°.

t°	% salt	Sp. gr.
11.5	1	1.0049
12.4	2	1.0096
15.1	3	1.01401
14.1	4	1.0187
16.7	5	1.0230
14.1	6	1.0281
15.7	7	1.0236
15.2	8	1.0378
16.5	9	1.0410
15.2	10	1.0462
13.7	11	1.0504
11.5	12	1.0550
14.5	13	1.0594
11.3	14	1.0643
12.5	15	1.0680
13.2	16	1.0718

(de Coninck, C. R. 1900, 131. 1219.)

Sp. gr. of a sat. aq. solution = 1.7536 at 17°, containing 54.77% UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.

Sp. gr. = 1.0257 when 2.80% UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> is present. (Vassiliev, C. C. 1912, I, 1430.)

Sp. gr. of solution in HNO<sub>3</sub>+Aq.

Pts of salt in 100 pts. HNO <sub>3</sub> sp. gr. 1.103	1	2	3	4	5
Temp.	11.0°	11.8°	11.3°	12.0°	11.6°
Sp. gr. of the solution	1.1585	1.1614	1.1663	1.1698	1.1751

(de Coninck, C. R. 1901, 132. 90.)

Sp. gr. of solution in H<sub>2</sub>SO<sub>4</sub>+Aq.

Pts of salt in 100 pts. H <sub>2</sub> SO <sub>4</sub> sp. gr. 1.138	1 pt	2 pts	3 pts	4 pts	5 pts
Temp.	11.2°	11.8°	10.7°	12.0°	11.4°
Sp. gr. of solution	1.1427	1.1459	1.1511	1.1540	1.1576

(de Coninck.)

Very sol. in dil. HBr and selenic acid (d=1.4). Sol. in conc. H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, dil. HCl and less sol. in conc. HCl. (de Coninck, C. R. 1900, 131. 1220.)

Sp. gr. of solution in HBr+Aq of sp. gr. 1.21.

Sp. gr.	% salt dissolved
1.2122	1
1.2168	2
1.2198	3
1.2250	4
1.2305	5

(de Coninck, Belg. Acad. Bull. 1901. 222.)

Insol. in KOH+Aq, NaOH+Aq or NH<sub>4</sub>OH+Aq. Sol. in lime water. (de Coninck, C. R. 1900, 131. 1220.)

Sl. attacked by liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 830.)

At 15°, uranyl nitrate is sol. in comm. methyl alcohol, dil. and conc. ethyl alcohol, propyl and isobutyl alcohol, comm. amyl alcohol, acetone, ether, ethyl acetate, dil. and conc. formic acid and dil. acetic acid; sl. sol. in comm. essence of terebenthine; insol. in benzene (cryst.), comm. toluene and xylene, ligroin, CHCl<sub>3</sub>, glycerine and CS<sub>2</sub>. (de Coninck, C. R. 1900, 131. 1220.)

1 pt. is sol. in 55 pts. methyl alcohol at ca. 11.8°.

1 pt. is sol. in 30 pts. ethyl alcohol (85°) at ca. 12.9°.

1 pt. is sol. in 65 pts. acetone at ca. 12.0°.

1 pt. is sol. in 5.6 pts. acetic acid (d=1.035) at ca. 14.25°.

(de Coninck, C. R. 1900, 131. 1304.)

1 pt. sol. in 23.5 pts. methyl alcohol at 11.2°.

1 " " " 16.0 " ether " 11.9°.

1 " " " 18.4 " ethyl acetate " 10.3°.

1 " " " 5.3 " conc. formic acid at 15.1°.

(de Coninck, C. R. 1901, 132. 91.)

Sp. gr. of solution in comm. methyl alcohol at t°.

t°	% salt	Sp. gr. referred to H <sub>2</sub> O
11	1	0.8902
12.0	2	0.8938
12.2	3	0.9003
10.7	4	0.9068
12.8	5	0.9108

(de Coninck, C. R. 1900, 131. 1304.)

Sp. gr. of solution in ethyl alcohol (85°) at t°.

d<sub>2</sub>=sp. gr. referred to alcohol.

d<sub>1</sub>=sp. gr. referred to H<sub>2</sub>O

t°	t° alt	d <sub>1</sub>	d <sub>2</sub>
11.9	1	0.8918	1.0060
12.2	2	0.8979	1.0127
11.6	3	0.9023	1.0177
13.1	4	0.9056	1.0227
11.7	5	0.9131	1.0280

(de Coninek, C. R. 1900, 131. 1219.)

Sp. gr. of solution in acetic acid (d=1.055) at t°.

d<sub>1</sub>=sp. gr. referred to H<sub>2</sub>O

d<sub>2</sub>=sp. gr. referred to acetic acid

t°	t° salt	d <sub>1</sub>	d <sub>2</sub>
14.0	1	1.0387	1.0034
13.8	2	1.0434	1.0080
14.8	3	1.0469	1.0100
16.9	4	1.0505	1.0148
14.6	5	1.0564	1.0205
10.4	6	1.0626	1.0265
11.7	7	1.0662	1.0300

(de Coninek, C. R. 1900, 131. 1301)

When excess of UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> is shaken with ether at 7°, two layers are formed, the ether layer containing 59 g. salt per 100 g. solution and the aqueous layer 62.5 g. salt per 100 g. solution (Lebeau, C. R. 1911, 152. 440.)

Sol. in nearly all proportions in glycerine (Postans, Pharm. J. 1883, (3) 13. 752.)

Sol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601)

Sol. in acetone. (Eckmann, C. C. 1899, II, 1014, Naumann, B. 1904, 37. 6328)

+18H<sub>2</sub>O. Sat. aq. solution has D<sub>17</sub><sup>17</sup>/17°=1.7536 (Vasilieff, J. Russ. phys. Chem. Soc. 1911, 43. 1183)

Uranyl nitrate ammonia, (UO<sub>2</sub>)<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>·2NH<sub>4</sub>.

(v. Unruh, Dissert. 1909.)

(UO<sub>2</sub>)<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>·3NH<sub>4</sub>. (v. Unruh.)

(UO<sub>2</sub>)<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>·4NH<sub>4</sub>. (v. Unruh.)

Uranyl nitrate phosphate, UO<sub>2</sub>H<sub>4</sub>(PO<sub>4</sub>)<sub>2</sub>·UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>+14H<sub>2</sub>O.

Easily sol. in warm H<sub>2</sub>O, with gradual decomp. Easily sol. in HNO<sub>3</sub>, HCl, or H<sub>2</sub>SO<sub>4</sub>+Aq. Sol. in acetic acid with decomp. (Heintz, A. 151. 216.)

Divanadyl nitrate (?).

Known only in solution. Decomp. on evaporation.

Ytterbium nitrate, basic.

Easily sol. in H<sub>2</sub>O.

Ytterbium nitrate.

Very sol. in H<sub>2</sub>O.

+3H<sub>2</sub>O. Ppt. (Cleve, Z. anorg. 1902, 32. 140.)

+4H<sub>2</sub>O. (Cleve.)

Yttrium nitrate, basic, 2Y<sub>2</sub>O<sub>3</sub>, 3N<sub>2</sub>O<sub>5</sub>+9H<sub>2</sub>O.

Deliquescent in moist air. Decomp. by cold or boiling H<sub>2</sub>O. Sol. in a solution of yttrium nitrate without decomp. (Bahr and Bunsen, A. 137. 1.)

Yttrium nitrate, Y(NO<sub>3</sub>)<sub>3</sub>+6H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O, alcohol, or ether (Cleve.)

141.6 grams are sol. in 100 grams H<sub>2</sub>O at 25° (James, J. Am. Chem. Soc. 1910, 32. 876)

Zinc nitrate, basic, 8ZnO, N<sub>2</sub>O<sub>5</sub>+2H<sub>2</sub>O.

Insol. in H<sub>2</sub>O (Grouvelle, A. ch. 19. 137.)

6ZnO, N<sub>2</sub>O<sub>5</sub>+8H<sub>2</sub>O=Zn(NO<sub>3</sub>)<sub>2</sub>, 5Zn(OH)<sub>2</sub>

+3H<sub>2</sub>O (Bertels, J. B. 1784. 274)

5ZnO, N<sub>2</sub>O<sub>5</sub>+5½H<sub>2</sub>O. Insol. in cold,

somewhat sol. in hot H<sub>2</sub>O. (Havermann.)

+6H<sub>2</sub>O. Slowly decomp. by cold H<sub>2</sub>O.

(Roussseau and Tite)

9ZnO, 2N<sub>2</sub>O<sub>5</sub>. Decomp. by H<sub>2</sub>O. (Vogel

and Reischauer, N. Jahrb. Pharm. 11. 137)

4ZnO, N<sub>2</sub>O<sub>5</sub>+2H<sub>2</sub>O. (Selandier)

+3H<sub>2</sub>O (Ordway, Sil. Am. J. (2) 32. 14,

Gerhardt, J. Pharm. (3) 12. 61.)

Insol. in H<sub>2</sub>O, sol. in dil. acids (Athanasio, Bull. Soc. 1896, 15. 1080)

2ZnO, N<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O. Decomp. by H<sub>2</sub>O, and

slowly by alcohol (Wells, Am. Ch. J. 9. 304.)

7ZnO, 4N<sub>2</sub>O<sub>5</sub>+14H<sub>2</sub>O=4Zn(NO<sub>3</sub>)<sub>2</sub>,

3Zn(OH)<sub>2</sub>+11H<sub>2</sub>O (Bertels.)

Zinc nitrate, Zn(NO<sub>3</sub>)<sub>2</sub>

Very deliquescent. Easily sol. in H<sub>2</sub>O or alcohol.

Sp. gr. of Zn(NO<sub>3</sub>)<sub>2</sub>+Aq. F.=according to

Frauz (J. pr. (2) 5. 274) at 17.5°; O.=according to

Oudemans (Z. anal. 7. 410) at 14°:

	5	10	15% Zn(NO <sub>3</sub> ) <sub>2</sub>
F.	1.0496	1.0968	1.1476
O.	1.0425	1.067	1.1355

	20	25	30% Zn(NO <sub>3</sub> ) <sub>2</sub>
F.	1.2024	1.2640	1.3268
O.	1.1875	1.245	1.305

	35	40	45	50% Zn(NO <sub>3</sub> ) <sub>2</sub>
F.	1.906	1.4572	1.5258	1.5984
O.				

Calculated for Zn(NO<sub>3</sub>)<sub>2</sub>+6H<sub>2</sub>O:

	10	20	30	40	50% salt.
	1.05361	1.1131	1.1782	1.2496	1.3292

(Oudemans.)

Zn(NO<sub>3</sub>)<sub>2</sub>+Aq when heated soon decomposes, with formation of an insol. basic salt (Ordway.)

Sp. gr. of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at room temp containing:

15 955	30 626	44 5%	$\text{Zn}(\text{NO}_3)_2$
1.1155	1 2291	1 4367	

(Wagner, W. Ann 1883, 18. 270)

Sp. gr. of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at 25°

Concentration of $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
1-normal	1.0758
$\frac{1}{2}$ "	1.0404
$\frac{1}{4}$ "	1.0191
$\frac{1}{8}$ "	1.0096

(Wagner, Z. phys. Ch. 1890, 6. 40.)

Sp. gr. of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at 16°

$\frac{1}{2}$ $\text{Zn}(\text{NO}_3)_2$ g per 1000 g of solution	Sp gr. 16°/16°
0.0000	1.000000
0.9950	1.000814
2.0061	1.001646
4.1535	1.003413
8.1824	1.006733
17.7760	1.014702
34.5920	1.028890
68.6780	1.058644

(Dyken, Z. phys. Ch. 1897, 24. 108.)

Sp. gr. of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at 17.3°, when p = per cent strength of solution; d = observed density, w = volume conc. in grams per cc.  
 $\left(\frac{pd}{100} = w.\right)$

p	d	w
47.28	1.5504	0.73310
41.32	1.4579	0.60240
30.86	1.3136	0.40535
29.21	1.2933	0.37780
19.65	1.1830	0.23246
14.39	1.1284	0.16232
11.36	1.0988	0.12478
7.091	1.0597	0.07515
5.923	1.0491	0.06213
1.574	1.0118	0.01593
1.210	1.0087	0.01221

(Barnes, J. Phys. Chem. 1898, 2. 545.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J 1898, 20. 830)  
 $+ \frac{1}{2}\text{H}_2\text{O}$ . 100 pts  $\text{HNO}_3$  dissolve 28 pts at 13°, 55 pts. at 55°. (Ditte, A. ch. 1879, (5) 18. 335)  
 $+ 2\text{H}_2\text{O}$ . (Vasileff, C. C 1909, II 1966.)  
 $+ 3\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

37°	40°	41°	43°	45 5° mpt
66	38	67	42	68 21 69 26 77.77%
$\text{Zn}(\text{NO}_3)_2$				

(Funk, Z. anorg. 1899, 20. 401)

$+ 6\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at

-18°	-15°	-13°	-12°
44.63	45.26	45.51	45.75%
$\text{Zn}(\text{NO}_3)_2$			

0°	+12 5°	18°	25°
48.66	52.00	53.50	55.90%
$\text{Zn}(\text{NO}_3)_2$			

36 4° (mpt)	36°	33 5°
63.63	64.73	65.83%
$\text{Zn}(\text{NO}_3)_2$		

(Funk, Z. anorg. 1899, 20. 400.)

100 g.  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  sat. at 0° contain 48.7 g.  $\text{Zn}(\text{NO}_3)_2$ ; at 18°, 53.5 g.  $\text{Zn}(\text{NO}_3)_2$ . (Mylius, Z. anorg. 1910, 74. 411.)

Melts in its crystal  $\text{H}_2\text{O}$  at 36.4° (Ordway), 50° (Pierre); boils at 131° (Ordway).

Sp. gr. of solution sat. at 18° = 1.664, and contains 53.9%  $\text{Zn}(\text{NO}_3)_2$ . (Mylius, B. 1897, 30. 1718)

Sol in methyl acetate (Naumann, B. 1909, 42. 3790), ethyl acetate. (Naumann, B. 1910, 43. 314)

$+ 9\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at.

-25°	-22 5°	-20°	-18°
40.12	40.75	42.03	43.59%
$\text{Zn}(\text{NO}_3)_2$			

Cryohydrate is formed at -20°.

(Funk, Z. anorg. 1899, 20. 401.)

Zinc nitrate ammonia,  $\text{Zn}(\text{NO}_3)_2 \cdot 4\text{NH}_3$ .

Ppt. (Ephraim, B. 1915, 43. 638.)

$+ \frac{2}{3}\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (André, C. R. 100. 639.)

$13\text{ZnO}$ ,  $3\text{N}_2\text{O}_5$ ,  $2\text{NH}_3 + 18\text{H}_2\text{O}$ .

Insol. in cold, decomp. by warm  $\text{H}_2\text{O}$ . (André, C. R. 1885, 100. 640.)

Zinc nitrate cupric oxide,

$\text{Zn}(\text{NO}_3)_2 \cdot 3\text{CuO} + 3\text{H}_2\text{O}$ .

(Mailhe, A. ch. 1902, (7) 27. 169.)

Zinc nitrate hydrazine,  $\text{Zn}(\text{NO}_3)_2 \cdot 3\text{N}_2\text{H}_4$ .

Decomp. by hot  $\text{H}_2\text{O}$ .

Sol. in  $\text{NH}_4\text{OH}$ . (Franzen, Z. anorg 1908, 60. 279.)

Zirconium nitrate, basic,  $3\text{ZrO}_2 \cdot 2\text{N}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$ .

$\text{ZrO}_2 \cdot \text{N}_2\text{O}_5$ . Easily sol in  $\text{H}_2\text{O}$  and alcohol.

$+ \text{H}_2\text{O}$  As above.

Zirconium nitrate,  $\text{Zr}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$  (?).

Deliquescent, and sol. in  $\text{H}_2\text{O}$ .

Nitric oxide,  $\text{NO}$

See Nitrogen dioxide.

**Nitrilobromosmic acid.**

**Ammonium nitrilopentabromosmate,**  
 $(\text{OsNBr}_5)_2(\text{NH}_4)_2 + \text{H}_2\text{O}.$

Very sol. in  $\text{H}_2\text{O}$  Decomp. in dil. aq. solution.

Stable in  $\text{HBr} + \text{Aq}$

Insol. in organic solvents (Werner, B. 1906, 39, 501.)

**Cæsium hydrogen nitrilopentabromosmate,**  
 $(\text{OsNBr}_5)_2\text{Cs}_2\text{H}.$

Sl sol. in  $\text{H}_2\text{O}$ . (Werner.)

**Potassium nitrilotetrabromosmate,**  
 $(\text{OsNBr}_4)_2\text{K} + 2\text{H}_2\text{O}.$

Very sol. in  $\text{H}_2\text{O}$  Decomp. in aq. solution. Stable in  $\text{HBr} + \text{Aq}$ . Insol. in organic solvents. (Werner.)

**Rubidium nitrilopentabromosmate,**  
 $(\text{OsNBr}_5)_2\text{Rb}_2.$

Sol. in  $\text{H}_2\text{O}$ . Decomp. in dil. aq. solution after a short time. (Werner.)

**Nitrilochlorosmic acid.**

**Ammonium nitrilopentachlorosmate,**  
 $(\text{OsNCl}_5)_2(\text{NH}_4)_2.$

Sol. in  $\text{H}_2\text{O}$ ; insol. in conc.  $\text{HCl} + \text{Aq}$ . (Werner, B. 1901, 34, 2702.)

**Cæsium nitrilopentachlorosmate,**  
 $(\text{OsNCl}_5)_2\text{Cs}_2.$

Sol. in  $\text{H}_2\text{O}$ . (Werner.)

**Potassium nitrilopentachlorosmate,**  
 $(\text{OsNCl}_5)_2\text{K}_2.$

Sol. in  $\text{H}_2\text{O}$ ; pptd. by  $\text{HCl}$ ; insol. in organic solvents. (Werner.)

**Rubidium nitrilopentachlorosmate,**  
 $(\text{OsNCl}_5)_2\text{Rb}_2.$

Sol. in  $\text{H}_2\text{O}$ ; decomp. in dil. neutral solution. (Werner.)

**Nitrilotrimetaphosphoric acid,  $\text{H}_2\text{NP}_2\text{O}_7 =$**



Known only in solution. (Mente, A. 248, 260.)

**Aluminum nitrilotrimetaphosphate.**

Insol. in  $\text{H}_2\text{O}$ , conc.  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . Slowly sol. in boiling conc.  $\text{H}_2\text{SO}_4$ . Sol. in warm  $\text{NaOH} + \text{Aq}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$  without decomp. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Mente.)

**Barium —,  $\text{BaNP}_2\text{O}_7.$**

Insol. in dil. or conc. acids. Decomp. by boiling  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Mente.)

**Cadmium nitrilotrimetaphosphate.**

Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , or boiling  $(\text{NH}_4)_2\text{CO}_3$ , or  $\text{NaOH} + \text{Aq}$ . (Mente.)

**Calcium —,  $\text{CaNP}_2\text{O}_7 + \text{H}_2\text{O}.$**

Sol. in conc.  $\text{HCl} + \text{Aq}$  by long boiling, and more easily in fuming  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH}$  or  $\text{NaOH} + \text{Aq}$ . (Mente.)

**Chromium —.**

Slowly sol. in dil. acids. Easily sol. in ammonia. Sol. in cold  $\text{NaOH} + \text{Aq}$ . (Mente.)

**Cobalt —,  $\text{CoNP}_2\text{O}_7 + \text{H}_2\text{O}.$**

Insol. in  $\text{H}_2\text{O}$ . Sl sol. in dil. acids. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . (Mente.)

**Copper —.**

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by  $\text{NaOH} + \text{Aq}$ . (Mente.)

**Ferric —,  $\text{Fe}_2(\text{NP}_2\text{O}_7)_3.$**

Insol. in conc. acids. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Decomp. by  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . (Mente.)

**Lead —.**

Insol. in dil. acids. Sol. in fuming  $\text{HNO}_3$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $\text{NaOH} + \text{Aq}$ . (Mente.)

**Magnesium —,  $\text{MgNP}_2\text{O}_7 + \text{H}_2\text{O}.$**

Slowly sol. in  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{H}_2\text{SO}_4$ , or fuming  $\text{HNO}_3$  with addition of  $\text{Br}_2$ . Insol. in  $\text{NH}_4\text{OH}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Mente.)

**Manganous —,  $\text{MnNP}_2\text{O}_7 + \text{H}_2\text{O}.$**

Insol. in dil. acids. Very sl sol. in  $\text{NaOH} + \text{Aq}$ . Insol. in  $\text{Na}_2\text{CO}_3$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Mente.)

**Mercurous —,  $\text{Hg}_2\text{NP}_2\text{O}_7.$**

Insol. in dil. acids,  $\text{NH}_4\text{OH}$ ,  $\text{NaOH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Easily sol. in fuming  $\text{HNO}_3$ . (Mente.)

**Nickel —,  $\text{NiNP}_2\text{O}_7 + \text{H}_2\text{O}.$**

Insol. in dil. acids,  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Mente.)

**Zinc —,  $\text{ZnNP}_2\text{O}_7 + 2\text{H}_2\text{O}.$**

Easily sol. in  $\text{NH}_4\text{OH}$ ,  $\text{NaOH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Mente.)

**Nitrilosulphonic acid,  $\text{N}(\text{SO}_2\text{H})_3.$**

Not known in free state. (Raschig, A. 241, 161.)

**Potassium nitrilosulphonate,  $\text{N}(\text{SO}_2\text{K})_3 + 2\text{H}_2\text{O}.$**

Soluble in  $\text{H}_2\text{O}$ . (Raschig, A. 241, 161.) Is identical with "potassium ammontrisulphonate" of Claus.

Insol. in cold  $H_2O$  (Claus); sol. in 50 pts  $H_2O$  at  $23^\circ$  (Fremy); in  $H_2O$  at scarcely  $40^\circ$  without change. Decomp. by boiling (Claus.)

Potassium sodium nitrosulphonate,  
 $N(SO_3K)_2(SO_3Na)$ .

Nearly insol. in cold  $H_2O$ . (Raschig, A. 241. 161.)

Sodium nitrosulphonate,  $N(SO_3Na)_2$ .

Not isolated on account of its extreme solubility in  $H_2O$ . (Raschig, A. 241. 161.)

Nitrosulphophosphoric acid,  
 $NP(SH)_2$ .

Decomp. by  $H_2O$ . (Stock, B. 1906, 39. 2001.)

Ammonium nitrosulphophosphate,  
 $NP(SNH_2)_2$ .

Easily sol. in  $H_2O$ . Not decomp. by boiling with alkali. Decomp. by acid. (Stock.)

Easily sol. in liquid  $NH_3$ . (Stock, B. 1903, 36. 315.)

Ammonium hydrogen nitrosulphophosphate,  $SHP(SNH_2)_2N$ .

Not decomp. by boiling with alkali. Decomp. by acids. (Stock, B. 1906, 39. 1999.)

Barium nitrosulphophosphate,  $BaNP(SH)_2 + H_2O$ .

Sol. in  $H_2O$  with decomp. Decomp. by hot  $H_2O$ . Not decomp. by warming with alkali. Decomp. by acid. (Stock.)

Lead nitrosulphophosphate,  $NPS_2Pb$ .

Sol. in liquid  $NH_3$ . Solution decomp. rapidly with separation of  $PbS$ . (Stock.)

Sodium nitrosulphophosphate,  $NPSNa_2$ .

Not decomp. by boiling with alkali. Decomp. by acid. (Stock.)

Nitrosulphuric acid.

Ammonium nitrosulphate,  $N(SO_3NH_2)_2 + 2H_2O$ .

Rather sl. sol. in  $H_2O$ , but much more sol. than K salt. (Divers and Haga, Chem. Soc. 1901, 79. 1094.)

Sodium nitrosulphate,  $N(SO_3Na)_2 + 5H_2O$ .

Very sol. in  $H_2O$ . (Divers and Haga, Chem. Soc. 1901, 79. 1097.)

Nitrosulphurous acid.

Ammonium nitrosulphite,  $NH(SO_2NH_2)_2$ .

Somewhat deliquescent. Very sol. in  $H_2O$ . Slowly decomp. in solution. Decomp. by boiling with  $HCl$ . (Divers, Proc. Chem. Soc. 1901, 17. 163.)

Nitrocobaltic chloride.

Sol. in 200 pts cold  $H_2O$ . (Jørgensen, Z. anorg. 6. 172.)

Nitroplatin diamine nitrate,

$(NO_2)_2Pt(N_2H_4NO_2)_2$ .

Sol. in cold  $H_2O$  with decomp.; violently decomp. on warming. (Hadow, Chem. Soc. (2) 4. 345.)

Nitropurpureocobaltic comps.

See Xanthocobaltic comps.

Nitropurpureorhodium comps.

See Xanthorhodium comps.

Nitrocarbamic acid.

Potassium nitrocarbamate,  $NO_2.NK$ . COOK.

Decomp. by  $H_2O$ . (Thiele, B. 1894, 27. 1909.)

Nitro cobalt,  $Co_2NO_2$ .

Decomp. by  $H_2O$ . (Sabatier and Senderens, C. R. 115. 236.)

Nitro copper,  $CuNO_2$ .

Violently decomp. by  $H_2O$ . (Sabatier and Senderens, C. R. 116. 756.)

Nitroferri cyanhydric acid.

See Nitroprussic acid.

Nitrogen,  $N_2$ .

Nearly insol. in all known solvents.

1 vol. recently boiled  $H_2O$  absorbs 0.0147 vol  $N$  at  $15^\circ$  (Henry, 1803.)

1 vol. recently boiled  $H_2O$  absorbs 0.025 vol  $N$ . (Dalton.)

1 vol. recently boiled  $H_2O$  absorbs 0.0156 vol  $N$  at ord temp. (Dalton.)

1 vol.  $H_2O$  at  $t^\circ$  and 760 mm. absorbs  $V$  vols.  $N$  gas reduced to  $0^\circ$  and 760 mm.

$t^\circ$	$V$	$t^\circ$	$V$	$t^\circ$	$V$
0	0.02035	7	0.01713	14	0.01500
1	0.01981	8	0.01675	15	0.01478
2	0.01932	9	0.01640	16	0.01458
3	0.01884	10	0.01607	17	0.01441
4	0.01838	11	0.01577	18	0.01426
5	0.01794	12	0.01549	19	0.01413
6	0.01752	13	0.01523	20	0.01403

(Bunsen.)

Coefficient of absorption =  $0.020346 - 0.00053887t + 0.000011156t^2$ . (Bunsen.)

1 l.  $\text{H}_2\text{O}$  absorbs cem N from atmospheric air at 760 mm pressure and  $t^\circ$ .

$t^\circ$	cem N	$t^\circ$	cem N
0	19.29	15	13.95
5	17.09	20	12.80
10	15.36	25	11.81

(Dittmar, Challenger Exped. Report, vol. i)

$t^\circ$	cem N	$t^\circ$	cem N
0	19.14	15	13.73
5	16.93	20	12.63
10	15.14	25	11.80

(Hainberg, 1885.)

Absorption of N by  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm.  
 $\beta$  = coefficient of absorption

$t^\circ$	$\beta$	$t^\circ$	$\beta$	$t^\circ$	$\beta$
0	0.02388	18	0.01696	36	0.01252
1	2337	19	1697	37	1233
2	2288	20	1639	38	1215
3	2241	21	1611	39	1198
4	2196	22	1584	40	1182
5	2153	23	1557	41	1166
6	2111	24	1530	42	1151
7	2070	25	1504	43	1137
8	2031	26	1478	44	1124
9	1993	27	1453	45	1111
10	1956	28	1428	46	1099
11	1920	29	1404	47	1088
12	1885	30	1380	48	1078
13	1851	31	1357	49	1069
14	1818	32	1334	50	1061
15	1786	33	1312	60	1000
16	1755	34	1291	100	1000
17	1725	35	1271		

(Bohr and Bock, W. Ann. 44, 318.)

Absorption of N by  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm.  
 $\beta$  = coefficient of absorption;  $\beta_1$  = "Solubility" (see under Oxygen)

$t^\circ$	$\beta$	$\beta_1$
0	0.02348	0.02334
1	2291	2276
2	2236	2220
3	2182	2166
4	2130	2113
5	2081	2063
6	2032	2013
7	1986	1966
8	1941	1920
9	1898	1877
10	1857	1834
11	1819	1795
12	1782	1758
13	1747	1723
14	1714	1687

Absorption of N by  $\text{H}_2\text{O}$  at  $t^\circ$ .—Continued.

$t^\circ$	$\beta$	$\beta_1$
15	0.1682	0.1654
16	1651	1622
17	1622	1591
18	1594	1562
19	1567	1534
20	1542	1507
21	1519	1482
22	1496	1457
23	1473	1433
24	1452	1410
25	1432	1387
26	1411	1365
27	1392	1344
28	1374	1323
29	1356	1303
30	1340	1284
31	1321	1268
32	1304	1243
33	1287	1224
34	1270	1204
35	1254	1185
36	1239	1167
37	1224	1149
38	1210	1131
39	1196	1114
40	1183	1097
41	1171	1082
42	1160	1067
43	1149	1052
44	1139	1037
45	1129	1023
46	1120	1009
47	1111	995
48	1102	982
49	1094	968
50	1087	955
52	1072	9429
54	1058	9402
56	1045	9376
58	1033	9349
60	1022	9322
62	1011	9294
64	1001	9265
66	992	9236
68	983	9207
70	976	9178
72	970	9145
74	965	9114
76	961	9081
78	959	9046
80	957	9010
82	956	8972
84	955	8932
86	954	8888
88	953	8843
90	952	8794
92	951	8742
94	950	8687
96	949	8628
98	948	8566
100	947	8500

(Winkler, B. 24, 3606.)

Coefficient of absorption for  $\text{H}_2\text{O} = 0.01432$  at  $25^\circ$ ; 0.01621 at  $20^\circ$ ; 0.01789 at  $15^\circ$ ; 0.02003 at  $10^\circ$ ; 0.02173 at  $5^\circ$ . (Braun, Z phys. Ch. 1900, 33, 730.)

Solubility in  $\text{H}_2\text{O}$  at various pressures.

V = volume of the absorbing liquid.

P = Hg-pressure in metres.

$\lambda$  = coefficient of solubility.

V	$t^\circ$	P	$\lambda$
33.134 ccm.	19.4	0.8910	0.01617
		1.0453	0.01616
		1.2488	0.01611
		1.4764	0.01608
		1.8111	0.01603
		2.3901	0.01597
		2.9074	0.01585
		3.3411	0.01579
		4.1382	0.01561
		4.5958	0.01554
		5.1103	0.01546
		5.8349	0.01528
		6.2767	0.01515
		7.1059	0.01499
32.152 ccm.	24.9	7.5815	0.01487
		8.1074	0.01473
		0.8977	0.01498
		1.0129	0.01493
		1.1887	0.01491
		1.5573	0.01487
		1.9846	0.01482
		2.5171	0.01478
		2.8781	0.01463
		3.2956	0.01455
		4.0947	0.01440
		4.5581	0.01434
		5.0529	0.01426
		5.5935	0.01413
		6.1956	0.01408
		7.0333	0.01382
		7.5596	0.01377
		74.1846	0.01369

(Cassuto, Phys. Zeit. 1904, 5, 236)

Coefficient of absorption for  $\text{H}_2\text{O} = 0.01565$  at  $20.18^\circ$ . (Hufner, Z. phys. Ch. 1907, 57, 615.)

Absorption of  $\text{N}_2$  by distilled  $\text{H}_2\text{O}$  at  $t^\circ$ .  
a = ccm. of  $\text{N}_2$  absorbed by 1 l. of  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm.

$t^\circ$	a	$t^\circ$	a	$t^\circ$	a
0	23.00	17	16.29	34	12.93
1	22.50	18	16.03	35	12.79
2	22.02	19	15.78	36	12.65
3	21.55	20	15.54	37	12.52
4	21.09	21	15.29	38	12.39
5	20.64	22	15.06	39	12.27
6	20.20	23	14.84	40	12.15
7	19.77	24	14.63	41	12.04
8	19.35	25	14.43	42	11.92
9	18.94	26	14.23	43	11.80
10	18.54	27	14.04	44	11.68
11	18.16	28	13.87	45	11.57
12	17.80	29	13.71	46	11.46
13	17.46	30	13.55	47	11.35
14	17.14	31	13.39	48	11.24
15	16.84	32	13.23	49	11.13
16	16.56	33	13.08	50	11.02

(Fox, Trans. Faraday Soc. 1909, 5, 73.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 0.1561$  (Drucker and Moles, Z. phys. Ch. 1910, 75, 418.)

Solubility of  $\text{N}_2$  in  $\text{H}_2\text{O}$  at  $25^\circ = 0.0231$ . (Calculated according to special formula, for which see original article.) (Findlay and Craghton, Chem. Soc. 1911, 99, 1315.)

Coefficient of absorption for  $\text{H}_2\text{O} = 0.01689$  at  $15^\circ$ ; 0.01670 at  $16.2^\circ$ ; 0.01622 at  $17.2^\circ$ . (Muller, Z. phys. Ch. 1912, 81, 493.)

1 l. sea water (sp. gr. 1.027) absorbs ccm. N from atmosphere at  $t^\circ$  and 760 mm pressure—

$t^\circ$	According to Törnøe	According to Distmar	According to Hamberg
0	14.40	15.60	14.85
5	13.25	13.86	13.32
10	12.10	12.47	12.06
15	10.95	11.34	11.04
20		10.41	10.25
25		9.62	9.62

No. of ccm. of  $\text{N}_2$  (containing 1.185% argon) absorbed by a l. of sea-water from a free dry atmosphere of 760 mm. pressure at given temperatures

Ci per 1000	$0^\circ$	$4^\circ$	$8^\circ$	$12^\circ$	$16^\circ$	$20^\circ$	$24^\circ$	$28^\circ$
0	18.64	17.02	15.63	14.45	13.46	12.60	11.86	11.25
4								
8								
12								
16								
20								

(Fox, Trans. Faraday Soc. 1909, 5, 77.)

Absorption of  $N_2$  by  $H_2SO_4 + Aq$  at  $t^\circ$ . $\alpha$  = coefficient of absorption.

Normality of the acid	$t^\circ$	$\alpha$
0	20.9	0.0156
4.9	20.9	0.0091
8.9	20.9	0.0072
10.7	21.2	0.0066
20.3	21.1	0.0049
24.8	21.5	0.0048
29.6	20.8	0.0051
34.3	20.9	0.0100
35.8	21.1	0.0130

(Bohr, Z. phys. Ch. 1910, 71, 49.)

Absorption of  $N_2$  by  $BaCl_2 + Aq$ . $\alpha t^\circ$  = coefficient of absorption at  $t^\circ$ .

Per cent of $BaCl_2$ in the solution	$\alpha 25^\circ$	$\alpha 20^\circ$	$\alpha 15^\circ$	$\alpha 10^\circ$	$\alpha 5^\circ$
13.840	0.0047	0.0050	0.0052	0.0054	0.0056
11.927	"	"	"	"	"
6.903	"	"	"	"	"
6.738	"	"	"	"	"
4.870	"	"	"	"	"
3.325	"	"	"	"	"

(Braun, Z. phys. Ch. 1900, 33, 733.)

Absorption of  $N_2$  by  $NaCl + Aq$ . $\alpha t^\circ$  = coefficient of absorption at  $t^\circ$ .

Per cent of $NaCl$ in the solution	$\alpha 25^\circ$	$\alpha 20^\circ$	$\alpha 15^\circ$	$\alpha 10^\circ$	$\alpha 5^\circ$
11.732	0.0047	0.0050	0.0052	0.0054	0.0056
10.045	"	"	"	"	"
8.135	"	"	"	"	"
5.034	"	"	"	"	"
3.305	"	"	"	"	"
6.400	"	"	"	"	"
4.196	"	"	"	"	"
3.880	"	"	"	"	"
2.120	"	"	"	"	"
2.100	"	"	"	"	"
0.680	"	"	"	"	"
0.671	"	"	"	"	"

(Braun, l. c.)

At  $-101.5^\circ$  liquid oxygen dissolves 458 times its vol. or 50.7 per cent of its weight of gaseous nitrogen. (Erdmann, B. 1904, 37, 1191.)

At  $18^\circ$  and 760 mm 100 vols  $H_2O$  or alcohol of 0.84 sp. gr. absorb 4.2 vols  $N$  gas. (de Saussure, 1814.)

1 vol. alcohol at  $t^\circ$  and 760 mm. dissolves  $V$  vols  $N$  gas reduced to  $0^\circ$  and 760 mm.

$t^\circ$	$V$	$t^\circ$	$V$
0	0.12634	13	0.12192
1	0.12593	14	0.12166
2	0.12563	15	0.12142
3	0.12514	16	0.12119
4	0.12476	17	0.12097
5	0.12440	18	0.12076
6	0.12405	19	0.12056
7	0.12371	20	0.12030
8	0.12338	21	0.12021
9	0.12306	22	0.12005
10	0.12276	23	0.11990
11	0.12247	24	0.11976
12	0.12219	..	..

(Bunsen's Gasometry.)

1 vol. alcohol absorbs 0.126338-0.000418 $t$ +0.0000060 $t^2$  vols.  $N$  gas. (Carius, A. 84, 136.)Solubility in alcohol at  $25^\circ$ .

Vol $H_2O$	Vol % alcohol	Solubility
100	0	0.01634
80	20	0.01536
67	33	0.01719
0	100	0.1432

(Just, Z. phys. Ch. 1901, 37, 361.)

1 vol ether absorbs 0.15 vol  $N$  (Dobereiner), 1 vol. naphthalene absorbs 5 vols  $N$  in 5 weeks (Himly).Solubility of  $N_2$  in ether = 0.2580 at  $0^\circ$ ; 0.2561 at  $10^\circ$ . (Christoff, Z. phys. Ch. 1912, 79, 459.)

Solubility in organic solvents

Solvent	Solubility at $25^\circ C$	Solubility at $20^\circ C$	$\frac{ds}{dt}$
Glycerine	Not measurable		
Water	0.01031	0.01708	-0.000142
Aniline	0.03074	0.02092	+0.000104
Carbon bisulphide	0.05860	0.03200	+0.00114
Nitrobenzene	0.02353	0.00092	+0.00340
Benzene	0.1159	0.114	-0.0000
Glacial acetic acid	0.1190	0.1172	+0.00030
Xylene	0.1217	0.1185	+0.00062
Amyl alcohol	0.1225	0.1208	+0.00034
Toluene	0.1235	0.1186	+0.00098
Chloroform	0.1348	0.1282	+0.00132
Methyl alcohol	0.1415	0.1348	+0.00134
Ethyl alcohol (99.8%)	0.1432	0.1400	+0.00044
Acetone	0.1460	0.1383	+0.00164
Amyl acetate	0.1542	0.1512	+0.0006
Ethyl acetate	0.1727	0.1678	+0.00098
Isobutyl acetate	0.1734	0.1701	+0.00060

(Just, Z. phys. Ch. 1901, 37, 361.)

Coefficient of absorption for petroleum = 0.117 at  $20^\circ$ ; 0.135, at  $10^\circ$ . (Gniewasz and Walfisz, Z. phys. Ch. 1, 70.)

Absorption of  $N_2$  by propionic acid + Aq.  
 $\alpha t^\circ$  = coefficient of absorption at  $t^\circ$ .

Percent of propionic acid in the solution	$\alpha 25^\circ$	$\alpha 20^\circ$	$\alpha 15^\circ$	$\alpha 10^\circ$	$\alpha 5^\circ$
11 220	0 01301	0 01403	0 01503	0 01779	0 01851
11 023	0 01205	0 01347	0 01353	0 01300	0 01377
9 537	0 01242	0 01271	0 01244	0 01290	0 01294
9 155					
6 006					
5 591	0 01338	0 01480	0 01648	0 01872	0 02080
4 091	0 01365	0 01541	0 01688	0 01919	0 02065
3 810	0 01371	0 01547	0 01674	0 01915	0 02087

(Braun, Z. phys. Ch. 1900, 33. 732.)

Solubility of  $N_2$  in isobutyric acid + Aq at  $t^\circ$ .

P = Corrected pressure at end of experiment in mm. Hg at  $0^\circ$ .  
 S = Solubility of  $N_2$ .

Solvent	$t^\circ$	P	S
Pure isobutyric acid	25 05	262 6	0 1609(?)
		388 3	0 1640
		566 1	0 1647
		662 4	0 1656
		783 5	0 1656
37 5% solution of isobutyric acid + Aq	23 02	246.2	0 0393
		492.2	0 0393
		563.6	0 0393
Vapor pressure = 21.6 mm.		836.3	0 0400
		867.3	0 0401
" "	29 02	231	0 0373
		468.4	0 0384
		480.7	0 0383
		536	0 0385
		656	0 0384
		720	0 0386

(Drucker and Moles, Z. phys. Ch. 1910, 75. 434.)

Absorption of  $N_2$  by chloralhydrate + Aq.

$t^\circ$  = temp. of the solution.  
 P = % chloralhydrate in the solution.  
 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$ .  
 $\beta 15^\circ$  = coefficient of absorption at  $15^\circ$ .

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
15 6	15 8	0.01574	0.01580
15 4	23.2	0 01418	0.01422
16.4	37.25	0 01288	0.01300
16.9	47.0	0 01260	0.01275
17.0	56.52	0 01230	0 01245
16.3	71 5	0 01415	0 01420
14 8	78 8	0 01447	0 01495

(Müller, Z. phys. Ch. 1912, 81. 499.)

Absorption of  $N_2$  by organic substances + Aq at  $15^\circ$ .

P = % of the organic substance in the solvent

$\beta 15^\circ$  = coefficient of absorption at  $15^\circ$

$S 15^\circ$  = Solubility at  $15^\circ$ .

Organic substance used	P	$\beta 15^\circ$	$S 15^\circ$
Chloralhydrate	0	0 01725	
	0	0 01675	0 01796
	0	0 01706	
	6 9	0 0164	0.0173
	14 0	0 0154	0.0162
	15 0	0 0152	0.0160
	23 6	0 0134	0.0141
	26 1	0 0141	0 0149
	37 6	0 0123	0.0130
	48 9	0 0115	0.0121
	49 3	0 0118	0.0124
	61 3	0 0114	0.0120
	70 9	0 0131	0 0138
Glycerine	0	0 01707	
	0	0 01708	
	15 7	0 01425	
	15 7	0 01376	
	29 9	0 01087	
	46 6	0.00840	
	57 6	0 00698	
	67 1	0.00635	
	72 8	0 00552	
	74 7	0 00597	
	77 0	0 00527	
	85 1	0.00482	
	87 3	0 00492	
	88.5	0 00536	
	99.25	0 00524	

(Hammel, Z. phys. Ch. 1915, 90. 121.)

Absorption of  $N_2$  by glycerine + Aq.

$t^\circ$  = temp. of the solution.  
 P = % glycerine in the solution.  
 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$ .  
 $\beta 15^\circ$  = coefficient of absorption at  $15^\circ$ .

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
16 1	25.0	0.01240	0 01266
15 6	42.2	0.00966	0 00976
14.7	51.5	0.00759	0.00759
14 9	58.0	0.00703	0.00703
15 9	80.25	0.00520	0.00530
16.2	90 0	0.00570	0.00583
18 0	95 0	0.00578	0.00716

(Müller, Z. phys. Ch. 1912, 81. 496.)

Solubility of  $N_2$  in glycerine + Aq at  $25^\circ$ .  
 $G = \%$  by wt. of glycerine in the solvent.  
 $S =$  solubility of  $N_2$ .  
 $P =$  corrected pressure at end of experiment  
 in mm Hg at  $0^\circ$ .

G	P	S
16	598.4	0.0103
"	915.5	0.0103
29.7	556.5	0.0067
"	846.5	0.0068
48.9	617.7	0.0052
"	859.8	0.0051
74.5	588.5	0.0025
84.1	637.3	0.0024
"	757.0	0.0024

(Druker and Moles, Z. phys. Ch. 1910, 75, 418.)

Absorption of  $N_2$  by sucrose + Aq.

$t^\circ =$  temp. of the solution.

$P = \%$  sucrose in the solution

$\beta t^\circ =$  coefficient of absorption at  $t^\circ$ .

$\beta 15^\circ =$  coefficient of absorption at  $15^\circ$ .

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
16.2		0.01670	0.01700
17.2		0.01622	0.01688
16.8	11.38	0.01432	0.01480
16.9	20.00	0.01233	0.01280
17	29.93	0.01025	0.01053
17.8	30.12	0.01033	0.01090
18	47.89	0.00742	0.00785
17.7	48.57	0.00658	0.00700

(Muller, Z. phys. Ch. 1912, 81, 493.)

Absorption of  $N_2$  by organic substances + Aq  
 at  $t^\circ$

$V =$  absorbed volume reduced to  $0^\circ$  and  
 760 mm.

$\alpha =$  coefficient of absorption.

Solution	Vol of solution ccm	$t^\circ$	$V_{ccm}$	$\alpha$
N-dextrose	400.94	20.18	4.55	0.01215
$\frac{1}{2}$ N-dextrose	409.94	20.21	5.14	0.01380
$\frac{1}{2}$ N-dextrose	409.94	20.2	5.51	0.01480
N-levulose	409.94	20.25	4.27	0.01221
N-arabinose	409.94	20.21	4.40	0.01203
N-erythritol	409.94	20.25	4.87	0.01321
N-alanine	409.94	20.19	4.445	0.01213
N-glycocol	409.94	20.16	4.47	0.01212
N-urea	409.94	20.18	5.37	0.01477
N-acetamide	400.94	20.22	5.385	0.01475

(Hufner, Z. phys. Ch. 1907, 57, 618-621.)

Nitrogen bromide,  $NBr_3$ .

Decomp. under  $H_2O$ .

Nitrogen bromophosphide,  $PBr_2N$ .

Insol in  $H_2O$ . Sol. in ether, less sol. in  $CS_2$  or  $CHCl_3$  (Besson, C. R. 114, 1479.)

Nitrogen bromosulphide.

See Nitrogen sulphobromide.

Nitrogen chloride,  $NCl_3$ .

Very unstable. Explodes when heated to  $93^\circ$  or by contact with other substances. Insol. in  $H_2O$ , but is decomp. thereby (in 24 hours by cold  $H_2O$ ). Sol. in  $CS_2$ ,  $PCl_3$ , and  $S_2Cl_2$ . (H. Davy, Phil Trans 1813, 1, 242.) Sol. in  $C_6H_6$ ,  $CS_2$ ,  $CHCl_3$ ,  $CCl_4$ . (Hentschel B. 1897, 30, 1434.)

Nitrogen chlorophosphide,  $N_2P_2Cl_4$ .

Insol. in  $H_2O$ , but slowly decomp. thereby. Insol. in hot  $H_2SO_4$ ,  $HCl$ , or  $HNO_3$  + Aq. Decomp. by hot fuming  $HNO_3$ . Sol. in alcohol, very sol. in ether, but these solutions gradually decompose. Sol. in  $CS_2$ ,  $CHCl_3$ ,  $C_6H_6$ , and oil of turpentine.

Sol. in  $POCl_3$ . (Gladstone, Chem. Soc. 3, 138.)

Nitrogen chlorosulphide.

See Nitrogen sulphochloride.

Nitrogen fluoride.

Very explosive (Warren, C. N. 55, 289.)

Nitrogen moniodamine,  $NH_2I$ .

Very rapidly decomp. by  $H_2O$  into  $N_2H_4I_2$ . (Raschig, A. 230, 212.)

Nitrogen diiodamine,  $NH_2I_2$ .

Properties as triiodamine

Nitrogen triiodamine,  $NH_3I_3$ .

Decomp. by  $H_2O$ . (Raschig, A. 230, 212.) Insol. in absolute alcohol. Sol. with decomp. in  $HCl$  + Aq. (Bunsen.)

Nitrogen iodide,  $N_2I_2$ .

See Triazoidide.

Nitrogen iodide,  $NI_3$ .

Insol. in  $H_2O$ , but slowly decomp. thereby. Sol. in  $HCl$  + Aq. Sol. in  $KCN$  + Aq. (Millon, J. pr. 17, 1.)

Sol. in  $Na_2S_2O_3$  + Aq. (Guyard, C. R. 97, 526.)

Sol. in  $KSCN$  + Aq. (Raschig, A. 230, 212.)

Nitrogen iodide ammonia,  $NI_3 \cdot 3NH_3$ ;  $NI_3 \cdot 2NH_3$ ; and  $NI_3 \cdot NH_3$ .

(Hugot, C. R. 1900, 130, 507.)

$NI_3 \cdot 12NH_3$ . Ppt.; insol. in ether. (Ruff, B. 1900, 33, 3028.)

Nitrogen monoxide,  $N_2O$ .

- (a) *Liquid*. Miscible with alcohol or ether.  
 (b) *Gas*.

1 vol  $H_2O$  absorbs 0.78–0.86 vol  $N_2O$  at ordinary temp (Henry), 0.80 vol. at ordinary temp (Dalton), 0.70 vol at ordinary temp (de Saussure), 0.708 vol at  $18^\circ$  (Plesch), 0.81 vol (Davy).

1 vol.  $H_2O$  at  $t^\circ$  and 760 mm. absorbs V vols.  $N_2O$ , reduced to  $0^\circ$  and 760 mm

$t^\circ$	V	$t^\circ$	V
0	1.3052	13	0.8304
1	1.2605	14	0.8034
2	1.2172	15	0.7778
3	1.1752	16	0.7535
4	1.1346	17	0.7306
5	1.0954	18	0.7090
6	1.0575	19	0.6888
7	1.0210	20	0.6700
8	0.9858	21	0.6525
9	0.9520	22	0.6364
10	0.9196	23	0.6216
11	0.8885	24	0.6082
12	0.8588		

(Bunsen's Gasometry.)

1 vol.  $H_2O$  absorbs 1.30521–0.0453620t+0.00068430t<sup>2</sup> vols  $N_2O$  at  $t^\circ$  and 760 mm. (Bunsen.)

Coefficient of absorption by  $H_2O$  = 0.01883 at  $15^\circ$ . (Steiner, Z. phys. Ch 1895, 18. 14.)

Coefficient of absorption by  $H_2O$  = 0.600 at  $23.5^\circ$ , 0.773 at  $15.5^\circ$ , 0.951 at  $8.1^\circ$  (Gordon, Z. phys. Ch 1895, 18. 4.)

Absorption of  $N_2O$  by  $H_2O$  at  $t^\circ$ 

$t^\circ$	Coefficient of absorption
25	0.5752
20	0.6654
15	0.7896
10	0.9479
5	1.1403

(Roth, Z. phys. Ch. 1897, 24. 123.)

Solubility in  $H_2O$  at  $25^\circ$  = 0.5942, at  $20^\circ$  = 0.6756; at  $15^\circ$  = 0.7784, at  $10^\circ$  = 0.9101; at  $5^\circ$  = 1.067. (For formula for "solubility," see under oxygen.) (Geffcken, Z. phys. Ch. 1904, 49. 278.)

Solubility of  $N_2O$  in  $H_2O$  = 0.592 at  $25^\circ$  and 758–1363 mm. pressure. (Findlay and Creighton, Chem. Soc 1910, 97. 538.)

100 vols  $H_2SO_4$  (sp. gr. = 1.84) absorb 75.7 vols.  $N_2O$ ; 100 vols.  $H_2SO_4$  + Aq (sp. gr. = 1.80) absorb 66.0 vols  $N_2O$ ; 100 vols  $H_2SO_4$  + Aq (sp. gr. = 1.705) absorb 39.1 vols.  $N_2O$ ; 100 vols.  $H_2SO_4$  + Aq (sp. gr. = 1.45) absorb 41.6 vols.  $N_2O$ ; 100 vols.  $H_2SO_4$  + Aq (sp. gr. = 1.25) absorb 33.0 vols.  $N_2O$ .

$CaCl_2$  + Aq, and  $NaCl$  + Aq absorb considerable amounts of  $N_2O$ . (Lunge, B 14. 2188.)

## Absorption by acids + Aq

M = content in gram-equivalents per liter  
 S = solubility (see under Oxygen).

Absorption of  $N_2O$  by  $HNO_3$  + Aq.

M	S $25^\circ$	S $15^\circ$
0.610	0.5969	0.7770
0.614	0.5980	0.7766
1.253	0.6045	0.7767
1.254	0.6061	0.7767
2.405	0.6156	0.7735
2.435	0.6149	0.7737

(Geffcken, Z. phys. Ch 1904, 49. 278.)

Absorption of  $N_2O$  by  $HCl$  + Aq.

M	S $25^\circ$	S $15^\circ$
0.549	0.5775	0.7550
0.550	0.5759	0.7528
1.089	0.5670	0.7360
1.093	0.5657	0.7347
2.300	0.5546	0.7103
2.340	0.5504	0.7122

(Geffcken.)

Absorption of  $N_2O$  by  $\frac{H_2SO_4}{2}$  + Aq

M	S $25^\circ$	S $15^\circ$
0.523	0.5648	0.7328
0.526	0.5657	0.7340
1.050	0.5426	0.6997
1.054	0.5419	0.6984
2.042	0.5083	0.6440
2.047	0.5087	0.6428
2.971	0.4819	0.6024
2.963	0.4820	0.6030
3.897	0.4569	0.5648
3.973	0.4577	0.5640

(Geffcken.)

Absorption of  $N_2O$  by  $H_3PO_4$  + Aq at  $t^\circ$ 

$t^\circ$	% of $H_3PO_4$				
	3.38%	4.72%	8.84%	9.89%	13.35%
5	1.057	1.0365	0.9883	0.9635	0.9171
10	0.8827	0.8665	0.8296	0.8101	0.7711
15	0.7388	0.7258	0.6977	0.6826	0.6505
20	0.6253	0.6147	0.5926	0.5810	0.5555
25	0.5427	0.5329	0.5143	0.5054	0.4860

(Roth, Z. phys. Ch. 1897, 24. 134.)

100 vols. conc.  $FeSO_4$  + Aq absorb 19.5 vols.  $N_2O$ .

Solubility of  $N_2O$  in a solution containing 47.7 g.  $Fe(OH)_3$  per litre at  $25^\circ$  = 0.5799; 47.9 g.  $Fe(OH)_3$  per litre at  $25^\circ$  = 0.5787. (Geffcken, Z. phys. Ch. 1904, 49. 299.)

100 vols. KOH+Aq (sp. gr. =1.12) absorb 18.7 vols.  $N_2O$ ; 100 vols. KOH+Aq sat. with pyrogallol absorb 18.1 vols.  $N_2O$ ; 100 vols. NaOH+Aq (sp. gr. =1.1) (7% NaOH) absorb 23.1 vols.  $N_2O$ ; 100 vols. NaOH+Aq sat. with pyrogallol absorb 28.0 vols.  $N_2O$ .

Absorption of  $N_2O$  by KOH+Aq.

M = content in gram-equivalents per litre.

S = solubility (see under oxygen).

M	S 27°	S 15°
0 541	0 5087	0 6591
0 542	0.5093	0 6595
1 074	0.4252	0 5427
1 082	0.4221	0 5392

(Geffeken, Z. phys. Ch. 1904, 49. 278.)

Coefficient of solubility of  $N_2O$  in salts+Aq at t°.

Salt	Concentration of salt		Coeff of absorption at			
	G per 100 g solution	G mol per l	5°	10°	15°	20°
CaCl <sub>2</sub>	5 79 9 86 13 99	0 547 0 604 1 416	0 819 0 608 0 510	0 697 0 586 0 441	0 591 0 509 0 380	0 500 0 435 0 328
LiCl	1 35 3 85 11 48	0 319 0 928 2 883	0 086 0 878 0 606	0 831 0 743 0 512	0 700 0 629 0 437	0 599 0 536 0 382
Li <sub>2</sub> SO <sub>4</sub>	2 37 5 46 8 56	0 219 0 521 0 836	0 934 0 795 0 646	0 792 0 665 0 555	0 670 0 557 0 477	0 560 0 474 0 415
MgSO <sub>4</sub>	5 90 7 66 10 78	0 521 0 687 0 907	0 766 0 708 0 569	0 664 0 586 0 491	0 561 0 486 0 417	0 471 0 414 0 346
KCl	4 90 7 64 14 58 22 08	0 676 0 037 1 87 3 414	0 879 0 799 0 651 0 544	0 751 0 630 0 571 0 459	0 643 0 591 0 500 0 390	0 555 0 494 0 430 0 339
K <sub>2</sub> SO <sub>4</sub>	2 02 4 78	0 154 0 285	0 986 0 918	0 831 0 763	0 701 0 637	0 605 0 512
NaCl	6 20 8 88 12 78	1 107 0 614 2 391	0 800 0 713 0 634	0 682 0 603 0 532	0 585 0 510 0 449	0 509 0 434 0 386
Na <sub>2</sub> SO <sub>4</sub>	5 76 8 53 12 44	0 427 0 646 0 974	0 808 0 602 0 559	0 677 0 574 0 480	0 584 0 482 0 417	0 495 0 416 0 354
SrCl <sub>2</sub>	3 31 5 73 13 24	0 215 0 380 0 939	0 928 0 848 0 644	0 788 0 709 0 547	0 671 0 610 0 463	0 578 0 556 0 390

(Gordon, Z. phys. Ch. 1895, 18. 5.)

Absorption of  $N_2O$  by salts+Aq at 15°  
M = number of molecules of salt per litre.  
a = coefficient of absorption.

Salt	M	a
KCl	3 554 2 900 1 755 1 051 0 526	0 0892 0 1012 0 1279 0 1489 0 1667
KNO <sub>3</sub>	2 430 1 820 1 541 0 879 0 482	0 1180 0 1311 0 1391 0 1559 0 1683
K <sub>2</sub> CO <sub>3</sub>	4 352 2 939 2 156 1 376 0 690 0 341 0 209	0 0160 0 0285 0 0402 0 0761 0 1183 0 1501 0 1628
NHCl	4 815 2 801 2 049 0 825	0 0595 0 0925 0 1130 0 1548
NaNO <sub>2</sub>	5 711 3 980 2 656 1 413 0 679	0 0578 0 0810 0 1052 0 1370 0 1603
Na <sub>2</sub> CO <sub>3</sub>	1 218 0 819 0 438 0 207	0 0839 0 1082 0 1385 0 1639
Na <sub>2</sub> SO <sub>4</sub>	1 364 0 638 0 335	0 0775 0 1254 0 1519
LiCl	3 734 1 800 0 835	0 0990 0 1370 0 1619
MgSO <sub>4</sub>	2 501 1 631 0 936 0 433	0 0499 0 0797 0 1159 0 1501
ZnSO <sub>4</sub>	2 180 1 277 0 896 0 397	0 0605 0 0961 0 1175 0 1525
CaCl <sub>2</sub>	2 902 2 550 1 827 1 122 0 578 0 321	0 0619 0 0619 0 0839 0 1138 0 1450 0 1619

(Stener, Z. phys. Ch. 1895, 18 14-5.)

Coefficient of absorption of  $N_2O$  by  $NaCl + Aq$  at  $t^\circ$ .

$t^\circ$	Per cent of $NaCl$			
	0.900	1.808	3.688	5.805
5	1.0609	1.0032	0.9131	0.8428
10	0.8812	0.8383	0.7699	0.7090
15	0.7339	0.7026	0.6495	0.5976
20	0.6191	0.5962	0.5520	0.5088
25	0.5363	0.5190	0.4775	0.4424

(Roth, Z. phys. Ch. 1897, 24. 139.)

Absorption of  $N_2O$  by salts +  $Aq$  at  $20^\circ$ .

C = concentration of the solution in terms of normal.

 $\alpha$  = coefficient of absorption.Absorption of  $N_2O$  by  $KNO_3 + Aq$  at  $20^\circ$ .

P	C	$\alpha$
0		0.6270
1.063	0.1061	0.6173
2.720	0.2764	0.6002
5.389	0.5630	0.5713
10.577	1.1683	0.5196

Absorption of  $N_2O$  by  $NaNO_3 + Aq$  at  $20^\circ$ .

P	C	$\alpha$
0		0.6270
1.124	0.1336	0.6089
2.531	0.3052	0.5876
5.077	0.6286	0.5465
8.701	1.1200	0.4926

(Knopp, Z. phys. Ch. 1904, 48. 107.)

Absorption of  $N_2O$  by salts +  $Aq$ .M = content in gram-equivalents per litre.  
S = solubility.

Salt	M	S $25^\circ$	S $15^\circ$
$NH_4Cl$	0.598	0.5532	0.7203
	0.600	0.5504	0.7185
	1.158	0.5223	0.6800
	1.166	0.5200	0.6775
KI	0.550	0.5367	0.6950
	0.557	0.5344	0.6916
	0.886	0.5025	0.6466
	0.913	0.5012	0.6442
	0.514	0.5428	0.7074
	0.545	0.5406	0.7036
LiCl	0.558	0.5276	0.6884
	0.561	0.5278	0.6877
	1.057	0.4760	0.6163
	1.059	0.4773	0.6146

Absorption of  $N_2O$  by salts +  $Aq$ .—  
*Continued.*

Salt	M	S $25^\circ$	S $15^\circ$
KBr	0.546	0.5306	0.6877
	0.550	0.5318	0.6892
	0.937	0.4908	0.6352
	0.959	0.4899	0.6334
RbCl	0.439	0.5399	0.7050
	0.444	0.5386	0.7053
	0.977	0.4873	0.6306
	0.993	0.4846	0.6276
	0.558	0.5218	0.6782
	0.559	0.5217	0.6787
	1.070	0.4673	0.6046
	1.102	0.4639	0.6020

(Geffcken, Z. phys. Ch. 1904, 49. 278.)

Solubility of  $N_2O$  in a solution containing 39.6 g.  $As_2S_3$  per litre at  $25^\circ = 0.5819$ ; 42.4 g.  $As_2S_3$  per litre at  $25^\circ = 0.5833$ . (Geffcken.)1 vol. alcohol at  $t^\circ$  and 760 mm. absorbs V vols.  $N_2O$  gas reduced to  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V
0	4.1780	13	3.3734
1	4.1088	14	3.3200
2	4.0409	15	3.2678
3	3.9741	16	3.2169
4	3.9085	17	3.1672
5	3.8442	18	3.1187
6	3.7811	19	3.0714
7	3.7192	20	3.0253
8	3.6585	21	2.9805
9	3.5990	22	2.9368
10	3.5408	23	2.8944
11	3.4838	24	2.8532
12	3.4279		

(Bunsen's Gasometry.)

Coefficient of absorption =  $4.17805 - 0.0698160t + 0.0006090t^2$ . (Carnus.)At  $18^\circ$  and 760 mm., 100 vols.  $H_2O$  absorb 76 vols.  $N_2O$ , 100 vols. alcohol of 0.840 sp. gr. absorb 153 vols., 100 vols. rectified naphtha of 0.781 sp. gr. absorb 254 vols., 100 vols. oil of lavender of 0.880 sp. gr. absorb 275 vols., 100 vols. olive oil of 0.915 sp. gr. absorb 150 vols., 100 vols. sat.  $KCl$  4-Aq (297°  $KCl$ ) of 1.212 sp. gr. absorb 29 vols. (de Saussure, 1814.)  
1 vol. oil of turpentine absorbs 2.5-2.7 vols.  $N_2O$ . (de Saussure.)Absorption of  $N_2O$  by glycerine +  $Aq$  at  $t^\circ$ .

$t^\circ$	% by weight of glycerine			
	3.400%	0.726%	12.123%	16.244%
25	0.5558	0.5415	0.5268	0.5083
20	0.6468	0.6303	0.6050	0.5851
15	0.7672	0.7454	0.7098	0.6857
10	0.9172	0.8871	0.8411	0.8102
5	1.0967	1.0552	0.9990	0.9586

(Roth, Z. phys. Ch. 1897, 24. 128.)

Absorption of  $N_2O$  by urea + Aq at  $t^\circ$ 

$t^\circ$	$t^\circ$ by weight of urea				
	3.312%	1.071%	0.306%	7.290%	0.906%
25	0.5686	0.5069	0.5588	0.7502	0.5689
20	0.6533	0.6558	0.6530	0.6553	0.6508
15	0.7708	0.7732	0.7605	0.7722	0.7614
10	0.9209	0.9201	0.9086	0.9208	0.9007
5	1.1040	1.0964	1.0880	1.1012	1.0685

(Roth, Z. phys. Ch. 1897, 24, 124.)

Absorption of  $N_2O$  by sugar + Aq at  $15^\circ$ .

Number of molecules of $C_{12}H_{22}O_{11}$ per litre	Coefficient of absorption
1.099	0.0892
0.993	0.1284
0.520	0.1561

(Steiner, Z. phys. Ch. 1895, 18, 15.)

Absorption of  $N_2O$  by organic substances + Aq.

C = concentration of the solution in terms of normal

 $\alpha$  = coefficient of absorptionAbsorption of  $N_2O$  by chloral hydrate + Aq at  $20^\circ$ 

P	C	$\alpha$
0		0.6270
2.947	0.184	0.6182
6.848	0.445	0.6128
13.48	0.912	0.5960
16.15	1.165	0.5891
19.60	1.474	0.5793
24.02	1.911	0.5675

(Knopp, Z. phys. Ch. 1904, 48, 106.)

Absorption of  $N_2O$  by propionic acid + Aq at  $20^\circ$ 

P	C	$\alpha$
0		0.6270
1.492	0.2045	0.6323
5.702	0.816	0.6369
13.680	2.140	0.6504
15.011	2.385	0.6534
25.580	4.645	0.7219

(Knopp, Z. phys. Ch. 1904, 48, 107.)

Absorption of  $N_2O$  by oxalic acid + Aq at  $t^\circ$ .

$t^\circ$	Coeff of abs in $H_2C_2O_4$ + Aq of given % strength	
	3.122%	3.090%
25	0.5786	0.5643
20	0.6694	0.6538
15	0.7940	0.7745
10	0.9526	0.9264
5	1.1450	1.1094

(Roth, Z. phys. Ch. 1897, 24, 130.)

Coefficient of absorption for petroleum = 2.11 at  $20^\circ$ , 2.49 at  $10^\circ$ . (Gnielwasz and Walfisz, Z. phys. Ch. 1, 70.)The solubility of  $N_2O$  in various colloidal solutions has been determined by Findlay and Creighton (Chem. Soc. 1910, 97, 538), for which see original article.Nitrogen dioxide,  $NO$ .1 vol.  $H_2O$  absorbs 0.1 vol.  $NO$  gas at ordinary temp (Davis), 1 vol. absorbs 0.05 vol. (Henrici), 1 vol. absorbs 1/27 vol. (Dalton)Absorption of  $NO$  by  $H_2O$  at 760 mm. $\beta$  = Coefficient of absorption, pressure  
 $\beta'$  = "Solubility"

$t^\circ$	$\beta$	$\beta'$	$t^\circ$	$\beta$	$\beta'$
0	0.07381	0.07337	55	0.08040	0.02570
5	0.6461	0.6405	60	2954	2375
10	5709	5640	65	2877	2169
15	5147	5061	70	2810	1947
20	4706	4599	75	2751	1706
25	4323	4189	80	2700	1439
30	4004	3838	85	2665	1146
35	3734	3529	90	2648	0817
40	3507	3254	95	2638	0439
45	3311	3000	100	2628	0000
50	3152	2771			

(Winkler, B. 1901, 34, 1414.)

205.69 cc.  $H_2O$  absorb 9.6798 cc.  $NO$  at  $20^\circ$  and 760 mm. (Hufner, Z. phys. Ch. 1907, 59, 420.)Sol. in conc.  $HNO_3$  + Aq.  
100 vols.  $HNO_3$  + Aq. of 1.3 sp. gr. agitated with  $NO$  gas take up 20 vols.  $NO$ . If acid is twice as strong or one-half as strong, the quantity  $NO$  is proportional to the amount of  $HNO_3$ . Very dil.  $HNO_3$  + Aq. absorbs scarcely more  $NO$  than pure  $H_2O$ . (Dalton.)100 pts.  $HNO_3$  + Aq. of 1.4 sp. gr. absorb 60 pts.  $NO$  (Dalton), sol. in  $Br_2$  and very dil. sol. in conc.  $H_2SO_4$  (Berthelot.)1 cem. conc.  $H_2SO_4$  of 1.84 sp. gr. absorbs 0.035 cem.  $NO$ ; of 1.50 sp. gr., 0.017 cem.  $NO$  (Lunge, B. 18, 1391.)

Absorption of NO by  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $18^\circ$  and 760 mm.

$\alpha$  = Coefficient of solubility

$\text{H}_2\text{SO}_4$	$\alpha$	$\text{H}_2\text{SO}_4$	$\alpha$
98%	not constant	70%	0.0113
90%	0.0193	60%	0.0118
80%	0.0117	50%	0.0120

(Tower, Z. anorg. 1906, 50. 387.)

Very sol. in aqueous solutions of ferrous salts, especially the sulphate (Priestley.)

1 vol.  $\text{FeSO}_4 + \text{Aq}$  of 1.081 sp. gr., containing 1 grain  $\text{FeSO}_4$  to 6 grains  $\text{H}_2\text{O}$ , absorbs 6 vols. NO (Dalton.)

Absorption by ferrous salts + Aq is proportional to the amount of Fe present, irrespective of the acid or concentration of the solution. Between  $0^\circ$  and  $10^\circ$ , about 2 mols. NO are absorbed for each atom of Fe; between  $10^\circ$  and  $15^\circ$ , 1 mol. NO for 2 atoms of Fe; and at  $25^\circ$ , only 1 mol. NO for  $2\frac{1}{2}$  to 3 atoms of Fe. The amount of NO absorbed also varies with the pressure. The sp. gr. of the ferrous salt solution is greater after the absorption of NO than before. The solutions are decomp. by heat, and at  $100^\circ$  all NO is given off. (Gay, A. ch. (6) 5. 145)

Absorption of NO by  $\text{FeSO}_4 + \text{Aq}$  at  $25^\circ$ .

A = vol.  $\text{H}_2\text{O}$  (in litres) containing 1 mol.  $\text{FeSO}_4$ .

V = vol. NO (in litres) absorbed.

A	V	A	V
1.2	1.47	7.2	5.52
1.8	2.01	12.0	6.46
2.4	2.55	18.0	8.01
4.82	4.40	36.0	10.40

(Kohlschütter, B. 1907, 40. 877.)

Absorption of NO by  $\text{FeSO}_4 + \text{Aq}$  at  $t^\circ$ .

205.69 cc.  $\text{FeSO}_4 + \text{Aq}$  contain 0.0221 g. Fe  
Coefficient of absorption = 0.06067 at  $20.09^\circ$ .

$t^\circ$	Pressure mm	NO absorbed cc.
20.1	704.9	14.42
20.1	683.5	14.10
20.1	668.6	13.80
20.2	651.9	13.58
20.05	632.9	13.15
20.0	613.7	12.98

Absorption of NO by  $\text{FeSO}_4 + \text{Aq}$  at  $t^\circ$ .—  
Continued.

205.69 cc. of  $\text{FeSO}_4 + \text{Aq}$  contain 0.0296 g. Fe.

Coefficient of absorption = 0.06505.

$t^\circ$	Pressure mm	NO absorbed cc.
20.05	677.5	14.30
20.05	655.3	14.07
20.04	639.1	13.81
20.00	620.2	13.39
20.15	600.5	13.20
20.14	581.2	12.92

205.69 cc. of  $\text{FeSO}_4 + \text{Aq}$  contain 0.0409 g. Fe.

Coefficient of absorption = 0.06684

$t^\circ$	Pressure mm	NO absorbed cc.
20.04	667.6	16.79
20.02	650.6	16.65
20.00	613.1	15.71
20.00	594.6	15.41
20.10	577.1	15.32

205.69 cc. of  $\text{FeSO}_4 + \text{Aq}$  contain 0.0513 g. Fe.

Coefficient of absorption = 0.07981.

$t^\circ$	Pressure mm.	NO absorbed cc.
20.10	644.8	18.82
20.10	623.8	18.47
20.08	606.4	18.02
20.10	589.7	17.56
20.10	571.1	17.19
20.10	553.1	16.95

205.69 cc. of  $\text{FeSO}_4 + \text{Aq}$  contain 0.0663 g. Fe.

Coefficient of absorption = 0.08059.

$t^\circ$	Pressure mm	NO absorbed cc.
20.10	697.3	21.91
20.10	678.9	21.60
20.10	660.4	21.18
20.08	638.2	20.71
20.04	620.7	20.28
20.00	602.5	19.87

205.69 cc. of  $\text{FeSO}_4 + \text{Aq}$  contain 0.099 g. Fe.  
Coefficient of absorption = 0.11661.

$t^\circ$	Pressure mm	NO absorbed cc.
20.10	649.9	34.26
20.15	631.1	33.82
20.20	618.4	33.26
20.00	603.3	32.76
19.85	588.6	32.34
19.85	574.2	31.95

(Hüfner, Z. phys. Ch. 1907, 59. 419.)

Absorption of NO by  $\text{NiSO}_4 + \text{Aq}$  at  $t^\circ$ .  
205.09 cc.  $\text{NiSO}_4 + \text{Aq}$  contain 0.0506 g. Ni  
Coefficient of absorption = 0.08311.

$t^\circ$	Pressure mm	NO absorbed cc
20 2	651 7	23 00
20 2	620 8	22 54
20 2	609 5	22.03
20 15	591 7	21 65
20 14	573 4	21 18

(Hufner, *l. c.*)

Absorption of NO by  $\text{CoSO}_4 + \text{Aq}$  at  $t^\circ$ .  
205.69 cc.  $\text{CoSO}_4 + \text{Aq}$  contain 0.0598 g. Co.  
Coefficient of absorption = 0.09146.

$t^\circ$	Pressure mm	NO absorbed cc
20 15	678.3	23 47
20 16	653.5	23 01
20 20	636.6	23 55
20 30	615 9	21 90
20 40	600 0	21 56

(Hufner, *l. c.*)

Absorption of NO by  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O} + \text{Aq}$  at  $t^\circ$ .  
205 69 cc.  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O} + \text{Aq}$  contain 0.0697 g. Mn.  
Coefficient of absorption = 0.06111.

$t^\circ$	Pressure mm	NO absorbed cc
20 0	711.96	14 25
20 05	686.5	13 99
20 2	657 4	13 49
20 3	638 9	13 05
20 45	621 0	12 81

(Hufner, *l. c.*)

Coefficient of absorption for  $\text{FeSO}_4 + \text{Aq}$  of concentration used by Hufner (*Z. phys. Ch.* 1907, 59, 417) = 0.180 at  $20^\circ$ . Hufner's results are incorrect because he assumed that the absorption-coefficient of NO always had the same value, whereas it does not. NO is reduced by  $\text{FeSO}_4 + \text{Aq}$ . (Usher, *Z. phys. Ch.* 1908, 82, 624.)

Coefficient of absorption for  $\text{CoSO}_4 + \text{Aq}$  sat. at  $20^\circ$  = 0.0288. (Usher, *Z. phys. Ch.* 1908, 82, 624.)

Coefficient of absorption for  $\text{NiSO}_4 + \text{Aq}$  of the concentration used by Hufner (*cf. Z. phys. Ch.* 1907, 59, 422) = 0.048 at  $20^\circ$ .

Coefficient of absorption for  $\text{NiSO}_4 + \text{Aq}$  sat. at  $20^\circ$  = 0.0245. (Usher, *l. c.*)

Coefficient of absorption for  $\text{MnCl}_2 + \text{Aq}$  sat. at  $20^\circ$  = 0.0082. (Usher, *Z. phys. Ch.* 1908, 82, 624.)

Absorption of NO by  $\text{FeCl}_2 + \text{Aq}$  at  $22^\circ$ .  
A = vol.  $\text{H}_2\text{O}$  (in litres) containing 1 mol.  $\text{FeCl}_2$ .  
V = vol. NO (in litres) absorbed.

A	V
2 5	3 30
5.18	4 83
10 35	6 56
20 7	8 32
51.8	11.89

(Kohlschütter, *B.* 1907, 40, 878.)

Absorption by  $\text{HCl} + \text{FeCl}_2 + \text{Aq}$ .  
10.37 l. 30%  $\text{HCl}$  containing 1 mol.  $\text{FeCl}_2$  in solution absorb 15.64 l. NO.

10.37 l. 10%  $\text{HCl}$  containing 1 mol.  $\text{FeCl}_2$  in solution absorb 6.17 l. NO.

(Kohlschütter, *l. c.*)

Absorption by salts +  $\text{FeCl}_2 + \text{Aq}$ .  
10.37 l. sat.  $\text{NaCl} + \text{Aq}$  containing 1 mol.  $\text{FeCl}_2$  in solution absorb 6.549 l. NO.

10.37 l. sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  containing 1 mol.  $\text{FeCl}_2$  in solution absorb 6.549 l. NO.

(Kohlschütter, *l. c.*)

Solubility of NO in  $\text{Fe}(\text{NO}_3)_2 + \text{Aq}$  at  $23^\circ$ .  
A = vol.  $\text{H}_2\text{O}$  (in litres) containing 1 mol.  $\text{Fe}(\text{NO}_3)_2$ .  
V = vol. NO (in litres) absorbed.

A	V
3 25	2 77
6 50	4 16
13 00	5.54
26 00	6.61

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuCl}_2 + \text{Aq}$ .  
A = vol.  $\text{H}_2\text{O}$  (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
V = vol. NO (in litres) absorbed.

A	V
0 231	0 120
0 277	0 068
0 371	0 052

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuCl}_2 + \text{conc. HCl}$ .  
A = vol. conc.  $\text{HCl}$  (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
V = vol. NO (in litres) absorbed.

A	V	A	V
0 389	0 801	7 499	3.931
0 410	0 933	12 500	3.606
0 840	2 898	18 750	3.153
1.230	3 426	28 650	1 976
2.462	3 989		

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuCl}_2$  + acetic acid.  
 A = vol. acetic acid (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V
252	51 77
504	39 67
1269	81 60

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuCl}_2$  + 98% formic acid.

A = vol. 98% formic acid (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V
27 9	12 76
56 0	13 17
140 0	14 34
280 0	18 08
1400 0	27 29

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuCl}_2$  + acetone

A = vol. acetone (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V	A	V
4.667	14 04	291 60	40 99
29 16	24 01	583 20	67 22
58 33	24 60	1166 40	81 96

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuCl}_2$  + methyl alcohol

A = vol. methyl alcohol (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
 V = vol. NO (in litres) absorbed

A	V	A	V
1 60	3 30	20.50	6 15
8 22	5 60	82 25	4 90

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuCl}_2$  + ethyl alcohol.

A = vol. ethyl alcohol (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V	A	V
1.50	8.70	38.41	18 15
3 84	12 38	76 83	18.05
12 80	15 43	192 10	15.92

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuBr}_2$  + Aq.

A = vol.  $\text{H}_2\text{O}$  (in litres) containing 1 mol.  $\text{CuBr}_2$ .  
 V = vol. NO (in litres) absorbed

A	V
0 37	0 515
0 62	0 120
0 925	0 000

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuBr}_2$  + ethyl alcohol.

A = vol. alcohol (in litres) containing 1 mol.  $\text{CuBr}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V	A	V
2 625	16 02	131 20	22 23
5.25	19 26	262 50	23.46
13 12	20 51	656 10	30 48
43 74	21.13		

(Kohlschütter, *l. c.*)

Sol. in stannous and chromous salts + Aq. (Peligot.)

Not absorbed by  $\text{Fe}_2(\text{SO}_4)_3$  + Aq. (Dalton.)  
 1 vol. absolute alcohol absorbs 0.31606 - 0.003487t + 0.000049t<sup>2</sup> vols. NO between 0° and 25°. (Bunsen.)

1 vol. alcohol at t° and 760 mm. absorbs V vols. NO gas reduced to 0° and 760 mm.

t°	V	t°	V
0	0.31606	13	0 27901
1	0.31262	14	0 27685
2	0 30928	15	0 27478
3	0.30604	16	0 27281
4	0.30290	17	0 27094
5	0 29985	18	0 26917
6	0.29690	19	0 26750
7	0 29405	20	0 26592
8	0 29130	21	0 26444
9	0 28865	22	0 26306
10	0.28609	23	0 26178
11	0 28363	24	0 26060
12	0 28127		..

(Bunsen's Gasometry.)

Abundantly absorbed by  $\text{CS}_2$ . (Friedburg, C N 48. 97.)

Nitrogen trioxide,  $\text{N}_2\text{O}_3$

Sol. in  $\text{H}_2\text{O}$  at 0°. If large amt. of  $\text{H}_2\text{O}$  is present, the solution is quite stable at ordinary temp. (Fremy, C. R. 79. 61.)

Sol. in  $\text{HNO}_3$  + Aq.

Sol. in conc.  $\text{H}_2\text{SO}_4$  to form  $\text{HNOSO}_4$ .

Sol. in ether.

**Nitrogen dioxide stannic chloride,  $N_2O_3$ ,  $SnCl_4$ .**

Decomp. by  $H_2O$  (Weber, Pogg 118. 471)

**Nitrogen tetroxide,  $NO_2$  or  $N_2O_4$**

Sol. in  $H_2O$  at  $0^\circ$  with decomp. Miscible with very conc.  $HNO_3$ . Insol. in  $CHCl_3$  and  $C_2H_5Cl$ . (C. N. 47. 52)

Sol. in  $C_6H_6$ ,  $NO_2$

Sl. sol. in  $H_2S$  + Aq.

Sol. in  $H_2SO_4$  or conc.  $HNO_3$  + Aq.

$H_2PO_4$  absorbs some liquid  $NO_2$ . (Frankland, Chem. Soc. 1901, 79. 1362.)

**Nitrogen pentoxide,  $N_2O_5$ .**

Very deliquescent. Combines with  $H_2O$  to form  $HNO_3$  with evolution of heat

**Nitrogen hexoxide,  $NO_3$**

Decomposes upon air or with  $H_2O$ . (Hautefeuille and Chappin, C. R. 92. 80, 134; 94. 1111, 1306)

**Nitrogen oxybromide.**

See Nitrosyl and Nitroxyl bromide.

**Nitrogen oxychloride.**

See Nitrosyl and Nitroxyl chloride.

**Nitrogen oxyfluoride.**

See Nitrosyl fluoride and Nitroxyl fluoride.

**Nitrogen phosphochloride,  $P_3N_3Cl_6$**

See Nitrogen chlorophosphide.

**Nitrogen selenide,  $N_2Se$**

Very explosive. Insol. in  $H_2O$ . Sol. in  $HNO_3$  + Aq. and  $NaClO$  + Aq. (Espenschied, A. 113. 101.)

Insol. in  $H_2O$ , ether, absolute alcohol, very al. sol. in  $CS_2$ ,  $C_6H_6$ , and glacial acetic acid. Decomp. by  $HCl$  or  $KOH$  + Aq. (Vernehl, Bull. Soc. (2) 38. 518)

**Nitrogen sulphide,  $N_2S_4$**

Insol. in  $H_2O$ . Decomp. by hot  $H_2O$ . Sl. sol. in alcohol, ether, wood alcohol, oil of turpentine. Easily sol. in  $CS_2$ . Slowly decomp. by  $HCl$  + Aq. or  $KOH$  + Aq. rapidly by  $HNO_3$  + Aq. 15 g. dissolve in 1 kilo. of  $CS_2$ . (Fordos and Gélis, C. R. 31. 702)

Sol. in  $CHCl_3$ . (Demarçay, C. R. 91. 854)

Sol. in warm glacial acetic acid with decomp. on boiling. (Ruff and Geisel, B. 1904, 37. 1501.)

**Nitrogen pentasulphide,  $N_2S_5$**

Sol. in ether and most organic solvents, insol. in  $H_2O$ ; fairly stable in ethereal solution, but decomp. by light. (Muthmann, Z. anorg. 1897, 13. 206.)

**Nitrogen sulphobromide,  $N_2S_3Br$ .**

Decomp. by boiling  $H_2O$  and by dil. alkalis, also by boiling with alcohol. (Muthmann, B. 1897, 30. 630.)

$N_2S_4Br_2$ . Decomp. by moist air. (Clever, B. 1896, 29. 340-341.)

$N_2S_4Br_2$ . Decomp. by moist air. Very unstable (Clever)

$N_2S_5Br_2$ . Insol. most solvents; unstable. (Clever.)

**Nitrogen sulphochloride,  $N_2S_4Cl_4$ .**

Unstable on air. Sol. in warm  $CHCl_3$ , crystallizes out on cooling (Demarçay, C. R. 91. 854, 1066)

Demarçay calls this comp. thiazyl chloride. Sol. in hot dry benzene, and in  $CCl_4$ ; decomp. by moist air (Andreocci, Z. anorg. 1897, 14. 249.)

$N_2S_4Cl_2$ . Partly sol. in  $H_2O$ . (Demarçay, C. R. 92. 726.)

Demarçay calls this compound dithiotetra-thiazyl dichloride.

$N_2S_4Cl_2 = N_2S_3$ ,  $SCl_2$ . Decomp. on air. (Fordos and Gélis.)

Demarçay (C. R. 92. 726) calls this comp. thiothiazyl dichloride.

$N_2S_4Cl_2$ . Sol. in  $H_2O$  with subsequent decomp. More sol. than S in  $CS_2$  (Soubeiran, A. ch. 67. 71)

Is a mixture of  $S_2Cl_2$  and  $N_2S_4$  (Fordos and Gélis, C. R. 31. 702.)

$N_2S_4Cl_2$ . Sl. sol. in warm, insol. in cold  $CHCl_3$  (Demarçay, C. R. 92. 726.)

"Thiothiazyl chloride." (Demarçay.)

$N_2S_4Cl_2$ . Sol. in  $H_2O$ . Insol. in most solvents. Sl. sol. in  $CHCl_3$ . Easily sol. in thionyl chloride (Demarçay, C. R. 91. 854, 1066)

Demarçay calls the compound thiotri-thiazyl chloride  $= (NS)_3 \equiv S-Cl$ .

$N_2S_4Cl_2 = 2N_2S_3$ ,  $SCl_2$ . Decomp. on air. (Michaëlis.)

$N_2S_4Cl_2 = 3N_2S_2$ ,  $SCl_2$ . Not decomp. on air. Decomp. by  $H_2O$  containing ammonia.

**Nitrogen sulphoiodide,  $N_2S_4I_4$ .**

Readily decomp. by  $H_2O$ . (Muthmann and Setter, B. 1897, 30. 627.)

**Nitrohydroxylaminic acid,  $H_2N_2O_3$ .**

Known only in solution. (Angeli, Gazz. ch. it. 1897, 27 (2) 357.)

**Barium nitrohydroxylamine,  $BaN_2O_3 + H_2O$ .**

Ppt. More stable in the air than the sodium salt. Not decomp. by prolonged boiling with  $H_2O$ . (Angeli, Gazz. ch. it. 1896, 26. 17-25)

**Cadmium nitrohydroxylamine,  $CdN_2O_3 + H_2O$**

As Ba salt. (Angelico and Fanara, Gazz. ch. it. 1901, 31. (2) 21.)

Calcium nitrohydroxylamine,  $\text{CaN}_2\text{O}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

(Angeli, Gazz. ch. it. 1900, 30. (1) 593)

Calcium nitrohydroxylamine,  $\text{CaN}_2\text{O}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ .

(Angelico and Fanara, Gazz. ch. it. 1901, 31. (2) 15.)

Lead nitrohydroxylamine,  $\text{PbN}_2\text{O}_3$ .

(Angeli, Gazz. ch. it. 1900, 30. (1) 593)

Potassium nitrohydroxylamine,  $\text{K}_2\text{N}_2\text{O}_3$ .

Like Na salt. More hygroscopic. (Angeli, Gazz. ch. it. 1897, 27. (2) 357)

Sol. in  $\text{H}_2\text{O}$ . (Angeli, Gazz. ch. it. 1900, 30. (1) 593.)

Silver nitrohydroxylamine,  $\text{Ag}_2\text{N}_2\text{O}_3$ .

Ppt. (Angeli, C. C. 1901, I 1192.)

Sodium nitrohydroxylamine,  $\text{Na}_2\text{N}_2\text{O}_3$ .

Very sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol. Aqueous solution is readily decomp. by boiling. (Angeli, Gazz. ch. it. 1896, 26. (2) 17.)

Strontium nitrohydroxylamine,  $\text{SrN}_2\text{O}_3 + \text{H}_2\text{O}$ .

(Angeli, Gazz. ch. it. 1900, 30. (1) 593.)  
 $+1\frac{1}{2}\text{H}_2\text{O}$  (Angelico and Fanara, Gazz. ch. it. 1901, 31. (2) 15)

Nitroiodic acid,  $\text{I}_2\text{O}_4(\text{NO})_2$

See Nitrosiodic acid.

Nitronitrous acid.

Platinum potassium nitronitrite,  $\text{K}_2\text{Pt}(\text{NO}_2)_4 \cdot \text{N}_2\text{O}_4$ .

Decomp. by heat. (Miofati, C. C. 1896, II. 1088.)

Nitroplatinous acid.

See Platonitrous acid.

Nitroprussic acid,  $\text{H}_2\text{FeC}_5\text{N}_6\text{O} + \text{H}_2\text{O} = \text{H}_2\text{Fe}(\text{CN})_5\text{NO} + \text{H}_2\text{O}$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Playfair, A. 74. 317.)

Nitroprussides.

The alkali and alkali-earth nitroprussides are sol. in  $\text{H}_2\text{O}$ , and the solutions are not pptd. by alcohol. The others are mostly insol. in  $\text{H}_2\text{O}$ .

Ammonium nitroprusside,  $(\text{NH}_4)_2\text{Fe}(\text{CN})_5(\text{NO})$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ ; not pptd. therefrom by alcohol. (Playfair)

Barium nitroprusside,  $\text{BaFe}(\text{CN})_5\text{NO} + 4\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$   
 $+6\text{H}_2\text{O}$ .

Cadmium nitroprusside,  $\text{CdFe}(\text{CN})_5\text{NO}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . Insol. in dil. or conc.  $\text{HNO}_3 + \text{Aq}$  even when boiling. Not attacked by  $\text{NH}_4\text{OH}$  or  $\text{KOH} + \text{Aq}$ . (Norton, Am. Ch. J. 10. 222)

Calcium nitroprusside,  $\text{CaFe}(\text{CN})_5\text{NO} + 4\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  (Playfair.)

Cobalt nitroprusside,  $\text{CoFe}(\text{CN})_5\text{NO}$ .

Ppt. (Norton, Am. Ch. J. 10. 222.)  
 $+4\text{H}_2\text{O}$

Copper nitroprusside,  $\text{CuFe}(\text{CN})_5\text{NO} + 2\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$  or alcohol.

Ferrous nitroprusside,  $\text{FeFe}(\text{CN})_5\text{NO} + x\text{H}_2\text{O} (?)$

Insol. in  $\text{H}_2\text{O}$

Mercurous nitroprusside,  $\text{Hg}_2\text{Fe}(\text{CN})_5\text{NO}$ .

Insol. in  $\text{H}_2\text{O}$ . Unstable. (Norton, Am. Ch. J. 10. 222.)

Nickel nitroprusside,  $\text{NiFe}(\text{CN})_5\text{NO}$ .

As the Co salt (Norton.)

Potassium nitroprusside,  $\text{K}_2\text{Fe}(\text{CN})_5\text{NO} + 2\text{H}_2\text{O}$ .

Sl. deliquescent. Sol. in 1 pt.  $\text{H}_2\text{O}$  at  $16^\circ$ .  
 $\text{K}_2\text{Fe}(\text{CN})_5\text{NO}$ ,  $2\text{KOH}$ . Very sol. in  $\text{H}_2\text{O}$ .

Silver nitroprusside,  $\text{Ag}_2\text{Fe}(\text{CN})_5\text{NO}$ .

Insol. in  $\text{H}_2\text{O}$ , alcohol, or  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Sodium nitroprusside,  $\text{Na}_2\text{Fe}(\text{CN})_5\text{NO} + 2\text{H}_2\text{O}$ .

Sol. in  $2\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and in less hot  $\text{H}_2\text{O}$ .

Zinc nitroprusside,  $\text{ZnFe}(\text{CN})_5\text{NO}$ .

Very sl. sol. in cold, more in hot  $\text{H}_2\text{O}$ .

Nitrosulphonic acid.

Cupric nitrosulphonate,  $\text{NO} \left\langle \begin{smallmatrix} \text{O} \\ \text{SO}_2 \end{smallmatrix} \right\rangle \text{Cu}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Raschig, B. 1907, 40. 4583.)

Nitrosobromoruthenic acid.

Silver nitrosobromoruthenate ammonia,  $\text{Ag}_2\text{Ru}(\text{NO})\text{Br}_2 \cdot \text{NH}_3$

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Very sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Brizard, Bull. Soc. 1895, (3) 13. 1093.)

**Nitrosobromosmic acid.**

Potassium nitrosobromosmate,  $K_2Os(NO)Br_2$ .  
Stable in aqueous solution (Wintrebert, A. ch. 1904, (7) 28. 132.)

**Nitroschloroplatinic acid.**

Potassium nitroschloroplatinate,  
 $K_2PtCl_3(NO)$ .  
Sol. in  $H_2O$ . (Vèzes, C. R. 110. 757.)

**Nitroschlororuthenic acid.**

Ammonium nitroschlororuthenate,  
 $(NH_4)_2Ru(NO)Cl_6$ .  
Sol. in  $H_2O$ . (Joly, C. R. 107. 991.)  
5 pts. are sol. in 100 pts.  $H_2O$  at  $25^\circ$ .  
22 " " " " " " " " " " " " " " 60".  
(Howe, J. Am. Chem. Soc. 1894, 16. 390.)

Cæsium nitroschlororuthenate,  
 $Cs_2Ru(NO)Cl_6$ .  
0.20 pt. is sol. in 100 pts.  $H_2O$  at  $25^\circ$ .  
0.56 " " " " " " " " " " " " " " 100".  
(Howe.)  
+2 $H_2O$  Very sol. in  $H_2O$ . 105.8 pts. are  
sol. in 100 pts.  $H_2O$ . (Howe.)

Potassium nitroschlororuthenate,  
 $K_2Ru(NO)Cl_6$ .  
Sol. in  $H_2O$  (Joly.)  
12 pts. are sol. in 100 pts.  $H_2O$  at  $25^\circ$ .  
80 " " " " " " " " " " " " " " 60".  
(Howe.)

Rubidium nitroschlororuthenate,  
 $Rb_2Ru(NO)Cl_6$ .  
Sol. in boiling  $H_2O$  without decomp.  
0.57 pt. is sol. in 100 pts.  $H_2O$  at  $25^\circ$ .  
2.13 " " " " " " " " " " " " " " 60".  
(Howe.)

Silver nitroschlororuthenate ammonia,  
 $Ag_2Ru(NO)Cl_6, NH_3$ .  
Decomp. by  $H_2O$ . Sl. sol. in  $NH_4OH + Ag$ .  
Very sol. in  $Na_2S_2O_4 + Ag$  (Bizard, Bull.  
Soc. 1895, (3) 13. 1092.)

**Nitrosiodic acid,  $I_2O_4(NO)_2$  (?)**

Decomp. with  $H_2O$ , alcohol, ether, or acetic  
ether. Slowly sol. in  $H_2SO_4$  (Kammerer, J.  
pr. 83. 65)

**Nitrososulphonic acid.**

Potassium dinitrososulphonate,  $N_2O.OK$   
 $SO_3K$ .  
Sol. in  $H_2O$ . Very unstable. (Hantzsch,  
B. 1894, 27. 3268.)

Potassium nitrosodisulphonate,  $ON(SO_3K)_2$ .  
Sol. in  $H_2O$ . Very explosive. (Hantzsch,  
B. 1895, 28. 996 and 2744.)

Potassium nitrosodisulphonate,  $ON(SO_3K)_2$   
+  $H_2O$   
Sol. in  $H_2O$ . (Hantzsch, B. 1895, 28. 2750.)

Sodium nitrosodisulphonate,  $NO_2(SO_3)_2Na$ .  
Decomp. by  $H_2O$ . (Traube, B. 1913, 46.  
2521.)

Nitrososulphuric acid,  
 $H_2N_2SO_3 = H_2SO_3(NO)_2$ .  
Not known in free state.

Ammonium dinitrososulphate,  
 $(NH_4)_2(NO)_2SO_3$ .  
Sol. in  $H_2O$ . Insol. in hot alcohol. (Pe-  
louze, A. 15. 240.)

Barium —,  $Ba(NO)_2SO_3$ .  
Sol. in  $H_2O$ . (Divers and Haga, Chem. Soc.  
47. 364.)

Barium potassium —,  $BaK_2(SN_2O_4)_2$ .  
Sol. in much  $H_2O$  to form a clear liquid,  
but the solution gradually deposits  $BaSO_4$ .  
(Hantzsch, B. 1891, 27. 3271.)

Cupric nitrosodisulphate,  $Cu(NO)(SO_3)_2$ .  
(Sabatier, Bull. Soc. 1897, (3) 17. 787.)

Lead dinitrososulphate.  
Insol. in  $H_2O$ . (Divers and Haga, Chem.  
Soc. 47. 364.)

Potassium —,  $K_2(NO)_2SO_3$ .  
Decomp. by  $H_2O$  at ordinary temp. Insol.  
in alcohol. (Pelouze, A. ch. 60. 160.)  
Sol. in about 8 pts.  $H_2O$  at  $14.5^\circ$ . Less sol.  
in presence of  $KOH$ . (Divers and Haga,  
Chem. Soc. 1895, 67. 455.)

Sodium —,  $Na_2(NO)_2SO_3$ .  
More sol. than K salt. (Pelouze.)  
Sl. sol. in  $H_2O$ ; very unstable moist or dry;  
decomp. by  $H_2O$ . (Divers, C. N. 1895, 72.  
266.)

**Nitrososulphurous acid.**

Ruthenium sodium nitrososulphate,  
 $O[Ru(SO_3)_2(NO)Na_2] + 2H_2O$ .  
Sl. sol. in cold  $H_2O$ . (Miolati, Gazz. ch.  
it. 1900, 30. 511.)

Nitrosulphide of iron.  
See Ferrotetranitrososulphonic acid.

Binitrosulphide of iron.  
Roussin's comp. is ammonium ferrohepta-  
nitrososulphonate, which see.

**Nitrosulphonic acid**,  $\text{HNSO}_3 = \text{HO} \cdot \text{NO}_2 \cdot \text{SO}_2$

(*Lead chamber crystals.*) Rapidly sol. in  $\text{H}_2\text{O}$  with decomp. When brought into large amount of  $\text{H}_2\text{O}$ , no gas is evolved. (Fremy, C. R. 70. 61.)

Sol. in  $\text{H}_2\text{SO}_4$  without decomp. Sol. in cold  $\text{H}_2\text{SO}_4 + \text{Aq}$  of sp. gr. 1.7–1.55. (Weber, J. pr. 100. 37.)

Sl. sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$  of 1.6 sp. gr. (Dana.) More difficultly sol. in dil. than conc.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Müller.)

**Potassium nitrosulphonate**,  $\text{KOSO}_2\text{NO}_2(?)$ .

Decomp. by  $\text{H}_2\text{O}$ . (Schultz-Sellack, B. 4. 113.)

**Nitrosulphonic anhydride** (?),  $\text{N}_2\text{O}_3 \cdot 2\text{SO}_3 = \text{S}_2\text{O}_5(\text{NO}_2)_2$ .

Rapidly sol. in  $\text{H}_2\text{O}$  with decomp. Abundantly sol. in cold  $\text{H}_2\text{SO}_4$ . (Rose, Pogg. 47. 605.)

Insol. in cold, slowly sol. in warm  $\text{H}_2\text{SO}_4$ . (Prevostaye, A. ch. 73. 362.)

**Nitrosulphonic chloride**,  $\text{NO}_2\text{SO}_2\text{Cl} = \text{NO}_2\text{SO}_2\text{Cl}(?)$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in fuming  $\text{H}_2\text{SO}_4$  without decomp. Decomp. by conc.  $\text{H}_2\text{SO}_4$ . (Weber, Pogg. 123. 333.)

**Dinitrosulphuric acid.**

See Dinitrosulphuric acid.

**Nitrosyl bromide**,  $\text{NOBr}$ .

Decomp. with cold  $\text{H}_2\text{O}$ . (Landolt, A. 116. 177.)

**Nitrosyl tribromide**,  $\text{NOBr}_3$ .

Decomp. by  $\text{H}_2\text{O}$  or cold alcohol.

Miscible with ether. (Landolt, A. 116. 177.) Mixture of  $\text{NOBr}$  and  $\text{Br}_2$ . (Froehlich, A. 224. 270.)

**Nitrosyl platonic bromide**,  $2\text{NOBr} \cdot \text{PtBr}_4$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Topsee, J. B. 1868. 274.)

**Nitrosyl chloride**,  $\text{NOCl}$ .

Decomp. by  $\text{H}_2\text{O}$ . Absorbed by fuming  $\text{H}_2\text{SO}_4$  without decomp.

**Nitrosyl boron chloride**,  $\text{NOCl} \cdot \text{BCl}_3$ .

See Boron nitrosyl chloride.

**Nitrosyl platonic chloride**,  $2\text{NOCl} \cdot \text{PtCl}_4$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  with evolution of  $\text{NO}$ . (Rogers and Boye, Phil. Mag. J. 17. 397.)

**Nitrosyl thallium chloride**,  $2\text{NOCl} \cdot \text{TlCl}_3 \cdot \text{TlCl}_3$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  with decomp. (Sudborough, Chem. Soc. 69. 657.)

**Nitrosyl stannic chloride**,  $2\text{NOCl} \cdot \text{SnCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$ , chloroform, or benzene, not by carbon disulphide. (Jorgensen.)

**Nitrosyl titanium chloride**,  $2\text{NOCl} \cdot \text{TiCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weber, Pogg. 118. 476.)

**Nitrosyl zinc chloride**,  $\text{NOCl} \cdot \text{ZnCl}_2$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  with evolution of  $\text{NO}$ . (Sudborough, Chem. Soc. 69. 656.)

**Nitrosyl chloride sulphur trioxide**,  $\text{NOCl} \cdot \text{SO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$  with evolution of  $\text{HCl}$ . (Weber, Pogg. 123. 233.)

**Nitrosyl fluoride**,  $\text{NOF}$ .

Sol. in  $\text{H}_2\text{O}$ . Solution decomp. on standing with formation of  $\text{NO}$  and  $\text{HNO}_3$ . (Ruff and Stauber, Z. anorg. 1905. 47. 190.)

**Nitrosyl sulphate, acid**,  $\text{H}(\text{NO})\text{SO}_4$ .

See Nitrosulphonic acid.

**Nitrosyl sulphate, anhydro**,  $(\text{NO})_2\text{S}_2\text{O}_7$ .

See Nitrosulphonic anhydride.

**Nitrosyl selenic acid**,  $\text{SeO}_2(\text{ONO})_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Lenher and Mathews, J. Am. Chem. Soc. 1906. 28. 516.)

**Nitrosyl sulphuric acid**,  $\text{H}(\text{NO})\text{SO}_4$ .

See Nitrosulphonic acid.

**Nitrous acid**,  $\text{HNO}_2$ .

Known only in aqueous solution.

See Nitrogen trioxide.

**Nitrites.**

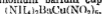
Normal nitrites, except  $\text{AgNO}_2$ , are sol. in  $\text{H}_2\text{O}$  and alcohol; but, as a rule, they are less sol. than the corresponding nitrates.

**Ammonium nitrite**,  $\text{NH}_4\text{NO}_2$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

$\text{H}_2\text{O}$  solution decomp. at  $50^\circ$ . (Berzelius.) Very dil. solution can be evaporated on water bath without decomp. (Bohlig, A. 126. 25.) Solution containing  $\frac{1}{100,000}$  pt.  $\text{NH}_4\text{NO}_2$  can be evaporated to  $\frac{1}{2}$  its vol. without decomp. Solution containing  $\frac{1}{100}$  pt. gives a distillate containing 8.6% of  $\text{NH}_4\text{NO}_3$ , while residue contains 82% of original quantity, 9.4% being lost. (Schoyen.)

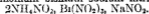
Very deliquescent, sol. in  $\text{H}_2\text{O}$ ; slowly but easily sol. in alcohol, insol. in ether. (Sørensen, Z. anorg. 1894. 7. 38.)

**Ammonium barium cupric nitrite,**

Ppt.; decomp. readily. (Przibylla, Z. anorg. 1897, 15, 421.)

**Ammonium bismuth silver nitrite,**

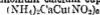
Moderately sol. in  $\text{H}_2\text{O}$ . Rapidly hydrolyzed by  $\text{H}_2\text{O}$ . (Ball and Abreu, Chem. Soc. 1913, 103, 2120.)

**Ammonium bismuth sodium nitrite,**

Easily decomp. (Ball, Chem. Soc. 1905, 87, 761.)

**Ammonium cadmium nitrite ammonia, basic,**

Decomp. by  $\text{H}_2\text{O}$ . (Monn, C. R. 100, 1497.)

**Ammonium calcium cupric nitrite,**

Ppt.; decomp. easily. Sol. in  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Przibylla, Z. anorg. 1897, 15, 423.)

**Ammonium cobaltic nitrite,  $3(\text{NH}_4)_2\text{O}, \text{Co}_2\text{O}_3,$** 

Sl. sol. in  $\text{H}_2\text{O}$ , decomp. in aq. solution on heating. (Rosenheim, Z. anorg. 1898, 17, 45.)

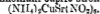


Somewhat sol. in cold  $\text{H}_2\text{O}$ , decomp. by boiling. Decomp. by conc.  $\text{H}_2\text{SO}_4$ , not by acetic or dil. mineral acids. (Fadmann, J. pr. 97, 405.)

**Ammonium cupric lead nitrite,**

Stable at ordinary temp.; sol. in  $\text{HNO}_3$  with decomp.

2.575 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ , or 2.51% salt in sat. solution at  $20^\circ$ . (Przibylla, Z. anorg. 1897, 15, 420.)

**Ammonium cupric strontium nitrite,**

Ppt.; sol. in  $\text{H}_2\text{O}$  with decomp. (Przibylla, l. c.)

**Ammonium iridium nitrite.**

See Iridonitrite, ammonium.

**Ammonium lead nickel nitrite,**

Ppt. (Przibylla, Z. anorg. 1897, 15, 433.)

**Ammonium osmium nitrite.**

See Osminitrite, ammonium.

**Ammonium osmyl oxynitrite.**

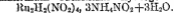
See Osmyloxynitrite, ammonium.

**Ammonium platinum nitrite.**

See Platonitrite, ammonium.

**Ammonium rhodium nitrite.**

See Rhodonitrite, ammonium.

**Ammonium ruthenium hydrogen nitrite,**

See Ruthenininitrite, ammonium hydrogen.

**Barium nitrite,  $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .**

Permanent. Very sol. in  $\text{H}_2\text{O}$ .

**Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .**

$t^\circ$	G. in 100 cc $\text{Ba}(\text{NO}_2)_2$	Sp. gr.
0	58	1.40
20	63	1.45
25	71	1.50
30	82	1.52
35	97	1.61

(Vogel, Z. anorg. 1903, 35, 389.)

100 pts.  $\text{H}_2\text{O}$  dissolve at.

$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$
63.5	69.5	79.5	93 pts. $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$
$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$
113	136	170	202 pts. $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$
$80^\circ$	$90^\circ$	$100^\circ$	$110^\circ$
254	331	461	765 pts. $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$

The sat. solution at  $17^\circ$  contains 40%  $\text{Ba}(\text{NO}_2)_2$ , and has sp. gr.  $17^\circ/0^\circ = 1.4897$  (Oswald, A. ch. 1914, (9) 1, 62.)

100 g.  $\text{H}_2\text{O}$  at  $13.5^\circ$  dissolve 64 g.  $\text{Ba}(\text{NO}_2)_2 + 10.2$  g.  $\text{AgNO}_3$  with excess of  $\text{AgNO}_3$ , and 75.6 g.  $\text{Ba}(\text{NO}_2)_2 + 9.5$  g.  $\text{AgNO}_3$  with excess of  $\text{AgNO}_3$ . (Oswald.)

Sol. in 64 pts. 94% alcohol; nearly insol. in absolute alcohol. (Lang, Pogg. 118, 285.)

**Solubility in alcohol + Aq at  $t^\circ$ .**

$t^\circ$	Solvent	100 cum. of the sat. solution contain g. $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$
19.5	10% alcohol	49.30
21.0	20% "	29.30
20.5	30% "	18.41
20.5	40% "	13.33
20.5	50% "	9.11
20.0	60% "	4.84
19.0	70% "	2.66
19.5	80% "	0.98
20.0	90% "	0.00
20.0	absolute alcohol	0.00

(Vogel, Z. anorg. 1903, 35, 390.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

**Barium caesium nitrite,  $\text{CsBa}_4(\text{NO}_2)_4$ .**

Sol. in  $\text{H}_2\text{O}$  (Jamieson, Am. Ch. J. 1907, 38. 616.)

$\text{Cs}_2\text{Ba}(\text{NO}_2)_4 + \text{H}_2\text{O}$ . Very sol in  $\text{H}_2\text{O}$  (Jamieson, Am. Ch. J. 1907, 38. 616.)

**Barium caesium silver nitrite,  $\text{Cs}_2\text{AgBa}(\text{NO}_2)_6 + 2\text{H}_2\text{O}$ .**

Decomp. by cold  $\text{H}_2\text{O}$ . (Jamieson, Am. Ch. J. 1907, 38. 616.)

**Barium cobaltic nitrite,  $2\text{BaO}$ ,  $\text{Co}_2\text{O}_3$ ,  $4\text{N}_2\text{O}_5 + 10\text{H}_2\text{O}$ .**

Sol in moderately warm  $\text{H}_2\text{O}$  without decomp but not recryst therefrom. (Rosenheim, Z. anorg. 1898, 17. 51-54.)

$3\text{BaO}$ ,  $\text{Co}_2\text{O}_3$ ,  $6\text{N}_2\text{O}_5 + \text{H}_2\text{O}$  Ppt; very unstable. Nearly insol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1898, 17. 47.)

**Barium cobaltous potassium nitrite,  $\text{Ba}(\text{NO}_2)_2$ ,  $\text{Co}(\text{NO}_2)_2$ ,  $2\text{KNO}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  (Erdmann, J. pr. 97. 385.)

**Barium cupric nitrite,  $\text{Ba}[\text{Cu}(\text{OH})(\text{NO}_2)_2]_2$ .**

Ppt. Insol in  $\text{H}_2\text{O}$ . Decomp by  $\text{H}_2\text{O}$  Insol. in alcohol, but slowly decomp. by it. (Kurtenacker, Z. anorg. 1913, 82. 208.)

**Barium cupric potassium nitrite,  $\text{BaCuK}_4(\text{NO}_2)_8$ .**

Stable when dry, easily decomp. when moist; sol. in  $\text{H}_2\text{O}$  with decomp.

45.86 pts are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ , or 31.45% salt is contained in sat. solution at  $20^\circ$ . (Przibylla, Z. anorg. 1897, 15. 424.)

**Barium cupric thallium nitrite,  $\text{BaCuTl}_2(\text{NO}_2)_6$ .**

Sl. sol. in  $\text{H}_2\text{O}$  (Przibylla, Z. anorg. 1898, 18. 461.)

**Barium iridium nitrite.**

See Iridonitrite, barium.

**Barium mercuric nitrite,  $2\text{Ba}(\text{NO}_2)_2$ ,  $3\text{Hg}(\text{NO}_2)_2 + 5\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$  and easily decomp. (Rây, Chem. Soc. 1910, 97. 327.)

**Barium nickel nitrite,  $2\text{Ba}(\text{NO}_2)_2$ ,  $\text{Ni}(\text{NO}_2)_2$ .**

Somewhat more easily sol. in  $\text{H}_2\text{O}$  than nickel potassium nitrite. (Lang.)

**Barium nickel potassium nitrite,  $\text{Ba}(\text{NO}_2)_2$ ,  $\text{Ni}(\text{NO}_2)_2$ ,  $2\text{KNO}_2$ .**

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$  without apparent decomp. (Lang.)

**Barium nickel thallium nitrite,  $\text{NiBaTl}_2(\text{NO}_2)_6$ .**

Ppt. (Przibylla, Z. anorg. 1898, 18. 462.)

**Barium osmium nitrite.**

See Osminitrite, barium.

**Barium osmyl oxynitrite.**

See Osmyloxynitrite, barium.

**Barium potassium nitrite,  $\text{Ba}(\text{NO}_2)_2$ ,  $2\text{KNO}_2 + \text{H}_2\text{O}$ .**

Easily sol in  $\text{H}_2\text{O}$ ; insol in alcohol. (Lang, Pogg, 118. 293.)

**Barium rhodium nitrite,  $3\text{Ba}(\text{NO}_2)_2$ ,  $\text{Rh}_4(\text{NO}_2)_6$ .**

See Rhodonitrite, barium.

**Barium silver nitrite,  $\text{Ba}(\text{NO}_2)_2$ ,  $2\text{AgNO}_2 + \text{H}_2\text{O}$ .**

Resembles the potassium salt. (Fischer.) Less stable than the Na salt. (Oswald.)

**Bismuth nitrite, basic,  $(\text{BiO})\text{NO}_2 + \frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{HCl}$  (Vanino, J. pr. 1906, (2) 74. 150)

**Bismuth caesium silver nitrite,  $\text{Cs}_2\text{BiAg}(\text{NO}_2)_6$ .**

Very sl sol in  $\text{H}_2\text{O}$ . Slowly decomp by  $\text{H}_2\text{O}$ . (Ball and Abram, Chem. Soc. 1913, 103. 2122.)

**Bismuth potassium nitrite,  $\text{Bi}(\text{NO}_2)_3$ ,  $3\text{KNO}_2 + \text{H}_2\text{O}$ .**

Decomp by  $\text{H}_2\text{O}$  (Ball, Chem. Soc. 1905, 87. 762.)

**Bismuth potassium silver nitrite,  $\text{K}_2\text{BiAg}(\text{NO}_2)_6$ .**

Less sol in  $\text{H}_2\text{O}$  than  $\text{NH}_4$  salt. (Ball and Abram, Chem. Soc. 1913, 103. 2121.)

**Bismuth rubidium silver nitrite,  $\text{Rb}_2\text{BiAg}(\text{NO}_2)_6$ .**

Sl sol in  $\text{H}_2\text{O}$  with slow hydrolysis. (Ball and Abram.)

**Bismuth silver thallic nitrite,  $\text{BiAgTl}_2(\text{NO}_2)_6$ .**

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby. (Ball and Abram.)

**Cadmium nitrite, basic,  $2\text{CdO}$ ,  $\text{N}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . (Hampe, A. 125. 335)

**Cadmium nitrite,  $\text{Cd}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .**

Deliquescent. Sol in  $\text{H}_2\text{O}$ . (Lang, J. B. 1862. 99)

**Cadmium potassium nitrite,  $\text{Cd}(\text{NO}_2)_2$ ,  $\text{KNO}_2$ .**

Easily sol in  $\text{H}_2\text{O}$ . Very difficultly sol. in absolute alcohol, and only sl. sol. in 90% alcohol. (Hampe, A. 125. 334.)

$\text{Cd}(\text{NO}_2)_2$ ,  $2\text{KNO}_2$  Easily sol. in  $\text{H}_2\text{O}$ . Insol in alcohol (Lang, J. B. 1862. 99.)

$\text{Cd}(\text{NO}_2)_2$ ,  $4\text{KNO}_2$ . More sol. in  $\text{H}_2\text{O}$  than the above salt. (Lang)

**Cæsium nitrite, CsNO<sub>2</sub>.**

Very hygroscopic. Very sol. in H<sub>2</sub>O. (Ball, Chem. Soc. 1913, 103, 2130.)

**Cæsium calcium nitrite, Cs<sub>2</sub>Ca(NO<sub>2</sub>)<sub>4</sub>·H<sub>2</sub>O.**  
Ppt. (Jamieson, Am. Ch. J. 1907, 38, 617.)**Cæsium cobaltic nitrite, Cs<sub>3</sub>Co(NO<sub>2</sub>)<sub>6</sub>·H<sub>2</sub>O**  
Sol. in 20,100 pts. H<sub>2</sub>O at 17°. (Rosenblatt, B. 19, 2531)**Cæsium lead nitrite, Cs<sub>2</sub>Pb(NO<sub>2</sub>)<sub>2</sub>·H<sub>2</sub>O.**  
Sol. in cold H<sub>2</sub>O without decomp. When solution is heated, some basic lead salt separates. (Jamieson, Am. Ch. J. 1907, 38, 618.)**Cæsium lead silver nitrite, Cs<sub>2</sub>AgPb(NO<sub>2</sub>)<sub>2</sub>·2H<sub>2</sub>O.**  
Ppt (Jamieson.)**Cæsium silver nitrite, CsAgNO<sub>2</sub>.**  
Decomp. by H<sub>2</sub>O (Jamieson)**Cæsium silver strontium nitrite, Cs<sub>2</sub>AgSr(NO<sub>2</sub>)<sub>6</sub>·2H<sub>2</sub>O.**  
Partially decomp. by H<sub>2</sub>O. (Jamieson.)**Cæsium strontium nitrite, CsSr(NO<sub>2</sub>)<sub>2</sub>·H<sub>2</sub>O.**  
Ppt. Sol. in H<sub>2</sub>O. (Jamieson.)**Calcium nitrite, Ca(NO<sub>2</sub>)<sub>2</sub>·H<sub>2</sub>O.**  
Very deliquescent. Insol. in dil. alcohol. (Fischer, Pogg. 74, 115)  
100 cem. of the sat. solution contain 111 g. Ca(NO<sub>2</sub>)<sub>2</sub>·H<sub>2</sub>O at 20.5°. (Vogel, Z. anorg. 1903, 35, 395)Solubility in H<sub>2</sub>O at t°.

t°	g. Ca(NO <sub>2</sub> ) <sub>2</sub>	Solid phase
0	38.3	Ca(NO <sub>2</sub> ) <sub>2</sub> , 4H <sub>2</sub> O
18 5	43	"
42	51.8	"
44	53.5	" + Ca(NO <sub>2</sub> ) <sub>2</sub> , H <sub>2</sub> O
54	55.2	Ca(NO <sub>2</sub> ) <sub>2</sub> , H <sub>2</sub> O
64	58.4	"
70	60.3	"
73	61.5	"
91	71.2	"

(Oswald, A. ch. 1914, (9) 1. 32.)

Sat. solution of Ca(NO<sub>2</sub>)<sub>2</sub>·AgNO<sub>2</sub> contains 92.4 g. Ca(NO<sub>2</sub>)<sub>2</sub> and 11.2 g. AgNO<sub>2</sub> per 100 g. H<sub>2</sub>O at 14°. (Oswald.)

Solubility in alcohol  
100 cem. of sat. solution in 90% alcohol contain 39.0 g. Ca(NO<sub>2</sub>)<sub>2</sub>·H<sub>2</sub>O at 20°.

100 cem. of sat. solution in absolute alcohol contain 1.1 g. Ca(NO<sub>2</sub>)<sub>2</sub>·H<sub>2</sub>O at 20°. (Vogel.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

+4H<sub>2</sub>O. The sat. solution at 16° contains 42.3% Ca(NO<sub>2</sub>)<sub>2</sub> and has sp. gr. at 16°/0° = 1.1205. (Oswald, A. ch. 1914, (9) 1. 66.)

**Calcium cobaltous potassium nitrite, Ca(NO<sub>2</sub>)<sub>2</sub>, Co(NO<sub>2</sub>)<sub>2</sub>, 2KNO<sub>2</sub>**  
Decomp. by H<sub>2</sub>O. (Erdmann.)**Calcium cupric potassium nitrite, CaCuK<sub>2</sub>(NO<sub>2</sub>)<sub>6</sub>.**

Ppt., insol. in alcohol; sol. in H<sub>2</sub>O with decomp.

14.97 pts. are sol. in 100 pts. H<sub>2</sub>O at 20°, or 13.02 per cent of salt is contained in sat. solution. (Prabylla, Z. anorg. 1897, 15, 422.)

**Calcium mercuric nitrite, Ca(NO<sub>2</sub>)<sub>2</sub>, Hg(NO<sub>2</sub>)<sub>2</sub>·5H<sub>2</sub>O**  
Very sol. in H<sub>2</sub>O. (Ray, Chem. Soc. 1910, 97, 327.)**Calcium nickel potassium nitrite, Ca(NO<sub>2</sub>)<sub>2</sub>, Ni(NO<sub>2</sub>)<sub>2</sub>, 2KNO<sub>2</sub>.**

Very sl. sol. in cold, easily in hot H<sub>2</sub>O. Insol. in alcohol. Sl. sol. in dil. HClO<sub>4</sub> + Aq. (Erdmann.)

**Calcium osmium nitrite.**  
See Osminitrite, calcium.**Calcium potassium nitrite, CaK(NO<sub>2</sub>)<sub>2</sub>·3H<sub>2</sub>O.**  
Sol. in H<sub>2</sub>O. (Topsøe, W. A. B 73, 2, 112.)  
Deliquescent. (Lang)**Cobaltous nitrite.**  
Known only in solution.**Cobaltic lead nitrite, 3PbO, Co<sub>2</sub>O<sub>3</sub>, 6N<sub>2</sub>O<sub>5</sub> + 12H<sub>2</sub>O.**  
Insol. in H<sub>2</sub>O. (Rosenheim, Z. anorg. 1898, 17, 48.)**Cobaltic lead potassium nitrite, 3K<sub>2</sub>O, 3PbO, 2Co<sub>2</sub>O<sub>3</sub>, 10N<sub>2</sub>O<sub>5</sub> + 4H<sub>2</sub>O.**  
Sol. by boiling in much H<sub>2</sub>O. Sol. in hot acids with evolution of N<sub>2</sub>O<sub>5</sub>. (Stromeyer, A. 96, 228.)**Cobaltous potassium nitrite, 2Co(NO<sub>2</sub>)<sub>2</sub>, 2KNO<sub>2</sub> + H<sub>2</sub>O.**  
Ppt. (Sadtler.)

Co(NO<sub>2</sub>)<sub>2</sub>, 2KNO<sub>2</sub>·H<sub>2</sub>O. Ppt. (Sadtler.)  
3Co(NO<sub>2</sub>)<sub>2</sub>, 6KNO<sub>2</sub>·H<sub>2</sub>O. Insol. in cold, sol. in hot H<sub>2</sub>O. Sl. sol. in KC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (Erdmann, J. pr 97, 397.)  
Insol. in ethyl acetate. (Naumann, B. 1904, 37, 3602.)

**Cobaltic potassium nitrite (cobalt yellow), Co<sub>2</sub>(NO<sub>2</sub>)<sub>6</sub>, 6KNO<sub>2</sub> + 3H<sub>2</sub>O.**  
Very sl. sol. in cold H<sub>2</sub>O. Insol. in alcohol and ether. Sol. in traces in CS<sub>2</sub>. (St. Evre,

C. R. 35. 552.) Insol. in boiling conc.  $K_2SO_4$ ,  $KCl$ ,  $KNO_3$ , or  $KC_2H_3O_2 + Aq$ .  
Sol. in 1120 pts  $H_2O$  at  $17^\circ$ . (Rosenbladt, B. 1886, 19. 2535.)

Decomp. when heated in aq. solution. (Rosenheim, Z. anorg. 1898, 17. 42.)

More sol. in  $NH_4Cl$  or  $NaCl + Aq$  than in  $H_2O$ . (Stromeyer.)

Sl. decomp. by  $KOH + Aq$ , except when very conc.; easily decomp. by  $NaOH$  or  $Ba(OH)_2 + Aq$ .

Very sl. sol. in  $KC_2H_3O_2 + Aq$ , or  $KNO_3 + Aq$ . (Fresenius.) Sol. in  $HCl + Aq$ .

Sol. in  $HC_2H_3O_2$ , or  $H_2C_2O_4 + Aq$ . (Stromeyer.)

Small quantity of  $HC_2H_3O_2 + Aq$  does not dissolve. (Fresenius.)

Cobaltic potassium silver nitrite,  
 $KCoAg_2(NO_2)_4$  and  $K_2CoAg(NO_2)_4$ .

Very sl. sol. in  $H_2O$ . Less sol. than Na comp. (Burgess and Karum, J. Am. Chem. Soc. 1912, 34. 653.)

Cobaltous potassium strontium nitrite,  
 $Co(NO_2)_2 \cdot 2KNO_3 \cdot Sr(NO_2)_2$ .

Decomp. by  $H_2O$ . (Erdmann, J. pr. 97. 385.)

Cobaltic rubidium nitrite,  $Rb_2Co(NO_2)_4 + H_2O$ .

Sol. in 19,800 pts  $H_2O$ . (Rosenbladt, B. 19. 2531.)

Cobaltic silver nitrite,  $CoAg_2(NO_2)_4$ .

Fairly sol. in  $H_2O$ . (Cunningham and Perkin, Chem. Soc. 1909, 95. 1568.)

$2Ag_2O$ ,  $Co_2O_3$ ,  $3N_2O_5 + 3H_2O$ . Sl. sol. in  $H_2O$ , decomp. by boiling  $H_2O$ . (Rosenheim, Z. anorg. 1898, 17. 56.)

Cobaltic silver hydroxynitrite,  
 $Co_2Ag_2(OH)_2(NO_2)_4$ .

Sl. sol. in  $H_2O$ . (Suzuki, Chem. Soc. 1910, 97. 729.)

Cobaltic silver nitrite ammonia,  $Co_2O_3$ ,  $Ag_2O$ ,  $4N_2O_5$ ,  $4NH_3$ .

See Cobalt ammonium comps.

Cobaltic sodium nitrite,  $2Na_2O$ ,  $Co_2O_3$ ,  $4N_2O_5$ .

Sol. in  $H_2O$  and alcohol. (Rosenheim, Z. anorg. 1898, 17. 50.)

$+ H_2O$ . Ppt. (Sadtler, Sill. Am. J. (2) 49. 193.)

$3Na_2O$ ,  $Co_2O_3$ ,  $6N_2O_5 + xH_2O$ . Sol. in  $H_2O$ ; decomp. on heating; insol. in alcohol. (Rosenheim, Z. anorg. 1898, 17. 43.)

Cobaltic strontium nitrite,  $2SrO$ ,  $Co_2O_3$ ,  $4N_2O_5 + 11H_2O$ .

Ppt. (Rosenheim, Z. anorg. 1898, 17. 54.)

Cobaltic thallium nitrite,  $Co_2(NO_2)_6$ , 6TINO<sub>2</sub>.  
Sol. in 23,810 pts.  $H_2O$  at  $17^\circ$ . (Rosenbladt, B. 19. 2531.)

Cobaltic zinc nitrite,  $2ZnO$ ,  $Co_2O_3$ ,  $3N_2O_5 + 11H_2O$ .

Sol. in dil. acetic acid. (Rosenheim, Z. anorg. 1898, 17. 56.)

Cobalt nitrite nitrate,  $2CoO$ ,  $Co_2O_3$ ,  $3N_2O_5$ ,  $Co(NO_2)_2 + 14H_2O$ .

Ppt. (Rosenheim, Z. anorg. 1898, 17. 58.)

Cupric nitrite, basic,  $2CuO$ ,  $N_2O_5$ .

(Hampe, A. 125. 345.)

$Cu(NO_2)_2 \cdot 3Cu(OH)_2$ . Very sl. sol. in  $H_2O$  or alcohol. Easily sol. in dil. acids or ammonia. (van der Meulen, B. 12. 758.)

Cupric nitrite.

Known only in solution.

Cupric lead potassium nitrite,  $CuPbK_2(NO_2)_4$ .

(van Liesen, R. t. c. 10. 13.)

3.056 pts. are sol. in 100 pts.  $H_2O$  at  $20^\circ$ , or 2.51% salt is contained in sat. solution at  $20^\circ$  p. 429. (Przybylla, Z. anorg. 1897, 15. 429.)

Cupric potassium strontium nitrite,  
 $CuSrK_2(NO_2)_4$ .

Sol. in  $H_2O$  with decomp. 10.82 pts. are sol. in 100 pts.  $H_2O$  at  $20^\circ$ , or 9.77 per cent salt is contained in sat. solution at  $20^\circ$ . (Przybylla, Z. anorg. 1897, 15. 425.)

Cupric rubidium nitrite,  $Rb_2Cu(NO_2)_4$ .

Easily sol. in  $H_2O$ . Sol. in alcohol. (Kurttenacker, Z. anorg. 1913, 82. 206.)

Cupric nitrite ammonia,  $Cu(NO_2)_2$ ,  $2NH_3 + 2H_2O$ .

Sol. in little  $H_2O$  with absorption of much heat. Decomp. by much  $H_2O$ . (Peligot, C. R. 53. 209.)

$3CuO$ ,  $N_2O_5$ ,  $2NH_3 + H_2O$ . As above. (Peligot.)

Iridium hydrogen nitrite,  $Ir_2H_4(NO_2)_{12}$ .

See Iridonitrous acid.

Iridium nitrite with  $MnO_2$ .

See Iridonitrite, M.

Iron (ferrous) lead potassium nitrite,

$FePbK_2(NO_2)_4$ .

Ppt.; insol. in cold  $H_2O$ ; stable at ordinary temp. (Przybylla, Z. anorg. 1897, 15. 439.)

Iron (ferrous) lead thallos nitrite,

$FePbTh_2(NO_2)_4$ .

Ppt. (Przybylla, Z. anorg. 1898, 18. 463.)

**Lead nitrite, basic**,  $4\text{PbO}$ ,  $\text{N}_2\text{O}_3 + \text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_2$ ,  $\text{PbO}$ .

Sol. in 143 pts  $\text{H}_2\text{O}$  at  $23^\circ$ , and 33 pts at  $100^\circ$ . (Chevreul.)

Sol. in 1250 pts. cold  $\text{H}_2\text{O}$ , and 34.5 pts. at  $100^\circ$ . (Pelgrot.)

Sol. in cold  $\text{HNO}_3$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ .

Composition is  $3\text{PbO}$ ,  $\text{N}_2\text{O}_3 + \text{H}_2\text{O}$ . (Meissner, J. B. 1876. 194.)

Composition is as above (v. Lorenz, W. A. B. 84, 2. 1133.)

$3\text{PbO}$ ,  $\text{N}_2\text{O}_3 = \text{Pb}(\text{NO}_2)_2$ ,  $2\text{PbO}$  Sol. in  $\text{H}_2\text{O}$ . (Bromeis, A. 72. 38; v. Lorenz.)

$2\text{PbO}$ ,  $\text{N}_2\text{O}_3 + \text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Bromeis.)

$+3\text{H}_2\text{O}$ . (Meissner.)

$4\text{PbO}$ ,  $3\text{N}_2\text{O}_3 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Meissner, J. B. 1876. 195.)

**Lead nitrite**,  $\text{Pb}(\text{NO}_2)_2 + \text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$ . (Pelgrot, A. ch. 77. 87.)

**Lead nickel potassium nitrite**,  $\text{Pb}(\text{NO}_2)_2$ ,  $\text{KNO}_3$ ,  $\text{Ni}(\text{NO}_2)_2$ .

Insol. in  $\text{H}_2\text{O}$ . (Baubigny, A. ch. (6) 17. 111.)

Ppt. (Przibylla, Z anorg 1897, 15. 432.)

**Lead nickel thalious nitrite**,  $\text{NiPbTl}_2(\text{NO}_2)_6$ .

Ppt. (Przibylla, Z anorg 1898, 18. 462.)

**Lead potassium nitrite**,  $4\text{Pb}(\text{NO}_2)_2$ ,  $6\text{KNO}_3 + 3\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and in absolute alcohol. (Hampe, A. 125. 334.)

$\text{Pb}(\text{NO}_2)_2$ ,  $2\text{KNO}_3 + \text{H}_2\text{O}$  Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Lang, J. B. 1862. 102.)

**Lead potassium silver nitrite**,  $\text{K}_3\text{AgPb}(\text{NO}_2)_6 + 2\text{H}_2\text{O}$ .

Ppt. (Jamieson, Ann. Ch. J. 1907, 38. 619.)

**Lead nitrite nitrate**.

See Nitrate nitrite, lead.

**Lithium nitrite**,  $\text{LiNO}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

Deliquescent. Easily sol. in alcohol and  $\text{H}_2\text{O}$ . (Vogel, Z. anorg 1903, 35. 403.)

Sat. solution of  $\text{LiNO}_2 + \frac{1}{2}\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  contains at.

$65^\circ$  81.5°  $91^\circ$   $96^\circ$   $92.5^\circ$   
63.8 68.7 72.4 91.8 94.3%  $\text{LiNO}_2$ .  
(Oswald.)

$+ \text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ , readily forming supersat. solutions. Very sol. in abs. alcohol. (Ball, Chem. Soc. 1913, 103. 2133.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$   $10^\circ$   $20^\circ$   
125 156 189 pts.  $\text{LiNO}_2 + \text{H}_2\text{O}$ .

$30^\circ$   $40^\circ$   $50^\circ$   
242 316 459 pts.  $\text{LiNO}_2 + \text{H}_2\text{O}$ .

$\text{LiNO}_2$ ,  $\text{H}_2\text{O} + \text{Aq}$  sat. at  $19^\circ$  contains 48.9%  $\text{LiNO}_2$  and has sp. gr. = 1.3186. (Oswald, A. ch. 1914, (9) 1. 61.)

100 g.  $\text{H}_2\text{O}$  dissolve 78.5 g.  $\text{LiNO}_2 + 10.5$  g.  $\text{AgNO}_3$  at  $14^\circ$ . (Oswald.)

**Lithium mercuric nitrite**,  $\text{LiNO}_2$ ,  $\text{Hg}(\text{NO}_2)_2 + \text{H}_2\text{O}$

(Ray, Chem. Soc. 1907, 91. 2033.)

$4\text{LiNO}_2$ ,  $\text{Hg}(\text{NO}_2)_2 + 4\text{H}_2\text{O}$ . Extremely deliquescent. (Ray.)

**Magnesium nitrite**,  $\text{Mg}(\text{NO}_2)_2 + 2\text{H}_2\text{O}$ .

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . Solution decomp. by boiling. Easily sol. in absolute alcohol. (Hampe, A. 125. 334.)

Insol. in absolute alcohol. (Fischer.)

$+3\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  and absolute alcohol.

Very deliquescent. (Vogel, Z. anorg. 1903, 35. 397.)

**Magnesium osmium nitrite**.

See Osminitrite, magnesium.

**Magnesium potassium nitrite**.

Deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Lang.)

**Magnesium silver nitrite**.

Sol. in  $\text{H}_2\text{O}$  with decomp. (Spiegel, Ch. Z. 1895, 19. 1423.)

**Manganous nitrite**.

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Mitscherlich.) Not obtained in a solid state, as the solution decomp. on evaporation. (Lang, Pogg. 118. 290.)

**Mercurous nitrite**,  $\text{Hg}_2(\text{NO}_2)_2$ .

Sol. in  $\text{H}_2\text{O}$  with partial decomp. to  $\text{Hg}$  and  $\text{Hg}(\text{NO}_2)_2$ . (Ray, A. 1901, 316. 252.)

Sol. in cold conc.  $\text{HNO}_3$ . Very slowly sol. in cold dil.  $\text{HNO}_3$ . (Ray, Chem. Soc. 1897, 71. 339.)

Decomp. by boiling  $\text{H}_2\text{O}$  and by cold dil.  $\text{H}_2\text{SO}_4$ . (Ray, Z. anorg. 1896, 12. 366.)

$+ \text{H}_2\text{O}$  Slowly decomp. by  $\text{H}_2\text{O}$ . (Ray, Chem. Soc. 1897, 71. 340.)

**Mercuric nitrite, basic**,  $\text{Hg}(\text{NO}_2)_2$ ,  $2\text{HgO} + \text{H}_2\text{O}$ .

Ppt. (Lang.)

$12\text{HgO}$ ,  $5\text{N}_2\text{O}_5 + 24\text{H}_2\text{O}$ . (Ray, Chem. Soc. 1897, 71. 341.)

**Mercuric nitrite**,  $\text{Hg}(\text{NO}_2)_2$ .

Deliquescent. Partly sol. in boiling  $\text{H}_2\text{O}$ , but the greater part is decomp. into  $\text{HgO} + \text{HNO}_2$ . (Ray, Proc. Chem. Soc. 1904, 20. 57.)

**Mercuriomercuric nitrite, basic**.

a.  $9\text{Hg}_2\text{O}$ ,  $4\text{HgO}$ ,  $5\text{N}_2\text{O}_5 + 8\text{H}_2\text{O}$ .

$\beta$ .  $\text{Hg}_3\text{O}$ ,  $2\text{HgO}$ ,  $\text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$ .  
(Ray, Chem. Soc. 1897, 71. 341.)

Mercuric potassium nitrite,  $\text{Hg}(\text{NO}_2)_2 \cdot 2\text{KNO}_2$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Lang, 1866.)

$\text{KHg}(\text{NO}_2)_2$ . Obtained from  $\text{K}_2\text{Hg}(\text{NO}_2)_4$ ,  $\text{H}_2\text{O}$  + Aq containing a small excess of  $\text{KNO}_2$ . Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1901, 28, 173.)

$\text{K}_2\text{Hg}(\text{NO}_2)_6 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Formula of Lang is incorrect. (Rosenheim, Z. anorg. 1901, 28, 172.)

Mercuric sodium nitrite,  $\text{Na}_2\text{Hg}(\text{NO}_2)_4$ .

Very hygroscopic. Decomp. by hot  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1901, 28, 173.)

+  $2\text{H}_2\text{O}$ . Deliquescent. (Ray, Chem. Soc. 1907, 91, 2032.)

$2\text{Hg}(\text{NO}_2)_2 \cdot 3\text{NaNO}_2$ . Decomp. by  $\text{H}_2\text{O}$ . (Ray, Chem. Soc. 1907, 91, 2032.)

Mercuric strontium nitrite,  $3\text{Hg}(\text{NO}_2)_2 \cdot 2\text{Sr}(\text{NO}_2)_2 + 5\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ . (Ray, Chem. Soc. 1910, 97, 327.)

Mercuric nitrite hydrazine,  $\text{Hg}(\text{NO}_2)_2 \cdot \text{N}_2\text{H}_4$

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Hofmann and Marburg, A. 1899, 305, 215.)

Nickel nitrite, basic,  $2\text{NiO} \cdot \text{N}_2\text{O}_3$

Ppt. (Hampe, A. 125, 343.)

Nickel nitrite,  $\text{Ni}(\text{NO}_2)_2$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Lang, J. B. 1862, 100.)

Nickel potassium nitrite,  $\text{Ni}(\text{NO}_2)_2 \cdot 4\text{KNO}_2$ .

Moderately sol. in  $\text{H}_2\text{O}$ . (Fischer, Pogg. 74, 115.) Extremely sol. in  $\text{H}_2\text{O}$ . (Hampe, A. 125, 346.) Insol. in absolute alcohol.

Nickel potassium strontium nitrite,  $\text{Ni}(\text{NO}_2)_2 \cdot 2\text{KNO}_2 \cdot \text{Sr}(\text{NO}_2)_2$ .

Sl sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ .

Nickel nitrite ammonia,  $\text{Ni}(\text{NO}_2)_2 \cdot 4\text{NH}_3$ .

Sol. in cold  $\text{H}_2\text{O}$ . Decomp. on standing or by heating. Insol. in alcohol. Can be recrystallized by dissolving in  $\text{NH}_4\text{OH}$  + Aq, and adding much absolute alcohol. (Erdmann, J. pr. 97, 395.)

$\text{Ni}(\text{NO}_2)_2 \cdot 5\text{NH}_3$ . Decomp. in the air giving  $\text{Ni}(\text{NO}_2)_2 \cdot 4\text{NH}_3$ . (Ephraim, B. 1913, 46, 3110.)

Osmium nitrite,  $\text{Os}(\text{NO}_2)_2$ .

Ppt (Wintrebert, C. R. 1905, 140, 587.)

Osmium nitrite with  $\text{MNO}_2$ .

See Osmnitrite, M.

Osmyl nitrite with  $\text{MNO}_2$ .

See Osmynitrite, M.

Osmyl oxynitrite with  $\text{MNO}_2$ .

See Osmylloxynitrite, M.

Osmyl nitrite ammonia,  $\text{OsO}_2(\text{NO}_2)_2 \cdot 4\text{NH}_3$ .

(Wintrebert, A. ch. 1903, (7) 28, 56.)

Palladous nitrite with  $\text{MNO}_2$ .

See Palladonitrite, M.

Platinous hydrogen nitrite,  $\text{H}_2\text{Pt}(\text{NO}_2)_4$ .

See Platonitrous acid.

Platinous nitrite with  $\text{MNO}_2$ .

See Platonitrite, M.

Potassium nitrite,  $\text{KNO}_2$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ .

Pure  $\text{KNO}_2$  is not deliquescent. (Oswald, A. ch. 1914, (9) 1, 32.)

Sol in about  $1/3$  its wt. of  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1899, 75, 86)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

0°	10°	20°	30°	40°
281	291	302	313	325 pts. $\text{KNO}_2$ .

50°	60°	70°	80°	90°
337.5	351	365	380	396 pts. $\text{KNO}_2$ .

100°	110°	120°	130°
413	432	451	473 pts. $\text{KNO}_2$ .

Bpt of sat.  $\text{KNO}_2$  + Aq is  $132^\circ$  at 758.5 mm. pressure.

(Oswald, A. ch. 1914, (9) 1, 58.)

Sp. gr. of  $\text{KNO}_2$  + Aq at  $17.5^\circ$  containing:

10	20	30	40% $\text{KNO}_2$
1.049	1.126	1.208	1.295

50	60	70	74.5% $\text{KNO}_2$
1.377	1.491	1.599	1.646

(Oswald.)

100 g.  $\text{H}_2\text{O}$  at  $13.5^\circ$  dissolve 18 g.  $\text{KNO}_2$  + 2.36 g.  $\text{AgNO}_2$ ; at  $25^\circ$ , 23.1 g.  $\text{KNO}_2$  + 5.3 g.  $\text{AgNO}_2$  with excess of  $\text{AgNO}_2$ .

100 g.  $\text{H}_2\text{O}$  at  $13.5^\circ$  dissolve 276 g.  $\text{KNO}_2$  + 26.3 g.  $\text{AgNO}_2$ ; at  $25^\circ$ , 279 g.  $\text{KNO}_2$  + 39.3 g.  $\text{AgNO}_2$  with excess of  $\text{KNO}_2$ . (Oswald.)

See also under  $\text{AgNO}_2$ .

Very sol. in liquid  $\text{NH}_3$  (Franklin, Am Ch J. 1898, 20, 829.)

Deliquesces in 90% alcohol; insol. in cold 94% alcohol. More sol in  $\text{H}_2\text{O}$  than  $\text{KNO}_3$ , but less sol in alcohol. (Fischer.)

Ppt. from its conc. aq. solution by the addition of methyl alcohol. Addition of ethyl alcohol to a conc. aq. solution of  $\text{KNO}_2$  causes separation into two layers, of which the lower aq. solution contains 71.9%  $\text{KNO}_2$  while the upper alcoholic layer contains 6.9%  $\text{KNO}_2$ . (Donath, Ch. Z. 1911, 35, 773.)

Very sl sol. in acetone (Krug and M'Elroy, J. Anal. Ch. 6, 184.)

Insol in acetone. (Tidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4320.)

Insol in methyl acetate. (Naumann, B. 1908, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3602.)

Potassium rhodium nitrite,  $6\text{KNO}_2$ ,  $\text{Rh}_2(\text{NO}_2)_6$ .

See Rhodonitrite, potassium.

Potassium ruthenium nitrite.

See Ruthenonitrite, potassium.

Potassium silver nitrite,  $\text{KNO}_2$ ,  $\text{AgNO}_2 + \frac{1}{2}\text{H}_2\text{O}$

Completely sol. in a little  $\text{H}_2\text{O}$ , but decomp. by more  $\text{H}_2\text{O}$ . Sol. in  $\text{KNO}_2 + \text{Aq}$  without decomp. Insol. in alcohol. (Lang.)

Potassium strontium nitrite,  $2\text{KNO}_2$ ,  $\text{Sr}(\text{NO}_2)_2$ .

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Lang, Pogg. 118. 293.)

Potassium zinc nitrite,  $2\text{KNO}_2$ ,  $\text{Zn}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .

Deliquescent Easily sol. in  $\text{H}_2\text{O}$ . (Lang, J. B. 1862. 101)

$\text{K}_2\text{Zn}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$  Very hygroscopic  
Decomp. by  $\text{H}_2\text{O}$  (Rosenheim, Z. anorg. 1901, 28. 174)

Rhodium nitrite with  $\text{MNO}_2$ .

See Rhodonitrite, M.

Rubidium nitrite,  $\text{RbNO}_2$ .

Deliquescent; very sol. in  $\text{H}_2\text{O}$ , sl. sol. in hot alcohol, almost insol. in acetone. (Ball, Chem. Soc. 1913, 103. 2131.)

Ruthenium nitrite with  $\text{MNO}_2$ .

See Ruthenonitrite, M.

Silver nitrite,  $\text{AgNO}_2$

Sol. in 120 pts. cold  $\text{H}_2\text{O}$  (Mitscherlich), in 300 pts. (Fischer), and more abundantly in hot  $\text{H}_2\text{O}$ .

1 l.  $\text{H}_2\text{O}$  dissolves 3.1823 g. or 0.02067 g. mols. at  $18^\circ$ . (Naumann and Rucker, B. 1905, 38. 2291.)

1 litre  $\text{H}_2\text{O}$  dissolves at—

$0^\circ$	0.0113 mol. $\text{AgNO}_2$
$8^\circ$	0.0159 " "
$14^\circ$	0.0189 " "
$16^\circ$	0.0203 " "
$18^\circ$	0.0216 " "
$25^\circ$	0.0260 " "
$33^\circ$	0.0370 " "

(Pick and Abegg, Z. anorg. 1906, 51. 3.)

1 l.  $\text{H}_2\text{O}$  dissolves 3.609 g.  $\text{AgNO}_2$  at  $21^\circ$ . (Oswald, A. ch. 1914, (9) 1. 33.)

### Solubility in $\text{H}_2\text{O}$ at $t^\circ$ .

$t^\circ$	% $\text{AgNO}_2$
1	0.1539
15	0.2752
25	0.4125
35	0.6018
51	1.0240
60	1.3625

(Creighton and Ward, J. Am. Chem. Soc. 1915, 37. 2335.)

### Solubility in $\text{AgNO}_3 + \text{Aq}$ at $18^\circ$ .

Mols. $\text{AgNO}_3$ per l. of the solution	Mols. $\text{AgNO}_2$ dissolved per l.
0.	0.0207
0.0026	0.0198
0.0052	0.0190
0.0103	0.0189
0.0207	0.0144
0.0413	0.0117
0.0827	0.0096

(Abegg and Pick, B. 1905, 38. 2573.)

1 l. 0.2-N  $\text{NaNO}_2 + \text{Aq}$  dissolves 4.956 g.  $\text{AgNO}_2$  at  $25^\circ$ . (Ley and Schaefer, B. 1906, 39. 1263.)

1 l. sat.  $\text{KNO}_2 + \text{Aq}$  dissolves 26%  $\text{AgNO}_2$  at  $13.5^\circ$ . (Oswald, A. ch. 1914, (9) 1. 33.)

### Solubility in salts + $\text{Aq}$ at $25^\circ$ .

Salt	Conc. of the salt mols. per l.	G. $\text{AgNO}_2$ in 100 g. of solution
		0.4135
$\text{AgNO}_3$	0.00258 0.00588 0.01177 0.02355 0.04710	0.3991 0.3735 0.3432 0.2943 0.2408
$\text{KNO}_2$	0.00258 0.00588 0.01177 0.02355 0.04710	0.3974 0.3820 0.3560 0.3119 0.2765

(Creighton and Ward, J. Am. Chem. Soc. 1915, 37. 2336.)

See also under  $\text{KNO}_2$ .

$\text{AgNO}_2 + \text{NaNO}_2$ .

1 l. 0.02 N- $\text{NaNO}_2 + \text{Aq}$  dissolves 3.185 g.  $\text{AgNO}_2$  at  $25^\circ$ , 0.2-N  $\text{NaNO}_2$ , 3.016 g.  $\text{AgNO}_2$ . (Ley and Schaefer, B. 1906, 39. 1263.)

100 g.  $\text{H}_2\text{O}$  sat. with  $\text{AgNO}_2$  and  $\text{Sr}(\text{NO}_2)_2$  contain 10.9 g.  $\text{AgNO}_2$  and 78.3 g.  $\text{Sr}(\text{NO}_2)_2$  at  $14^\circ$ . (Oswald)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am Ch J. 1898, 20, 829.)

Insol in alcohol.

Sol in acetone. (Eidmann, C. C. 1899, II 1014; Naumann, B. 1904, 37, 4328.)

100 pts. acetone dissolve 23 pts. at ord temp.; 40 pts. at  $81.6^\circ$ . (Scholl and Steinkopf, B. 1906, 39, 4393.)

Sl. sol. in methyl acetate. (Bezold, Dissert 1906.)

Insol. in ethyl acetate. (Hammers, Dissert. 1906; Naumann, B. 1910, 43, 314.)

Silver sodium nitrite,  $\text{AgNO}_2$ ,  $\text{NaNO}_2$ .

Completely sol. in a little  $\text{H}_2\text{O}$ , but decomp. by more  $\text{H}_2\text{O}$ . (Fischer.)

$+\frac{1}{2}\text{H}_2\text{O}$ . (Oswald, A. ch. 1914, (9) 1. 75.)

Silver nitrite ammonia,  $\text{AgNO}_2$ ,  $\text{NH}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; less sol. in alcohol; nearly insol in ether. (Reychler, B. 18, 2425.)

$\text{AgNO}_2$ ,  $2\text{NH}_3$ . (Reychler.)

$\text{AgNO}_2$ ,  $3\text{NH}_3$ . Deliquescent. Sol in  $\text{H}_2\text{O}$ . (Reychler.)

Sodium nitrite,  $\text{NaNO}_2$ .

Not deliquescent. Very sol. in  $\text{H}_2\text{O}$ .

More sol. in  $\text{H}_2\text{O}$  than  $\text{NaNO}_3$ , but less in alcohol.

6 pts.  $\text{H}_2\text{O}$  dissolve 5 pts.  $\text{NaNO}_2$  at  $15^\circ$ . (Divers, Chem Soc. 1899, 75, 86.)

100 g.  $\text{H}_2\text{O}$  dissolve 83.25 g.  $\text{NaNO}_2$  at  $15^\circ$ . (Niemetowski and Roszkowski, J. phys. Ch. 1897, 22, 146.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$   $10^\circ$   $20^\circ$   $30^\circ$   $40^\circ$   
73 78 84 91.5 98 5 pts.  $\text{NaNO}_2$ ,

$50^\circ$   $60^\circ$   $70^\circ$   $80^\circ$   
107 116 125.5 136 pts.  $\text{NaNO}_2$ ,

$90^\circ$   $100^\circ$   $110^\circ$   $120^\circ$   
147 160 5 178 198 5 pts.  $\text{NaNO}_2$ .

B-pt. of sat.  $\text{NaNO}_2 + \text{Aq} = 128^\circ$  at 761.5 mm. pressure. Sat. solution at  $20^\circ$  has a sp. gr. = 1.3585. (Oswald, A. ch. 1914, (9) 1. 59.)

Solubility in  $\text{NaNO}_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	100 pts $\text{H}_2\text{O}$ dissolve	
	$\text{NaNO}_2$	$\text{NaNO}_2$
0	73	0
	68 5	19
	67 1	36 3
	64 9	41.7*
	50.3	46.8
	30 2	55.4
	0	74 2

Solubility in  $\text{NaNO}_2 + \text{Aq}$  at  $t^\circ$ .—Continued.

$t^\circ$	100 pts $\text{H}_2\text{O}$ dissolve	
	$\text{NaNO}_2$	$\text{NaNO}_2$
21	84.75 81 1 79 7 73 8 73 1 64 2 46 8 21.6 0	0 9 6 23 5 50 8 54.5* 56.7 62 8 74 7 89 3
52	108.8 107.9 104.3 101.8 99 5 98 0 97 8 65 2 44 2 27 2 14.7 0	0 6 7 20 6 34.5 43.2 62 6* 82 0 88 0 92 9 101 4 109 118
65	120 7 111 5 108 5 107 8 78.3 49 5 28.4 14.7 0	0 34 8 62 8 90.6* 96 104 1 113.4 121.4 131
81	137 1 125 7 122 7 122 6 79 1 50 0 27 2 0	0 38 8 69 8 101 0* 111 5 121 0 131 7 150
92	149.7 141 2 134 6 132 3 80.2 30 3 0	0 23 6 57 6 107 8* 130 6 145.0 163.5
103	166 153.3 148.8 142.4 100.0 60.1 0	0 33 2 58 8 116 0* 126 8 142.9 181.2

\* Both salts in solid phase.

(Oswald, A. ch. 1914, (9)-1. 71.)

Solubility in  $H_2O$  is decreased by presence of  $Na_2SO_4$ . 100 pts.  $H_2O$  dissolve 11.8 pts.  $Na_2SO_4$  + 53.9 pts.  $NaNO_2$ . (Oswald.)  
Very sol. in liquid  $NH_3$ . (Franklin, Am Ch. J. 1898, 20, 829.)

Neither dissolved nor attacked by liquid  $NO_2$ . (Frankland, Chem. Soc. 1901, 79, 1361.)

Sol. in warm 90% alcohol. (Hampe, A. 125, 336.)

100 pts. absolute methyl alcohol dissolve 4.43 pts. at  $19.5^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 0.31 pt. at  $19.5^\circ$ . (de Bruyn, Z. phys. Ch. 10, 783.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1910, 43, 314.)

#### Strontium nitrite, $Sr(NO_2)_2$ .

Very sol. in  $H_2O$ , and very sl. sol. in boiling alcohol. (Lang, Pogg. 118, 287.)

Easily sol. in 90% alcohol. (Hampe, A. 125, 310.)

+  $H_2O$ . Hygroscopic. 100 cem. of the sat. solution contain 62.83 g.  $Sr(NO_2)_2 + H_2O$  at  $19.5^\circ$ . (Vogel, Z. anorg. 1903, 35, 393.)

100 pts. $H_2O$ dissolve at:				
$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$	
58.9	67.6	75.5	84	pts. $Sr(NO_2)_2 + H_2O$ ,
$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$	
94	105	116	130	pts. $Sr(NO_2)_2 + H_2O$ ,
$80^\circ$	$90^\circ$	$100^\circ$		
145	162	182	pts.	$Sr(NO_2)_2 + H_2O$

Bpt. of sat. solution is  $112.5^\circ$  at 763 mm. pressure. The sat. solution at  $19^\circ$  contains 39.8%  $Sr(NO_2)_2$  and has sp. gr. at  $19^\circ/0^\circ = 1.4461$ . (Oswald, A. ch. 1914, (9) 1, 64.)

Solubility in alcohol 100 cem. of the solution in 90% alcohol contain 0.42 g.  $Sr(NO_2)_2 + H_2O$  at  $20^\circ$ . 100 cem. of the solution in absolute alcohol contain 0.04 g.  $Sr(NO_2)_2 + H_2O$  at  $20^\circ$ . (Vogel, Z. anorg. 1903, 35, 393.)

#### Thallous nitrite, $TlNO_2$ .

Sol in  $H_2O$ . Ppt. from solution in  $H_2O$  by absolute alcohol (Vogel, Z. anorg. 1903, 35, 404.)

Very sol in  $H_2O$ ; insol in alcohol (Ball, Chem. Soc 1913, 103, 2131.)

Zinc nitrite, basic,  $2ZnO, N_2O_3$ .  
(Hampe, A. 125, 334.)

Zinc nitrite,  $Zn(NO_2)_2 + 3H_2O$ .

Deliquescent. Sol. in  $H_2O$  and alcohol. (Lang, J. B. 1862, 90.)

#### Nitrous oxide, $N_2O$ .

See Nitrogen monoxide.

#### Nitroxyl bromide, $NO_2Br$ .

Decomp. spontaneously or with  $H_2O$ . (Hasenbach, J. pr. (2) 4, 1.)

Does not exist. (Fischlich, A. 224, 270.)

#### Nitroxyl chloride, $NO_2Cl$ .

Decomp. by  $H_2O$  without evolution of gas. Probably does not exist. (Geuther, A. 245, 98.)

#### Nitroxyl fluoride, $NO_2F$ .

Absorbed by  $H_2O$  with formation of  $HNO_2$  and  $HOF$ . Decomp. by  $H_2O$ , alcohol, and ether. (Moissan and Lebeau, C. R. 1905, 140, 1024.)

#### Nitroxypyrosulphuric acid, ( $HO$ ) $S_2O_5$ ( $NO_2$ ), $H_2O$ .

Very deliquescent. Sol in  $H_2O$  with decomp. (Weber, Pogg. 142, 602.)

#### Nitryl chloride, $NO_2Cl$ .

See Nitroxyl chloride.

#### Octamine cobaltic compounds.

The formulae of the following octamine cobaltic compounds should be reduced one-half, and they should be classed with the tetramine cobaltic compounds. (Jorgensen, Z. anorg. 2, 279.)

#### Octamine cobaltic carbonate, $Co_2(NH_3)_8(CO_3)_2 + 3H_2O$ .

Easily sol in  $H_2O$ . (Vortmann and Blasberg, B. 22, 2654.)

#### See Carbonatotetramine carbonate.

$Co_2(NH_3)_8(CO_3)_4 + 3H_2O$ . Rather difficultly sol in  $H_2O$ .

— — — chloride (?),  $Co_2(NH_3)_8(OH)_2Cl_4 + 2H_2O$ .

Ppt.  
 $Co_2(NH_3)_8(OH)_2Cl_4$ ,  $2HgCl_2$ ,  
 $Co_2(NH_3)_8(OH)_2Cl_4$ ,  $PtCl_4 + H_2O$ . (Vortmann and Blasberg, B. 22, 2654.)

— — — mercuric chloride,  $Co_2(NH_3)_8Cl_6$ ,  $3HgCl_2 + H_2O$ .

$Co_2(NH_3)_8Cl_6$ ,  $HgCl_2$ . Difficultly sol. in cold  $H_2O$ , decomp. on warming (Vortmann.)

— — — chlorosulphite,  $Co_2(NH_3)_8(SO_3)_2Cl_2 + 4H_2O$ .

Sol. in  $H_2O$  (Vortmann and Magdeburg, B. 22, 2635.)

— — — chromate,  
 $Co_2(NH_3)_8(CrO_4)_2(H_2O)_2 + 2H_2O$ .

Sol. in  $H_2O$  or acetic acid, +  $8H_2O$ . Sol in warm  $H_2O$  or acetic acid.  
 $Co_2(NH_3)_8(CrO_4)_2Cr_2O_7(H_2O)_2 + H_2O$ . Easily sol in  $H_2O$ , from which it is precipitated by dil.  $HNO_3$  + Aq. (Vortmann, B. 15, 5896.)

Octamine cobaltic nitrate,  $\text{Co}_2(\text{NH}_3)_8(\text{NO}_3)_4 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , precipitated by conc  $\text{HNO}_3 + \text{Aq}$  (Vortmann.)

— — — nitratocarbonate,  
 $\text{Co}_2(\text{NH}_3)_8(\text{NO}_3)_2(\text{CO}_3)_2 + \text{H}_2\text{O}$ .

Less sol than other octamine carbonates. (Vortmann and Blasberg, B 22. 2650.)

See Carbonatotetramine cobaltic nitrate.

— — — purpureochloride,  
 $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2$ .

Easily sol. in  $\text{H}_2\text{O}$ ; partly precipitated from aqueous solution by conc  $\text{HCl} + \text{Aq}$ . (Vortmann, B. 10. 1451.)

= Chlorotetramine cobaltic chloride,  
 $\text{ClCo}(\text{NH}_3)_4(\text{OH})_2\text{Cl}_2$ , wick see. (Jorgensen, J pr. (2) 42. 211.)

— — — purpureomercuric chloride,  
 $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2, 6\text{HgCl}_2$ .

Sl. sol in cold, easily in hot  $\text{H}_2\text{O}$ . (Vortmann)

= Chlorotetramine cobaltic mercuric chloride. (Jorgensen, J pr. (2) 42. 211.)

— — — purpureomercuric hydroxychloride,  
 $\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgCl})_4(\text{HgOH})_4\text{Cl}_4$ .

Ppt. (Vortmann and Morgulis, B 22. 2647.)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_4\text{Cl}_4$  (V and M.)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_4\text{Cl}_4(\text{OH})_2$ . (V. and M.)

— — — purpureomercuriodide, basic,  
 $\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_4\text{I}_4$

(Vortmann and Borsbach, B 23. 2805)

— — — purpureochloroplatinate.

Very sl sol. in  $\text{H}_2\text{O}$ . (Vortmann)

= Chlorotetramine cobaltic chloroplatinate,  
 $\text{ClCo}(\text{NH}_3)_4(\text{OH})_2\text{PtCl}_6 + 2\text{H}_2\text{O}$ . (Jorgensen, J. pr. (2) 42. 215.)

— — — roseochloride,  $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2 + 2\text{H}_2\text{O}$ , or  $4\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Vortmann, B 15. 1891.)

See Roseotetramine cobaltic chloride.

— — — roseomercuric chloride,  
 $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2, 6\text{HgCl}_2 + 3\text{H}_2\text{O}$ .  
Ppt. (Vortmann)

— — — roseomercuric hydroxychloride,  
 $\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgCl})_4(\text{HgOH})_4\text{Cl}_6$ .

(Vortmann and Morgulis, B 22. 2647)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_4\text{Cl}_6$ . (V. and M.)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_4\text{Cl}_6(\text{OH})_2$ . (V. and M.)

— — — roseomercuric iodide,  
 $\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgI})_4\text{I}_4$

Ppt Sol in  $\text{HCl}$  or  $\text{HNO}_3$ . (Vortmann and Borsbach, B. 23. 2806.)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgI})_4\text{I}_6$  Ppt. (V. and B.)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgI})_4(\text{OH})_2$  Ppt. (V and B.)

Octamine cobaltic sulphate,  
 $\text{Co}_2(\text{NH}_3)_8(\text{OH})_2(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ . (?)

Insol. in  $\text{H}_2\text{O}$  or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in moderately conc  $\text{HCl} + \text{Aq}$ . (Vortmann and Blasberg, B. 22. 2653.)

$\text{Co}_2(\text{NH}_3)_8(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Vortmann.)

$+ 4\text{H}_2\text{O}$ . Easily sol in  $\text{H}_2\text{O}$ .

See Roseotetramine cobaltic sulphate.

— — — sulphatocarbonate,  
 $\text{Co}_2(\text{NH}_3)_8\text{SO}_4(\text{CO}_3)_2 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vortmann, B 10. 1458)

See Carbonatotetramine cobaltic sulphate.

$\text{Co}_2(\text{NH}_3)_8(\text{SO}_4)_2\text{CO}_3 + 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ . (Vortmann and Blasberg, B. 22. 2650.)

— — — ammonium sulphate,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3\text{NH}_4)_6 + 10\text{H}_2\text{O}$

See Octamine cobaltisulphite, ammonium.

Octamine cobaltisulphurous acid.

Ammonium octamine cobaltisulphite,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3\text{NH}_4)_6 + 10\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vortmann and Magdeburg, B. 22. 2632.)

$\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2(\text{SO}_3\text{NH}_4)_2 + 4\text{H}_2\text{O}$ .

Ammonium barium — — —  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2\text{Ba}_2(\text{NH}_4)_2 + 7\text{H}_2\text{O}$   
Ppt. (V. and M.)

Barium — — —,  $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2\text{Ba}_2 + 7\text{H}_2\text{O}$ .

Ppt (V and M)

Cobaltic — — —,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2\text{Co}_2 + 36\text{H}_2\text{O}$ , and  
 $24\text{H}_2\text{O}$ .

Luteocobaltic — — —,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2(\text{NH}_3)_{12}\text{Co}_2 + 3\text{H}_2\text{O}$ .  
Ppt. (V. and M.)

Octamine iridium chloride,  
 $\text{Ir}_2(\text{NH}_3)_8\text{Cl}_6$ .

Very sol. in  $\text{H}_2\text{O}$  (Palmaer, B. 22. 16.)

Octamine iridium chlorosulphate,  
 $\text{Ir}_2(\text{NH}_3)_8\text{Cl}_6\text{SO}_4 + 4\text{H}_2\text{O}$ .  
(Palmaer.)

Osmiamic acid,  $\text{H}_2\text{N}_2\text{O}_8\text{O}_6$ , or  
 $\text{H}_2\text{N}_2\text{O}_8\text{O}_6(?)$ .

Known only in aqueous solution, which is unstable

**Ammonium osmiamate.**

Easily sol. in  $H_2O$  or alcohol. (Fritzsche and Struve, J. pr. 41. 97.)

**Barium osmiamate,  $BaOsOs_2$ .**

Moderately sol. in  $H_2O$ .

**Lead osmiamate.**

Ppt. Sol. in acids without decomp.

**Lead osmiamate chloride.**

Ppt.

**Mercurous osmiamate.**

Ppt.

**Mercuric osmiamate.**

Ppt.

**Potassium osmiamate,  $K_2OsOs_2$ , or  $K_2N_2Os_2Os_2$ .**

Sl. sol. in cold, much more easily in hot  $H_2O$ . Sl. sol. in alcohol. Insol. in ether.

**Silver osmiamate,  $Ag_2N_2Os_2Os_2$ .**

Extremely sl. sol. in  $H_2O$  or cold  $HNO_3$  + Aq. Sol. in  $NH_4OH$  + Aq.

**Sodium osmiamate.**

Easily sol. in  $H_2O$  or alcohol.

**Zinc osmiamate,  $ZnN_2Os_2Os_2$ .**

Decomp. by  $H_2O$ . Nearly insol. in  $NH_4OH$  + Aq.

**Osmic acid,  $H_2OsO_4$ .**

Stable in  $H_2O$  containing alcohol. Sol. in  $HNO_3$  or  $HCl$  + Aq. Not attacked by  $H_2SO_4$  + Aq. (Moraht and Wischin, Z. anorg. 3. 153.)

100 g.  $H_2O$  dissolve 5.68 g.  $H_2OsO_4$  at  $15^\circ$ . (Squire and Cains, Pharm. J. 1905, 74. 720.)

Attacked by liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

**Barium osmate,  $BaOsO_4 + H_2O$ .**

Insol. in  $H_2O$ . (Claus, Pogg. 65. 205.)

**Calcium osmate,  $CaOsO_4$ .**

Insol. in  $H_2O$ . (Fremy, J. pr. 33. 411.)

**Lead osmate.**

Insol. in  $H_2O$ . (Fremy.)

**Potassium osmate,  $K_2OsO_4 + 2H_2O$ .**

Sl. sol. in cold, much more sol. in hot  $H_2O$ , but is decomp. thereby. Sl. sol. in  $KNO_3$  + Aq. Insol. in dil. or conc. alcohol and ether. (Fremy, A. ch. (3) 12. 516.)

Insol. in conc. saline solutions. (Gibbs, Am. J. Sci. (2) 31. 70.)

**Sodium osmate,  $Na_2OsO_4$ .**

Sol. in  $H_2O$ ; insol. in alcohol and ether. (Fremy, l. c.)

**Perosmic acid.**

See Perosmic acid.

**Osminitrous acid.****Ammonium osminitrite,  $(NH_4)_2Os(NO_2)_2 + 2H_2O$** 

Sol. in  $H_2O$ . Decomp. when solution is warmed. (Wintrebert, C. R. 1905, 140. 586.)

**Barium osminitrite,  $BaOs(NO_2)_2$ .**

+  $H_2O$ ; +  $4H_2O$ . (Wintrebert.)

**Calcium osminitrite,  $CaOs(NO_2)_2 + 4H_2O$ .**

(Wintrebert.)

**Magnesium osminitrite,  $MgOs(NO_2)_2 + 4H_2O$ .**

(Wintrebert.)

**Potassium osminitrite,  $K_2Os(NO_2)_2$** 

Very hygroscopic. Very sol. in  $H_2O$ . Decomp. by  $HCl$ ,  $HBr$  and  $HI$ . (Wintrebert, A. ch. 1903, (7) 28. 135.)

**Silver osminitrite,  $Ag_2Os(NO_2)_2 + 2H_2O$ .**

Sl. sol. in  $H_2O$  with partial decomp. (Wintrebert, C. R. 1905, 140. 586.)

**Sodium osminitrite,  $Na_2Os(NO_2)_2 + 2H_2O$ .**

Sol. in  $H_2O$ . (Wintrebert.)

**Strontium osminitrite,  $SrOs(NO_2)_2 + 2H_2O$ .**

(Wintrebert.)

**Zinc osminitrite,  $ZnOs(NO_2)_2 + \frac{1}{2}H_2O$ .**

(Wintrebert.)

**Osmyloxynitrous acid.****Ammonium osmyloxynitrite,**

$(NH_4)_2OsO_3(NO_2)_2$ .

Decomp. by boiling conc.  $HCl$  and by  $KOH$  + Aq. (Wintrebert, A. ch. 1903, (7) 28. 107.)

**Barium osmyloxynitrite,  $BaOsO_3(NO_2)_2 + 4H_2O$ .**

(Wintrebert.)

**Potassium osmyloxynitrite,  $K_2OsO_3(NO_2)_2 + 3H_2O$ .**

Sl. sol. in cold  $H_2O$ . Aqueous solution decomp. slowly. Sol. with decomp. in dil.  $KOH$  + Aq. (Wintrebert.)

**Silver osmyloxynitrite,  $Ag_2OsO_3(NO_2)_2 + H_2O$ .**

(Wintrebert.)

Strontium osmyloxynitrate,  $\text{SrOsO}_3(\text{NO}_2)_2 + 3\text{H}_2\text{O}$ . (Wintrebert.)

### Osmynitrous acid.

Potassium osmylnitrite,  $\text{K}_2\text{OsO}_2(\text{NO}_2)_4$ .

Decomp. by  $\text{H}_2\text{O}$  and by excess of  $\text{KOH} + \text{Aq}$ . (Weinland, A. ch. 1903, (7) 28. 64.)

### Osmisulphurous acid.

Potassium osmisulphite,  $[\text{Os}(\text{H}_2\text{O})(\text{SO}_2)_2]\text{K}_3 + 4\text{H}_2\text{O}$ .

Ppt. (Rosenheim, Z. anorg. 1899, 21. 144.)

Potassium hydrogen osmisulphite,  $[\text{Os}_2(\text{H}_2\text{O})(\text{SO}_2)_{11}]\text{K}_{11}\text{H}_2 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (Rosenheim.)  
 $[\text{Os}(\text{SO}_2)_2]\text{K}_4\text{H}_2 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Rosenheim.)

Sodium osmisulphite,  $[\text{Os}(\text{SO}_2)_2]\text{Na}_4 + 8\text{H}_2\text{O}$ .

Only sl. sol. in  $\text{H}_2\text{O}$ .

$[\text{Os}_2(\text{H}_2\text{O})(\text{SO}_2)_2]\text{Na}_8 + 4\text{H}_2\text{O}$ . Ppt.  
 $[\text{OsO}(\text{SO}_2)_2]\text{Na}_4 + 3\text{H}_2\text{O}$ . Ppt. (Rosenheim.)

### Osmium, Os.

When finely divided and not ignited to a very high temperature, Os is sol. in  $\text{HNO}_3 + \text{Aq}$  or aqua regia. When ignited it is not attacked by any acid.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. ch. J. 1898, 20.. 828)

### Osmium ammonium comps.

See—

Oxyosmiumamine comps.,  $\text{OsO}(\text{NH}_3)_2\text{X}$ .  
 Oxyosmiumdiamine comps.,  $\text{OsO}_2(\text{NH}_3)_4\text{X}_2$ .

### Osmium bromide with MBr.

See Bromosmate, M.

### Osmium dichloride, $\text{OsCl}_2$ .

Deliquescent. Sol. in little, but decomp. by more  $\text{H}_2\text{O}$ , with pptn. of Os. Sol. in conc. alkali chlorides + Aq with combination and partial decomp. (Berzelius.)

Sol. in alcohol and ether.

Insol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ . Sl. sol. in  $\text{HNO}_3$  and aqua regia. Slowly sol. in strong alkali. Insol. in liquid  $\text{Cl}_2$ . Insol. in alcohol and formaldehyde (Ruff, Z. anorg. 1910, 66. 455.)

### Osmium trichloride, $\text{OsCl}_3$ .

Hydrosopic. Sol. in conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and conc.  $\text{HNO}_3$ . Sol. in alkali and in  $\text{NH}_4\text{OH}$ . Insol. in liquid  $\text{Cl}_2$ . Easily sol. in alcohol. Sl. sol. in ether. (Ruff, Z. anorg. 1910, 66. 453.)

+  $3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Moraht and Wischin, Z. anorg. 3. 153.)

### Osmium tetrachloride, $\text{OsCl}_4$ .

Sol. in a little  $\text{H}_2\text{O}$ , but decomp. by further addition of that solvent. Sol. in conc.  $\text{HCl} + \text{Aq}$ .

### Osmium trichloride with MCl.

See Chlorosmate, M.

### Osmium tetrachloride with MCl.

See Chlorosmate, M.

### Osmium sodium chloride, $\text{Na}_2\text{OsCl}_3 + 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  and in alcohol (Rosenheim, Z. anorg. 1899, 21. 133.)

### Osmium tetrafluoride, $\text{OsF}_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Ruff, B. 1913, 46. 948.)

### Osmium hexafluoride, $\text{OsF}_6$ .

Decomp. by  $\text{H}_2\text{O}$  and conc.  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{NaOH} + \text{Aq}$ . (Ruff, B. 1913, 46. 945.)

### Osmium octofluoride, $\text{OsF}_8$ .

Sol. in  $\text{H}_2\text{O}$ , but is somewhat hydrolyzed. Sol. in conc.  $\text{H}_2\text{SO}_4$  with decomp. Sol. in  $\text{NaOH} + \text{Aq}$ . (Ruff, B. 1913, 46. 944.)

### Osmium monohydroxide, $\text{OsO}$ , $x\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{KOH} + \text{Aq}$ . Slowly but completely sol. in acids. (Berzelius.)

### Osmium dihydroxide, $\text{OsO}_2$ , $\text{H}_2\text{O}$ .

Sol. in  $\text{HCl} + \text{Aq}$  while still moist. Insol. in  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$ .  
 +  $2\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  while still moist (Claus and Jacoby.)

### Osmium sesquihydroxide, $\text{Os}_2\text{O}_3\text{H}_4$ .

Sol. in acids, and partly sol. in  $\text{KOH} + \text{Aq}$ . (Claus and Jacoby.)

### Osmium iodide, $\text{OsI}_4$ .

Extremely deliquescent. Sol. in  $\text{H}_2\text{O}$  of alcohol, but solution is unstable. (Moraht and Wischin, Z. anorg. 3. 153.)

### Osmium potassium nitroschloride, $\text{K}_2\text{Os}(\text{NO})\text{Cl}_4$ .

Stable in aqueous solution. Only sl. attacked by hot  $\text{HNO}_3$ . (Wintrebert, A. ch. 1903, (7) 28. 132.)

### Osmium monoxide, $\text{OsO}$ .

Insol. in  $\text{H}_2\text{O}$  or acids. (Claus and Jacoby.)

### Osmium dioxide, $\text{OsO}_2$ .

Insol. in  $\text{H}_2\text{O}$  or acids.

### Osmium sesquioxide, $\text{Os}_2\text{O}_3$ .

Insol. in acids. (Claus and Jacoby.)

**Osmium trioxide, "Osmic acid,"**  $\text{OsO}_3$ .

See Osmic acid.

**Osmium tetroxide, "Perosmic acid,"**  $\text{OsO}_4$ .

Slowly but abundantly sol in  $\text{H}_2\text{O}$ . Sol in alcohol and ether with gradual decomposition. Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$ , the solution undergoing decomposition on heating.

**Osmium oxide ammonia,**  $\text{OsO}_2 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$ .

See Oxyosmiumamine hydroxide.

**Osmium oxysulphide,**  $\text{Os}_2\text{S}_3\text{O}_5 + 2\text{H}_2\text{O}$ .

Unstable.

$\text{OsSO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ . (v. Meyer, J. pt. (2) 16, 77.)

$\text{Os}_2\text{O}_3\text{S}_2 + \text{H}_2\text{O}$  Decomp and dissolved by  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Moraht and Wischin, Z. anorg. 3, 153.)

**Osmium sulphide,**  $\text{Os}_2\text{S}_3$  (?).

(Berzelius)

Mm *Lauride* Insol in all acids, even in aqua regia.

**Osmium disulphide,**  $\text{OsS}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; not more sol in alkali hydrates or carbonates + Aq. Insol. in alkalis after drying (Fremy, A. ch. (3) 12, 521)

**Osmium tetrakisulphide,**  $\text{OsS}_4 + \text{H}_2\text{O}$ .

Insol. in alkali sulphides, carbonates, or hydroxides + Aq. Sol. in cold dil  $\text{HNO}_3 + \text{Aq.}$  (Claus.)

**Osmocyanhydric acid,**  $\text{H}_4\text{Os}(\text{CN})_6$ .

Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Insol in ether (Martius, A. 117, 361.)

**Barium osmocyanide,**  $\text{Ba}_2\text{Os}(\text{CN})_6 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and dil. alcohol. (M.)

**Barium potassium osmocyanide,**

$\text{BaK}_2\text{Os}(\text{CN})_6 + 3\text{H}_2\text{O}$

Efflorescent. Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ .

**Ferric osmocyanide,**  $\text{Fe}_4[\text{Os}(\text{CN})_6]_3 + x\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ .

**Potassium osmocyanide,**  $\text{K}_4\text{Os}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Moderately sol. in boiling, less in cold  $\text{H}_2\text{O}$ . Insol in alcohol and ether.

**Osmosyl ammonium comps.**

See Oxyosmium amine comps.

**Osmosyl potassium bromide,**  $\text{K}_2\text{OsO}_3\text{Br}_4 + 2\text{H}_2\text{O}$

Same properties as the chloride. (Wintrebert, A. ch. 1903, (7) 28, 94.)

**Osmyl potassium chloride,**  $\text{K}_2\text{OsO}_2\text{Cl}_4$ .

Very sol in  $\text{H}_2\text{O}$ . Solution is stable only in the presence of a small amt. of  $\text{HCl}$ . Decomp. by hot conc.  $\text{HCl}$ .

+  $2\text{H}_2\text{O}$ . As the anhydrous salt. (Wintrebert, A. ch. 1903, (7) 28, 86)

**Osmyl ditetramine comps.**

See Oxyosmium diamine comps.

**Oxamidodisulphonic acid.**

See Hydroxylamine monosulphonic acid.

**Oximidosulphonic acid.**

See Hydroxylamine disulphonic acid.

**Oxyamidodisulphonic acid.**

See Hydroxylamine sulphonic acid.

**Oxyammonium salts.**

See Hydroxylamine salts.

**Oxycobaltamines, acid comps.**

(Maquenne, C. R. 96, 344.)

Are anhydrous oxycobaltamine comps., which see. (Vortmann, M. ch. 6, 404)

**Oxycobaltamine chloride,**

$\text{Co}_2(\text{NH}_3)_{10} \left( \begin{smallmatrix} \text{OH} \\ \text{O}(\text{OH}) \end{smallmatrix} \right) \text{Cl}_4$ .

(Vortmann, M. ch. 6, 404.)

$\text{Co}_2(\text{NH}_3)_{10}\text{O}_2\text{Cl}_4$ ,  $\text{HCl} + 3\text{H}_2\text{O}$ . Is anhydrous oxycobaltamine chloride, which see.

— chloronitrate hydrochloride,

$\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O.OH})(\text{NO}_2)_2\text{Cl}_2$ ,  $4\text{HCl} + 3\text{H}_2\text{O}$ .

Is anhydrous oxycobaltamine chloronitrate, which see.

— chlorosulphate,

$\text{Co}_2(\text{NH}_3)_{10} \left( \begin{smallmatrix} \text{OH} \\ \text{O}(\text{OH}) \end{smallmatrix} \right) (\text{SO}_4)_2\text{Cl}_2$ ,  $4\text{HCl}$

Easily decomp.

— iodide,  $\text{Co}_2(\text{NH}_3)_{10} \left( \begin{smallmatrix} \text{OH} \\ \text{O}(\text{OH}) \end{smallmatrix} \right) \text{I}_4$

Sl. sol in  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$ . (Vortmann)

— nitrate,  $\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O.OH})(\text{NO}_3)_4 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ .

$\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O.OH})(\text{NO}_3)_4$ ,  $\text{HNO}_3 + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ .

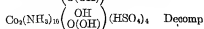
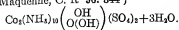
— nitratodisulphate,

$\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O.OH})(\text{SO}_4)(\text{NO}_3)_3$ ,  $4\text{HNO}_3$ .

Decomp. at once by  $\text{H}_2\text{O}$ .

Oxycobaltamine sulphate,  
 $\text{Co}_2(\text{NH}_3)_{10}\text{O}_2(\text{SO}_4)_2, \text{H}_2\text{SO}_4 + \text{H}_2\text{O}.$

Verv sl. sol in  $\text{H}_2\text{O}$  with decomp; more easily sol. in acidified  $\text{H}_2\text{O}$  Sol. in acids (Maquenne, C. R. 96. 344)



violently by  $\text{H}_2\text{O}$

**Oxygen, O.**

100 vols  $\text{H}_2\text{O}$  absorb 4.6 vols O gas at ord temp (Ost-Graham)

Sol in 27 pts  $\text{H}_2\text{O}$  at ord temp (Pelouze and Fremy)

100 vols  $\text{H}_2\text{O}$  dissolve 0.025 vol O (Gay-Lussac)

1 vol  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm. absorbs V vols. O gas, reduced to  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0.04114	7	0.03465	14	0.03034
1	0.04007	8	0.03389	15	0.02989
2	0.03907	9	0.03317	16	0.02949
3	0.03810	10	0.03250	17	0.02914
4	0.03717	11	0.03189	18	0.02884
5	0.03628	12	0.03133	19	0.02858
6	0.03544	13	0.03082	20	0.02838

(Bunsen's Gasometry)

Coefficient of absorption of O by  $\text{H}_2\text{O} = 0.04115 - 0.0010899t + 0.000022563t^2$  (Bunsen and Pauli, A. 93. 21.)

Coefficient of absorption of O in  $\text{H}_2\text{O}$  at  $6.4^\circ = 0.041408$ ; at  $12.6^\circ = 0.036011$  (Timofejew, Z. phys. Ch. 6. 148.)

Absorption of O by  $\text{H}_2\text{O}$   $\beta_1 = \text{"solubility,"}$   $t, e$ , the amount of gas (reduced to  $0^\circ$  and 760 mm) which is absorbed by 1 vol of the liquid when the barometer indicates 760 mm. pressure;  $\beta =$  coefficient of absorption,  $t, e$ , amount absorbed by the liquid when the pressure of the gas itself without the tension of the liquid amounts to 760 mm;  $\beta_1 = \beta \frac{760-f}{760}$ , when  $f =$  vapour tension of solvent at  $t^\circ$ .

$t^\circ$	$\beta$	$\beta_1$
0	0.04890	0.04860
1	4759	4728
2	4633	4601
3	4512	4479
4	4397	4362
5	4286	4250
6	4181	4142
7	4080	4040
8	3983	3941
9	3891	3847
10	3802	3756
11	3718	3670
12	3637	3587
13	3560	3507

Absorption of O by  $\text{H}_2\text{O} - \text{Continued}$

$t^\circ$	$\beta$	$\beta_1$
14	0.3486	0.3431
15	3415	3358
16	3347	3288
17	3283	3220
18	3220	3155
19	3161	3093
20	3102	3031
21	3044	2970
22	2988	2911
23	2934	2853
24	2881	2797
25	2831	2743
26	2783	2691
27	2736	2641
28	2691	2592
29	2649	2545
30	2608	2500
31	2572	2459
32	2537	2419
33	2503	2380
34	2471	2342
35	2440	2306
36	2410	2270
37	2382	2236
38	2355	2203
39	2330	2171
40	2306	2140
41	2280	2107
42	2256	2075
43	2232	2043
44	2209	2012
45	2187	1981
46	2166	1952
47	2145	1922
48	2126	1894
49	2108	1865
50	2090	1837
52	2057	1782
54	2026	1728
56	1998	1674
58	1971	1619
60	1946	1565
62	1921	1508
64	1897	1450
66	1874	1392
68	1853	1332
70	1833	1270
72	1815	1208
74	1799	1144
76	1785	1078
78	1772	1010
80	1761	9939
82	1752	9865
84	1743	9788
86	1736	9707
88	1729	9622
90	1723	9532
92	1717	9437
94	1712	9337
96	1708	9231
98	1704	9119
100	7001	0000

(Winkler, B. 24. 3000)

Absorption of O by H<sub>2</sub>O at t° and 760 mm. $\beta$  = coefficient of absorption.

t°	$\beta$	t°	$\beta$	t°	$\beta$
0	0.04961	23	0.03006	46	0.02163
1	.4838	24	.2950	47	.2139
2	.1720	25	.2904	48	.2115
3	.4606	26	.2857	49	.2092
4	.4406	27	.2808	50	.2070
5	.4350	28	.2762	51	.2049
6	.4286	29	.2718	52	.2029
7	.4186	30	.2676	53	.2009
8	.4089	31	.2635	54	.1990
9	.3994	32	.2596	55	.1973
10	.3903	33	.2558	56	.1955
11	.3816	34	.2521	57	.1938
12	.3732	35	.2486	58	.1922
13	.3651	36	.2452	59	.1907
14	.3573	37	.2410	60	.1893
15	.3497	38	.2367	65	.1832
16	.3425	39	.2356	70	.1787
17	.3357	40	.2326	75	.1752
18	.3292	41	.2297	80	.1726
19	.3230	42	.2269	85	.1707
20	.3171	43	.2241	90	.1693
21	.3114	44	.2214	95	.1684
22	.3059	45	.2188	100	.1679

(Bohr and Boek, W. Ann. (2) 44. 318.)

Coefficient of absorption of O by H<sub>2</sub>O between 0° and 30° = 0.04890 - 0.0013413t + 0.0000283t<sup>2</sup> - 0.00000029534t<sup>3</sup> (Winkler, l. c.)  
 Solubility in H<sub>2</sub>O at 25° = 0.03080; at 15° = 0.03830. (Geffcken, Z. phys. Ch. 1904, 49. 269.)

Absorption of O<sub>2</sub> by distilled H<sub>2</sub>O at t°a = ccn of O<sub>2</sub> absorbed by 1 l. of H<sub>2</sub>O at t° and 760 mm.

t°	a	t°	a	t°	a
0	49.24	17	33.21	34	25.19
1	47.94	18	32.58	35	24.85
2	46.65	19	32.01	36	24.52
3	45.45	20	31.44	37	24.20
4	44.31	21	30.91	38	23.89
5	43.21	22	30.38	39	23.59
6	42.15	23	29.86	40	23.30
7	41.15	24	29.38	41	23.03
8	40.19	25	28.90	42	22.75
9	39.28	26	28.42	43	22.49
10	38.37	27	27.94	44	22.24
11	37.51	28	27.51	45	22.00
12	36.75	29	27.08	46	21.77
13	35.98	30	26.65	47	21.55
14	35.26	31	26.27	48	21.34
15	34.55	32	25.90	49	21.14
16	33.88	33	25.54	50	20.95

(Fox, Trans. Faraday Soc. 1909, 5. 74.)

Solubility in H<sub>2</sub>O at various pressures.

V = volume of the absorbing liquid

P = Hg-pressure in metics.

 $\lambda$  = coefficient of solubility.

V	t°	P	$\lambda$
33.320 ccm.	23°	0.9595	0.02937
		1.0941	0.02939
		1.2883	0.02938
		1.4976	0.02935
		1.7638	0.02939
		2.0838	0.02931
		2.5011	0.02928
		3.0402	0.02909
		3.8875	0.02886
		4.2504	0.02872
32.003 ccm.	25.9°	4.8301	0.02855
		5.1360	0.02832
		5.6973	0.02818
		6.1857	0.02797
		6.7343	0.02772
		7.3051	0.02741
		7.7138	0.02729
		8.1406	0.02708
		0.8611	0.02848
		0.9808	0.02849
		1.0833	0.02846
		1.2039	0.02842
		1.4112	0.02845
		1.6602	0.02847
		2.3854	0.02831
		2.6482	0.02826
		2.8995	0.02816
		3.2883	0.02803
		3.9133	0.02798
		4.2720	0.02785
		4.6905	0.02776
		5.0559	0.02762
		5.6141	0.02749
		6.0120	0.02734
		6.5687	0.02719
		7.1056	0.02687
		7.4729	0.02676
		8.1889	0.02645

(Cassuto, Phys. Zeit. 1904, 5. 236.)

Solubility of O in H<sub>2</sub>O at 25° = 0.0294  
 (Findlay and Creighton, Bioch. J. 1911, 5. 294.)

Coefficient of absorption for H<sub>2</sub>O = 0.03398  
 at 15°; 0.03375 at 15.3°, 0.03330 at 16.2°.  
 (Müller, Z. phys. Ch. 1912, 81. 494.)

Solubility in H<sub>2</sub>O at t°

$l_{760}$  = solubility of atmospheric O<sub>2</sub> in H<sub>2</sub>O at 760 mm and t°.

t°	$l_{760}$	t°	$l_{760}$
0	10.26	13	7.51
1	9.99	14	7.36
2	9.73	15	7.21
3	9.48	16	7.07
4	9.25	17	6.93
5	9.02	18	6.80
6	8.80	19	6.67
7	8.59	20	6.55
8	8.39	21	6.43
9	8.20	22	6.32
10	8.02	23	6.21
11	7.84	24	6.10
12	7.67	25	6.00

(Carlson, Zett. angew. Ch. 1913, 26, 714.)

Solubility of atmospheric O<sub>2</sub> in mixtures of distilled H<sub>2</sub>O with sea water diminishes regularly with the proportion of sea water present. (Clowes, J. Soc. Chem. Ind. 1904, 23, 359.)

No. of ccm. of O<sub>2</sub> absorbed by 1 l. of sea water from a free dry atmosphere of 760 mm. pressure.

Cl per 1000	t=0°	4°	8°	12°	16°	20°	24°	28°
0	10.29	9.26	8.40	7.68	7.08	6.57	6.14	5.75
4	9.83	8.85	8.04	7.36	6.80	6.33	5.91	5.53
8	9.36	8.45	7.68	7.04	6.52	6.07	5.67	5.31
12	8.90	8.04	7.33	6.74	6.24	5.82	5.44	5.08
16	8.43	7.64	6.97	6.43	5.96	5.56	5.20	4.86
20	7.97	7.23	6.62	6.11	5.69	5.31	4.95	4.62

(Fox, Trans. Faraday Soc. 1909, 5, 77.)

For O absorbed from the air, see also air, atmospheric, p. 1.

Absorption of O<sub>2</sub> by acids + Aq.

M = content in gram-equivalents per litre  
S = solubility

HNO<sub>3</sub> + Aq.

M	S 25°	S 15°
0.492	0.03021	0.03478
0.494	0.03016	0.03490
1.00	0.02954	0.03354
1.008	0.02963	0.03365
1.88	0.02853	0.03175
1.901		0.03166

Absorption of O<sub>2</sub> by acids + Aq.—Continued

## HCl + Aq.

M	S 25°	S 15°
0.578	0.02963	0.03431
0.579	0.02960	0.03410
1.170	0.02817	0.03217
1.176	0.02833	0.03109
1.736	0.02733	0.03069
1.982	0.02674	0.02988

 $\frac{H_2SO_4}{2} + Aq$ 

M	S 25°	S 15°
0.489	0.02887	0.03366
0.527	0.02875	0.03375
0.977	0.02757	0.03210
1.017	0.02745	0.03217
1.896	0.02545	0.02886
1.829	0.02577	0.02930
2.947	0.02285	0.02584
3.512	0.02198	0.02399
4.951		0.02174
5.293	0.01918	0.02067

(Geffcken, Z. phys. Ch. 1904, 49, 269.)

Absorption of O<sub>2</sub> by H<sub>2</sub>SO<sub>4</sub> + Aq at t°.

$\alpha$  = coefficient of absorption

Normality of the acid	t°	$\alpha$
0	20.9	0.0310
4.9	20.9	0.0195
8.9	20.9	0.0155
10.7	21.2	0.0143
20.3	21.1	0.0119
24.8	21.5	0.0103
29.6	20.8	0.0117
34.3	20.9	0.0201
35.8	21.2	0.0275

(Bohr, Z. phys. Ch. 1910, 71, 49.)

Absorption of O<sub>2</sub> by NaOH + Aq.

M = content in gram-equivalents per litre  
S = solubility.

M	S 25°	S 15°
0.559	0.02434	0.02777
0.601	0.02424	0.02784
1.033	0.02020	0.02291
1.059	0.01991	0.02262
2.077	0.01295	0.01479
2.089	0.01272	0.01456

Absorption of O<sub>2</sub> by KOH+Aq.

M	S 25°	S 15°
0 577	0 02447	0.02791
0 579	0 02435	0.02791
1 157	0 01920	0.02191
1 170	0 01914	0.02181

(Geffcken, Z. phys. Ch. 1904, 49. 270.)

NaCl+Aq with a chlorine content of 1,930 per 100,000 dissolved 82.9% of the amount of O<sub>2</sub> dissolved by distilled H<sub>2</sub>O alone (Clowes, J. Soc. Chem. Ind 1904, 23. 359.)

Absorption of O<sub>2</sub> by salts+Aq.

M = content in gram-equivalents per litre.  
S = solubility.

Absorption of O = by  $\frac{K_2SO_4}{2}$  + Aq.

M	S 25°	S 15°
0 499	0 02528	0 02944
0 506	0 02530	0 02922
0 968		0 02395
0 970	0 02096	0 02377

Absorption of O<sub>2</sub> by NaCl+Aq

M	S 25°	S 15°
0 530	0.02598	0 03045
0 535	0 02604	0 03052
1 020	0 02226	0.02601
1.034	0 02202	0.02557
1 880		0.01898
1 890	0.01863	0.01904
1 921	0.01654	0.01869

(Geffcken, Z. phys. Ch. 1904, 49. 270.)

Solubility of O<sub>2</sub> in NaCl+Aq.

Data indicate cc. O<sub>2</sub> dissolved per l at 760 mm. and 0°.

t°	NaCl+Aq 1 g. mol. per l.	NaCl+Aq 2 g. mol. per l.	NaCl+Aq sat. at 20°
0	6.50	3 14	1 27
5	5.80	2 84	1 22
10	5.25	2 59	1 17
15	4.77	2 41	1.12
20	4.39	2 25	1 07
25	4 06	2 13	1 02
30	3 76	2 01	0 97

\* (Winkler, Z. anorg. 1911, 24. 342.)

Solubility of O<sub>2</sub> in KCN+Aq at 20°.

% KCN 1 10 20 30 50  
Coeff. of abs. 0.029 0.018 0 013 0.008 0.003  
(McLaurin, J. S. C. I. 1893, 63. 737.)

1 vol. alcohol absorbs 0.28397 vol O at all temperatures between 0° and 24°. (Bunsen.)

## Absorption by alcohol (99.7%) at t°.

$\beta$  = coefficient of absorption;

$\beta_1$  = solubility. (See p 635.)

t°	$\beta$	$\beta_1$
0	0 23370	0 22978
1	0 23296	0 22878
2	0.23222	0.22777
3	0.23149	0.22675
4	0 23077	0.22572
5	0.23005	0 22469
6	0 22934	0 22365
7	0 22863	0 22260
8	0 22793	0 22155
9	0 22724	0 22047
10	0 22656	0 21937
11	0 22588	0.21827
12	0 22521	0 21715
13	0 22455	0.21601
14	0 22389	0 21484
15	0 22324	0 21365
16	0.22259	0 21245
17	0 22195	0 21122
18	0 22132	0 20994
19	0 22069	0 20862
20	0 22007	0 20733
21	0 21946	0 20600
22	0 21886	0 20459
23	0 21826	0.20317
24	0 21767	0 20172

(Timofejew, Z. phys. Ch. 6. 151.)

Solubility of O<sub>2</sub> in alcohol at 20° and 760 mm.

Wt % alcohol	Vol % abs O <sub>2</sub>	Wt % alcohol	Vol. % abs. O <sub>2</sub>
0 0	2 98	33 33	2.67
9 09	2.78	50 0	3 50
16 67	2.63	66 67	4.95
23.08	2.52	80 0	5 66
28 57	2 49		

(Lubarsch, W. Ann. 1889, (2) 37. 525.)

Solubility of O<sub>2</sub> in methyl alcohol at t°.

t°	l	t°	l.
0	0.31864	25	0.23642
5	0.30506	30	0 21569
10	0.29005	40	0 16990
15	0 27361	50	0.11840
20	0 25574		

(Levi, Gazz. ch. it 1901, 31. II, 513.)

Solubility of O<sub>2</sub> in ether at 0° = 0.4235; at 10° = 0.4215 (Christoff, Z. phys. Ch. 1912, 79. 459.)

Solubility of O<sub>2</sub> in acetone at t°

t°	l.	t°	l.
0	0.2997	25	0.2127
5	0.2835	30	0.1935
10	0.2667	40	0.1533
15	0.2493	50	0.1067
20	0.2313		

(Levi, Gazz. ch. it 1901, 31, II, 513.)

Absorption of O<sub>2</sub> by chloralhydrate + Aq.

t° = temp. of the solution.  
 P = % chloralhydrate in the solution.  
 $\beta$  t° = coefficient of absorption at t°.  
 $\beta$  15° = coefficient of absorption at 15°.  
 $\beta$  20° = coefficient of absorption at 20°.

t°	P	$\beta$ t°	$\beta$ 15°
18.3	22.9	0.02759	0.02940
16.9	28.0	0.02690	0.02800
15.4	36.6	0.02590	0.02560
16.6	38.6	0.02402	0.02477
12.8	51.3	0.02439	0.02339
16.2	58.44	0.02350	0.02407
15.9	70.0	0.02659	0.02710
17.2	80.85	0.03200	0.03300
16.9	80.9	0.03140	0.03250

			$\beta$ 20°
20.0	16.9	0.02795	0.02795
21.0	32.0	0.02443	0.02495
21.0	52.9	0.02375	0.02325
20.4	61.08	0.02390	0.02410
21.8	65.5	0.02500	0.02580
21.0	71.4	0.02680	0.02730
22.2	78.0	0.03090	0.03280

(Müller, Z. phys. Ch. 1912, 81, 499)

Absorption of O<sub>2</sub> by glycerine + Aq

t° = temp. of the solution.  
 P = % glycerine in the solution.  
 $\beta$  t° = coefficient of absorption at t°.  
 $\beta$  15° = coefficient of absorption at 15°.

t°	P	$\beta$ t°	$\beta$ 15°
12.2	20.5	0.02904	0.02742
12.5	25.0	0.02654	0.02521
14.6	37.3	0.02038	0.02022
13.5	45.0	0.01800	0.01744
12.4	52.0	0.01623	0.01570
12.1	71.5	0.01010	0.00950
13.3	88.5	0.00906	0.00886

(Müller.)

Absorption of O<sub>2</sub> by glucose + Aq.

t° = temp. of the solution.  
 P = % glucose in the solution.  
 $\beta$  t° = coefficient of absorption at t°.  
 $\beta$  20° = coefficient of absorption at 20°.

t°	P	$\beta$ t°	$\beta$ 20°
21.2	10.84	0.02650	0.02690
21.5	20.7	0.02202	0.02250
19.9	33.8	0.01814	0.01815
20.5	51.9	0.01378	0.01390
21.7	58.84	0.01221	0.01250

(Müller)

Absorption of O<sub>2</sub> by sucrose + Aq.

t° = temp. of the solution.  
 P = % sucrose in the solution.  
 $\beta$  t° = coefficient of absorption at t°.  
 $\beta$  15° = coefficient of absorption at 15°.

t°	P	$\beta$ t°	$\beta$ 15°
15.3		0.03375	0.03400
16.2		0.03330	0.03397
16.0	12.1	0.02911	0.02969
15.6	24.38	0.02367	0.02396
16.6	28.44	0.02113	0.02181
15.6	42.96	0.01582	0.01600
16.2	49.25	0.01348	0.01380
17.2	50.0	0.01302	0.01359

(Müller.)

Abundantly absorbed by oil of turpentine. Oil of turpentine absorbs its own vol. O when exposed two weeks to the air, but does not give it off on boiling. (Brandes.)

Absorbed by other oils, but this is decomposition rather than absorption, as the oils are oxidized. (See Storer's Diet.)

100 vols. arterial blood dissolve 10-13 vols. O. (Magnus.)

Coefficient of absorption for petroleum = 0.202 at 20°; 0.229 at 10°. (Gniewas and Walfisz, Z. phys. Ch. 1, 70.)

The author examined the solubility of O<sub>2</sub> and N<sub>2</sub> at low temp. in alcohols, ethers, acetone, CHCl<sub>3</sub>, petroleum, benzene and various inorganic liquids; at low temp. the solubility of the N<sub>2</sub> increases at the same rate as that of the O<sub>2</sub> (Claude, C. R. 1900, 131, 448.)

## Oxymercuriammonium bromate,



(Rammelsberg, Pogg. 55, 82.)

— carbonate, (NH<sub>4</sub>OH<sub>2</sub>)CO<sub>3</sub> +  $\frac{1}{2}$ H<sub>2</sub>O.

Insol. in H<sub>2</sub>O. Decomp. by HCl + Aq. only when conc. Not decomp. by boiling KOH + Aq. Decomp. by KI or K<sub>2</sub>S + Aq. (Hnzcl.) + H<sub>2</sub>O. As above. (Hnzcl.)

**Oxydimercuri ammonium chloride,**  
( $\text{NH}_2\text{OH}_2$ )Cl.

Is dimercuri ammonium chloride,  $\text{NH}_2\text{Cl} + \text{H}_2\text{O}$ , which see

— **oxybimercuri ammonium chloride,**  
( $\text{NH}_2\text{OH}_2$ )Cl, ( $\text{NH}_2\text{OH}_2$ ) $\text{H}_2\text{Cl}$  (?)

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HCl} + \text{Aq.}$  More difficultly sol. in very dil.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq.}$  Insol. in conc.  $\text{H}_2\text{SO}_4$ . Sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq.}$  or ( $\text{NH}_4$ ) $\text{SO}_4 + \text{Aq.}$  Decomp. by  $\text{KOH} + \text{Aq.}$  (Schmieder.)

— **chromate,** ( $\text{NH}_2\text{OH}_2$ ) $\text{CrO}_4$ .

Not decomp. by  $\text{KOH} + \text{Aq.}$  (Hirzel, J. B. 1852. 421.)

— **mercuric chromate,** ( $\text{NH}_2\text{OH}_2$ ) $\text{CrO}_4$ ,  $4\text{HgO}$ ,  $3\text{CrO}_3$

Decomp. by  $\text{HNO}_3$  without going into solution. Easily sol. in  $\text{HCl}$  (Hirzel.)

Composition is ( $\text{NH}_2\text{OH}_2$ ) $\text{O}$ ,  $2\text{CrO}_3$ ,  $3[(\text{NH}_4)_2\text{O}$ ,  $2\text{Cr}_2\text{O}_3] = (\text{NH}_2\text{OH}_2)_2\text{Cr}_2\text{O}_7$ ,  $3(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ . (Heusgen, R. t. c. 6. 187.)

Probably ( $\text{NH}_2\text{OH}_2$ ) $\text{Cr}_2\text{O}_7$ ,  $3(\text{NH}_4)_2\text{Cr}_2\text{O}_7 + 2\text{H}_2\text{O}$ .

— **fluoride, acid,** ( $\text{NH}_2\text{OH}_2$ )F, HF.

(Finkener, Pogg. 110. 632.)

Probably  $\text{NH}_2\text{F}$ ,  $\text{HF} + \text{H}_2\text{O}$

— **hydroxide,** ( $\text{NH}_2\text{OH}_2$ )OH =  $\text{NH}_2\text{OH} + \text{H}_2\text{O}$ .

(Millon's base.) Sl. sol. in  $\text{H}_2\text{O}$ , especially if warm. Sol. in 13,000 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ , and 1700 pts. at  $80^\circ$ . Insol. in alcohol or ether. (Gerresheim, A. 195. 373.)

+  $\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol. in traces in  $\text{NH}_4\text{OH} + \text{Aq.}$  Not decomp. by cold  $\text{KOH} + \text{Aq.}$ ; sl. decomp. if hot (Millon.)

— **ammonium iodate,** ( $\text{NH}_2\text{OH}_2$ )IO $_3$ ,  $2\text{NH}_4\text{IO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Millon, A. ch. (3) 18. 410.)

— **iodide,** ( $\text{NH}_2\text{OH}_2$ )I.

Sol. in warm  $\text{HCl} + \text{Aq.}$  Not decomp. by boiling  $\text{KOH} + \text{Aq.}$  Sol. in warm  $\text{KI} + \text{Aq.}$  (Rummelsberg, Pogg. 48. 170.)

Correct formula is  $\text{NH}_2\text{OI} + \text{H}_2\text{O}$ . (Rummelsberg.)

— **nitrate,** ( $\text{NH}_2\text{OH}_2$ )NO $_3$ .

Insol. in  $\text{H}_2\text{O}$ ; not decomp. by boiling  $\text{KOH} + \text{Aq.}$  Sol. in cold  $\text{HCl} + \text{Aq.}$  from which it is precipitated by  $\text{H}_2\text{O}$ . Sl. sol. without decomp. in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Soubeiran.)

Is dimercuri ammonium nitrate,  $\text{NH}_2\text{NO}_3$ . (Pesci, Gazz. ch. it. 20. 485.)

— **ammonium nitrate,**  $\text{NH}_2\text{OH}_2\text{NO}_3$ ,  $2\text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Kane, A. ch. 72. 242.)

Is dimercuri ammonium ammonium nitrate,  $\text{NH}_2\text{NO}_3$ ,  $2\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$ . (Pesci.)

**Oxybimercuri ammonium oxide,**  
( $\text{NH}_2\text{OH}_2$ ) $\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol; not attacked by boiling conc.  $\text{KOH} + \text{Aq.}$  Sol. in hot  $\text{NH}_4\text{NO}_3$ , +  $\text{Aq.}$ ,  $\text{NH}_4\text{Cl} + \text{Aq.}$ , ( $\text{NH}_4$ ) $\text{SO}_4 + \text{Aq.}$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq.}$ , ( $\text{NH}_4$ ) $\text{C}_2\text{O}_4 + \text{Aq.}$  (Millon, A. ch. (3) 18. 397.)

— **mercuric phosphate,**  $\text{Hg}(\text{NH}_2\text{OH}_2)\text{PO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Slowly sol. in hot  $\text{HNO}_3 + \text{Aq.}$ , not decomp. by boiling with  $\text{KOH} + \text{Aq.}$ , but by  $\text{KI}$  or  $\text{K}_2\text{S} + \text{Aq.}$  Sol. in  $\text{HCl} + \text{Aq.}$  or much hot ( $\text{NH}_4$ ) $\text{HPO}_4 + \text{Aq.}$  (Hirzel.)

— **mercuric sulphite,** ( $\text{NH}_2\text{OH}_2$ ) $\text{SO}_3$ ,  $\text{HgSO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in much ( $\text{NH}_4$ ) $\text{SO}_4 + \text{Aq.}$  Sol. in  $\text{HCl} + \text{Aq.}$  with decomposition. Insol. in boiling  $\text{KOH} + \text{Aq.}$  (Hirzel.)

— **sulphate,** ( $\text{NH}_2\text{OH}_2$ ) $\text{SO}_4$ .

Sol. in traces in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$  (Kane.)

Insol. in  $\text{HNO}_3 + \text{Aq.}$  (Hirzel.)

Slowly sol. in boiling conc.  $\text{H}_2\text{SO}_4$ . (Hirzel.)

Insol. in conc., easily sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Schmieder, J. pr. 75. 147.)

Moderately sol. in much ( $\text{NH}_4$ ) $\text{SO}_4$  or boiling  $\text{NH}_4\text{Cl} + \text{Aq.}$  Not decomp. by boiling  $\text{KOH} + \text{Aq.}$  (Hirzel.)

Easily decomp. by boiling with dil.  $\text{KOH} + \text{Aq.}$  (Schmieder.)

Does not exist. (Pesci.)

$2\text{NH}_3$ ,  $2\text{HgO}$ ,  $\text{SO}_4$

See Dimercuri ammonium sulphate.

**Oxytrimercuri ammonium chloride,**  
( $\text{NH}_2\text{OH}_2$ ) $\text{Cl}$  (?)

Insol. in  $\text{H}_2\text{O}$ .

— **nitrate,** ( $\text{NH}_2\text{OH}_2$ )NO $_3$ .

Sol. in cold  $\text{HCl} + \text{Aq.}$  from which it is precipitated by  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  without decomp. Not decomp. by  $\text{H}_2\text{SO}_4$  or warm  $\text{KOH} + \text{Aq.}$  (Pagenstecher.) Does not exist (Pesci, Gazz. ch. it. 20. 485.)

**Oxytrimercuri diammonium sulphate,**  
 $2\text{NH}_3$ ,  $3\text{HgO}$ ,  $\text{SO}_4$ .

See Trimercuri ammonium sulphate.

**Oxytrimercuri oxydimercuri ammonium sulphate,**  
 $\text{NH}_2\text{Hg}_2\text{O}_2 > \text{SO}_4$ .

Completely sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  or ( $\text{NH}_4$ ) $\text{SO}_4 + \text{Aq.}$  Sol. in dil. or conc.  $\text{HCl} + \text{Aq.}$  and very dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Insol. in  $\text{HNO}_3 + \text{Aq.}$  or conc.  $\text{H}_2\text{SO}_4$ . (Schmieder.)

Does not exist. (Pesci.)

**Oxytetramercuriammonium mercuric nitrate** (?),  $2(\text{NH}_4\text{O}_2)\text{NO}_2$ ,  $\text{HgNO}_2$  (?).

Completely insol. in  $\text{HNO}_3 + \text{Aq.}$  Sol. in warm  $\text{HCl} + \text{Aq.}$  Slowly decomp. by boiling  $\text{KOH} + \text{Aq.}$  Gradually sol. in hot conc.  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Hirzel.)

Does not exist. (Pesci, Gazz. ch. it. 20. 485.)

**Oxynitrosulphonic anhydride,**



Sol. in  $\text{H}_2\text{O}$  with decomp. (Weber, Pogg. 123. 339.)

**Oxysmiumamine hydroxide (Osmosyldiamine hydroxide),**



Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in acids. Sol. in  $\text{KOH} + \text{Aq.}$  When moist, sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$

**Oxysmiumdiamine chloride (Osmyletamine chloride),**  $\text{OsO}_2(\text{N}_2\text{H}_4\text{Cl})_2$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Gibbs, Am. Ch. J. 3. 233.)

— chloroplatinate,  $\text{OsO}_2(\text{N}_2\text{H}_4\text{Cl})_2$ ,  $\text{PtCl}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— hydroxide,  $\text{OsO}_2(\text{N}_2\text{H}_4\text{OH})_2$ .

Known only in solution

— nitrate,  $\text{OsO}_2(\text{N}_2\text{H}_4\text{NO}_2)_2$ .

— sulphate,  $\text{OsO}_2(\text{N}_2\text{H}_4)_2\text{SO}_4 + \text{H}_2\text{O}$ .

(Gibbs, Am. Ch. J. 3. 233.)

**Oxyphosphuretted hydrogen** (?),  $\text{P}_2\text{H}(\text{OH})$ .

$\text{P}_2\text{O}$  of Leverrier, and Goldschmidt has this formula according to Franke (J. pr. (2) 35. 341). Decomp. slowly by  $\text{H}_2\text{O}$  or alkalis. Forms potassium salt,  $\text{P}_2\text{H}(\text{OK})$ , sol. in  $\text{H}_2\text{O}$ .

— hydroxide,  $\text{P}_2\text{H}(\text{OH})$ ,  $\text{HI}$ .

Decomp. at  $80^\circ$ .

**Sesquioxysulphuric acid,**  $\text{Pt}_2\text{O}_5$ ,  $3\text{SO}_3$ ,  $\text{SO}_4\text{H}_2 + 11\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Blondel, A. ch. 1905, (8) 6. 113.)

**Barium sesquioxysulphate,**  $\text{Pt}_2\text{O}_5$ ,  $3\text{SO}_3$ ,  $\text{SO}_4\text{Ba} + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Blondel.)

**Potassium sesquioxysulphate,**  $\text{Pt}_2\text{O}_5$ ,  $3\text{SO}_3$ ,  $\text{SO}_4\text{K}_2 + 2\text{H}_2\text{O}$

(Blondel.)

**Sodium sesquioxysulphate,**  $\text{Pt}_2\text{O}_5$ ,  $3\text{SO}_3$ ,  $\text{SO}_4\text{Na}_2 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Blondel.)

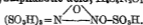
**Oxysulphantimonic acid.**

See Sulphoxyantimonic acid.

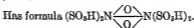
**Oxysulpharsenic acid.**

See Sulphoxyarsenic acid.

**Oxysulphazotic acid,**  $\text{H}_2\text{S}_2\text{N}_2\text{O}_{14} =$



Known only in its salts. (Claus, A. 158. 52, 194.)

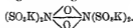


(Raschig, A. 241. 161.)

**Potassium oxysulphazotate,**  $\text{NO}(\text{SO}_2\text{K})_2$ .

Insol. in alcohol (Fremy, A. ch. (3) 15. 451.)

According to Raschig the formula is



Very sol. in water, with rapid decomposition. (Raschig.)

See also Peroxylaminesulphonate, potassium.

**Oxysulphotungstic acid.**

See Sulphotungstic acid.

**Oxysulphovanadic acid.**

See Sulphoxyvanadic acid.

**Ozone,  $\text{O}_3$ .**

Not appreciably sol. in  $\text{H}_2\text{O}$ . (Schönbein.) Imparts its taste and properties to  $\text{H}_2\text{O}$ . (Williamson.)

Later, Carius (B. 5. 520) found that 1000 vols.  $\text{H}_2\text{O}$  at  $1-2.5^\circ$  absorb 5.11 vols.  $\text{O}_3$  (red. to  $0^\circ$  and 760 mm.). He also still later (A. 174. 1) found, by conducting the gas for 9-12 hours through  $\text{H}_2\text{O}$ , that 1000 vols.  $\text{H}_2\text{O}$  absorb a maximum of 28.160 vols.  $\text{O}_3$ . The ozonized oxygen used contained 3.44 vols.  $\text{O}_2$  in 100 vols.  $\text{O}_3$ . Since gases are absorbed in proportion to their partial pressure, which is very small for the  $\text{O}_3$ , the amount of absorption of water for the  $\text{O}_3$  is very considerable. Carius calculated the coefficient of absorption at  $+1^\circ$  to be 0.834.

Ozone is not at all absorbed by  $\text{H}_2\text{O}$ ; the  $\text{H}_2\text{O}$  through which ozone had been passed gave no reactions for ozone. (Rammelsberg, B. 6. 603.)

Schöne (B. 6. 1224) corroborates Carius, and finds 8.81 vols. to 1000 vols.  $\text{H}_2\text{O}$  as a maximum amount absorbed.

Sol. in  $\text{H}_2\text{O}$ . (Leeds, B. 12. 1831.)

H<sub>2</sub>O takes up  $\frac{2}{3}$  of its vol of O<sub>3</sub> at 0° and 760 mm. pressure and  $\frac{1}{2}$  of its vol at 12°, or about 15 times that of oxygen at the same pressure and temp (Mailfert, C R 1894, 119. 951.)

Solubility in H<sub>2</sub>O at t°.

Temp	Wt. O <sub>3</sub> dissolved in 1 l H <sub>2</sub> O	Wt O <sub>3</sub> in gas-ous mixture above the solution	Coefficient of solubility of O <sub>3</sub>
0	39.4 mgr.	61.5 mgr.	0.641
6	34.3	61	0.562
11.8	29.9	59.6	0.500
13	28	58.1	0.482
15	25.9	56.8	0.456
19	21	55.2	0.381
27	13.9	51.4	0.270
32	7.7	39.5	0.195
40	4.2	37.6	0.112
47	2.4	31.2	0.077
55	0.6	19.2	0.031
60	0.0	12.3	0.000

(Mailfert, C. R. 1894, 119. 952.)

Solubility of ozone in acidulated H<sub>2</sub>O

Temp	Coefficient of solubility of ozone	Composition of solution
30°	0.240	} 1 l. H <sub>2</sub> O + 0.7 cc. H <sub>2</sub> SO <sub>4</sub> 1 l. H <sub>2</sub> O + 0.9 cc. " 1 l. " + 0.3 cc. "
33	0.224	
42.7	0.174	
40	0.156	
57	0.096	

(Mailfert.)

0.00002 pt. by weight is sol in 1 pt. by weight H<sub>2</sub>O at ordinary temp. and pressure (Ladenburg, B 1898, 31. 2510.)

The solution of O<sub>3</sub> in H<sub>2</sub>O cannot be brought into equilibrium, because when the gas is blown through the liquid, a portion is continually decomposed, although the concentration remains constant (Ingles, Chem. Soc. 1903, 89. 1012.)

About 10 mg. ozone are sol. in 1 l. H<sub>2</sub>O at +2°; 1.5 mg. ozone are sol. at +28°. (Moufang, C. C. 1911, II. 1674.)

Solubility in 0.1-N H<sub>2</sub>SO<sub>4</sub>

C solution: C gas = 0.23 at 20°; 0.44 at 0°. (Luther, Z. Elektrochem 1905, 11. 833.)

The absorption coefficient of the gas in 0.1 N H<sub>2</sub>SO<sub>4</sub> solution is 0.487 (Rothmund, C. C. 1912, I. 1261.)

Sol. in H<sub>2</sub>C<sub>2</sub>O<sub>4</sub> + Aq. (Jeremin, B. 11. 988.) Completely absorbed by oil of turpentine and oil of cinnamon. (Soret, A. ch. (4) 17. 113.)

Dipalladamine chloride, Cl<sub>2</sub>Pd<sub>2</sub>(NH<sub>3</sub>)<sub>4</sub>Cl<sub>4</sub> =



Sl. sol. in H<sub>2</sub>O. (Dewille and Debray, C. R. 38. 296.)

Palladium, Pd

Not attacked by H<sub>2</sub>O. Sl. attacked by HCl + Aq, but Pd sponge or filings are easily dissolved in warm HCl + Aq, with access of air. HNO<sub>3</sub> + Aq of 1.2 sp. gr dissolves Pd slightly, but it is easily sol in HNO<sub>3</sub> + Aq of 1.35 sp gr (Rose)

Easily sol. in aqua regia. Sl sol in conc., but insol in dil HI + Aq. Sol in conc boiling H<sub>2</sub>SO<sub>4</sub>. Sol. in boiling FeCl<sub>3</sub> + Aq. Sol. in HBr + Aq with a little HNO<sub>3</sub>.

Insol in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 828)

Palladium ammonium compounds.

See—

Dipalladamine comp., Cl<sub>2</sub>Pd<sub>2</sub>(NH<sub>3</sub>)<sub>4</sub>Cl<sub>4</sub>

Palladosamine " Pd(NH<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub>

Palladosamine " Pd(NH<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub>

Palladium dibromide.

Not known in pure state.

Palladium bromide with MBr.

See Bromopalladite, M.

Palladium tetrabromide with MBr.

See Bromopalladate, M.

Palladous phosphorus bromide, Pd<sub>2</sub>P<sub>2</sub>Br<sub>10</sub>.

Properties as the corresponding chloride. (Strecker, B. 1909, 42. 1776)

Palladium subchloride, Pd<sub>2</sub>Cl<sub>3</sub>

Deliquescent. Decomp. by H<sub>2</sub>O, NH<sub>4</sub>Cl, KI, or NH<sub>4</sub>OH + Aq. (Kane.)

Sol. in acetone. Naumann, B 1904, 37. 4328.)

Palladium dichloride, PdCl<sub>2</sub>

Slowly but completely sol. in H<sub>2</sub>O + 2H<sub>2</sub>O. Not deliquescent when pure. Slowly sol. in H<sub>2</sub>O. Much more sol in H<sub>2</sub>O containing HCl

Sol. in acetone (Eidmann, C. C. 1899, II. 1014.)

Sol. in ethyl acetate. Naumann, B 1904, 37. 3601)

Palladium dichloride with MCl.

See Chloropalladite, M.

Palladium tetrachloride with MCl.

See Chloropalladate, M.

Palladous phosphorus chloride, PdCl<sub>2</sub>, PCl<sub>2</sub>.

Decomp. by H<sub>2</sub>O into deliquescent P(OH)<sub>3</sub>, PdCl<sub>2</sub>. Decomp by alcohol. (Fink, C. R. 115. 176.)

Decomp. by H<sub>2</sub>O. Sol. in CHCl<sub>3</sub> and C<sub>6</sub>H<sub>6</sub>. Insol in ligroin and CCl<sub>4</sub>. (Strecker, B 1909, 42. 1775)

PdCl<sub>2</sub>, 2PCl<sub>2</sub>. Sol. in C<sub>6</sub>H<sub>6</sub>, and decomp. by H<sub>2</sub>O (Fink.)

**Palladous chloride carbon monoxide**,  $\text{PdCl}_2 \cdot 2\text{CO}$

Decomp. by heat (Fink, C. R. 1898, 126, 648)

$2\text{PdCl}_2 \cdot 3\text{CO}$  Decomp. by  $\text{H}_2\text{O}$  Sol. in  $\text{CCl}_4$  (Fink)

**Palladium difluoride**,  $\text{PdF}_2$

Sl. sol. in  $\text{H}_2\text{O}$  or  $\text{HF} + \text{Aq}$  Sl. sol. while moist, in  $\text{NH}_4\text{OH} + \text{Aq}$ , insol. after drying, in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol. in boiling  $\text{NaF}$  or  $\text{NaHF}_2 + \text{Aq}$  (Berzelius)

**Palladium hydride**,  $\text{Pd}_3\text{H}$  (?)

**Palladous hydroxide**,  $\text{PdO} \cdot x\text{H}_2\text{O}$  (?)

Easily sol. in acids or excess of alkali hydrates, and carbonates +  $\text{Aq}$  Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose.)

Insol. in  $\text{Na}_2\text{B}_4\text{O}_7$ , and  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ . (Claus.)

**Palladic hydroxide**,  $\text{PdO}_2 \cdot x\text{H}_2\text{O}$

Slowly sol. in acids Sol. in conc.  $\text{HCl} + \text{Aq}$  without decomp. With dil.  $\text{HCl} + \text{Aq}$ ,  $\text{Cl}_2$  is evolved. (Berzelius)

**Palladous hydroxide hydroxylamine**,

$\text{Pd}(\text{NH}_2\text{O})_4(\text{OH})_2$

Sl. sol. in  $\text{H}_2\text{O}$  Sol. in dil.  $\text{HCl}$  and in dil.  $\text{H}_2\text{SO}_4$ . (Ziesel, A. 1907, 351, 445)

**Palladous iodide**,  $\text{PdI}_2$

Insol. in  $\text{H}_2\text{O}$ . Can be detected as a brown coloration in presence of 400,000 pts.  $\text{H}_2\text{O}$ . (Lassaigne)

Sl. sol. in  $\text{HI} + \text{Aq}$  Easily sol. in  $\text{KI} + \text{Aq}$  (Lassaigne, J. ch. méd. 11, 57.)

Insol. in dil.  $\text{HCl} + \text{Aq}$ , but slightly sol. in saline solutions (Fresenius)

Sl. sol. in hot conc.  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ ,  $\text{Cl}_2 + \text{Aq}$ ,  $\text{Br}_2 + \text{Aq}$ ,  $\text{I}_2 + \text{Aq}$ , and  $\text{CN} + \text{Aq}$ , also in  $\text{HCN}$ , and  $\text{MCN} + \text{Aq}$ . Insol. in dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{HNO}_3$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or in the  $\text{K}$ ,  $\text{Na}$ , or  $\text{NH}_4$  salts of those acids Insol. in  $\text{CuCl}_2$ ,  $\text{ZnCl}_2$ , or  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . Insol. in  $\text{KBr} + \text{Aq}$  except in presence of a free mineral acid, but not  $\text{HC}_2\text{H}_3\text{O}_2$ . Insol. in sugar or starch +  $\text{Aq}$ , uric acid, alcohol, ether, or oil of lemon. Somewhat sol. in urine. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , even when dil., with evolution of heat and decomposition (Kersten, A. 87, 28.)

Insol. in alcohol or ether.

Sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

**Palladous potassium iodide**.

See Iodopalladite, potassium.

**Palladium suboxide**,  $\text{Pd}_2\text{O}$ .

Decomp. by acids into palladous salt and  $\text{Pd}$  (Kane, Phil. Trans. 1842, 1, 276.)

Insol. in acids, even boiling aqua regia. (Willm. B. 25, 220.)

**Palladous oxide**,  $\text{PdO}$ .

Slowly sol. in acids by boiling. (Wohler, A. 174, 160)

**Palladic oxide**,  $\text{PdO}_2$ .

Very sl. attacked by acids.

**Palladopalladic oxide**,  $4\text{PdO}$ ,  $\text{PdO}_2$

Not attacked by aqua regia (Schneider, Pogg. 141, 528)

**Palladous oxychloride**,  $3\text{PdO}$ ,  $\text{PdCl}_2 + 4\text{H}_2\text{O}$  (?)

Sol. in dil. acids (Kane.)

**Palladous oxychloride ammonia**,  $\text{PdO}$ ,  $\text{PdCl}_2$ ,  $6\text{NH}_3$  (?)

Sol. in  $\text{HCl} + \text{Aq}$   
 $3\text{PdO}$ ,  $\text{PdCl}_2$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$  (?) Ppt. (Kane.)

**Palladium selenide**,  $\text{PdSe}$ .

Insol. in  $\text{HNO}_3$  and aqua regia (Rössler, A. 180, 240)

**Palladium subsulphide**,  $\text{Pd}_2\text{S}$

Not attacked by acids except aqua regia, which attacks slightly (Schneider, Pogg. 141, 530.)

**Palladium monosulphide**,  $\text{PdS}$

Insol. in  $\text{H}_2\text{O}$  or  $(\text{NH}_4)_2\text{S} + \text{Aq}$  Sol. in  $\text{HCl} + \text{Aq}$  Pptd. in presence of 10,000 pts.  $\text{H}_2\text{O}$  (Fellenberg, Pogg. 50, 65)

Sol. in potassium thiocarbonate +  $\text{Aq}$ . (Rosenblatt, Z. anal. 26, 15)

A sol. colloidal form was obtained in very dilute solution (Winninger, Bull. Soc. (2) 49, 452.)

Does not exist (Kritschenko, Z. anorg. 4, 247.)

**Palladium disulphide**,  $\text{PdS}_2$

$\text{HNO}_3$  dissolves out part of the  $\text{S}$  Easily sol. in aqua regia without separation of  $\text{S}$  (Schneider)

**Palladium sulphide with  $\text{M}_2\text{S}$** .

See Sulphopalladate,  $\text{M}$ .

**Palladodiamine bromide**,  $\text{Pd}(\text{N}_2\text{H}_4\text{Br})_2$ .

Easily sol. in  $\text{H}_2\text{O}$ .

— bromopalladite,  $\text{Pd}(\text{N}_2\text{H}_4\text{Br})_2$ ,  $\text{PdBr}_2$ .

Properties as the corresponding chloropalladite

— carbonate.

Sol. in  $\text{H}_2\text{O}$ .

— chloride,  $\text{Pd}(\text{N}_2\text{H}_4\text{Cl})_2$ .

Easily sol. in  $\text{H}_2\text{O}$ .

**Palladodiamine chloropalladite**,  $\text{Pd}(\text{N}_2\text{H}_4\text{Cl})_2$ ,  $\text{PdCl}_2$ .

"Vauquelin's red salt." Insol. in cold  $\text{H}_2\text{O}$  (Fischer)

Sol. in boiling  $\text{H}_2\text{O}$  with decomp. Sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$

— fluoride.

Easily sol. in  $\text{H}_2\text{O}$ . (Müller.)

— fluosilicate.

Sl. sol. in cold, easily in warm  $\text{H}_2\text{O}$ . Insol. in alcohol.

— hydroxide,  $\text{Pd}(\text{N}_2\text{H}_4\text{OH})_2$ .

Sol. in  $\text{H}_2\text{O}$ .

— iodide,  $\text{Pd}(\text{N}_2\text{H}_4\text{I})_2$ .

Sol. in  $\text{H}_2\text{O}$ .

— nitrate,  $\text{Pd}(\text{N}_2\text{H}_4\text{NO}_3)_2$

Easily sol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$   
Insol. in alcohol.

— palladous nitrite,  $\text{Pd}(\text{N}_2\text{H}_4\text{NO}_2)_2$ ,  
 $\text{Pd}(\text{NO}_2)_2$ .

Easily sol. in  $\text{H}_2\text{O}$ .

— sulphate,  $\text{Pd}(\text{N}_2\text{H}_4)_2\text{SO}_4 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  Insol. in alcohol

— sulphite,  $\text{Pd}(\text{N}_2\text{H}_4)_2\text{SO}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ .

#### **Palladochloronitrous acid.**

**Potassium palladochloronitrite**,  
 $\text{Pd}(\text{NO}_2)_2\text{Cl}_2\text{K}_2$ .

Sol. in 2 pts. hot, and 3 pts. cold  $\text{H}_2\text{O}$ .  
(Vézes, C. R. 115. 111)

#### **Palladocyanhydric acid.**

**Ammonium palladocyanide**,  
 $(\text{NH}_4)_4\text{Pd}(\text{CN})_4$  (?).

Sol. in hot  $\text{H}_2\text{O}$  (Rossler, Z. ch. 1866. 175)

**Barium** —,  $\text{Ba}_2\text{Pd}(\text{CN})_4 + 4\text{H}_2\text{O}$ .

Not efflorescent Sol. in  $\text{H}_2\text{O}$ .

**Calcium** —,  $\text{CaPd}(\text{CN})_4 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Cupric** —,  $\text{CuPd}(\text{CN})_4$ .

Ppt.

**Lead** —,  $\text{PbPd}(\text{CN})_4$ .

Ppt.

**Magnesium** —,  $\text{MgPd}(\text{CN})_4$ .

Very sol. in  $\text{H}_2\text{O}$ .

**Magnesium** — platinumocyanide,  $\text{MgPd}(\text{CN})_4$ ,  
 $\text{MgPt}(\text{CN})_4 + 14\text{H}_2\text{O}$ .

Extremely sol. in  $\text{H}_2\text{O}$ .

**Potassium** —,  $\text{K}_2\text{Pd}(\text{CN})_4 + 3\text{H}_2\text{O}$ .

Efflorescent. Sol. in  $\text{H}_2\text{O}$ .

+  $\text{H}_2\text{O}$ . Not efflorescent

**Silver** —,  $\text{Ag}_2\text{Pd}(\text{CN})_4$ .

Ppt.

**Sodium** —,  $\text{Na}_2\text{Pd}(\text{CN})_4$ .

Not efflorescent Sol. in  $\text{H}_2\text{O}$

+  $\text{H}_2\text{O}$

#### **Palladoiodonitrous acid.**

**Potassium palladoiodonitrite**,  
 $\text{Pd}(\text{NO}_2)_2\text{I}_2\text{K}_2 + 3\text{H}_2\text{O}$ .

Effloresces in the air

Decomp. by  $\text{H}_2\text{O}$  and dil. acids (Rosenheim, Z. anorg. 1900, 23. 28.)

#### **Palladonitrous acid.**

**Potassium palladonitrite**,  $\text{K}_2\text{Pd}(\text{NO}_2)_4 + 2\text{H}_2\text{O}$ .

Efflorescent, sol. in  $\text{H}_2\text{O}$ . (Lang, J. pr. 83. 415.)

**Silver palladonitrite**,  $\text{Ag}_2\text{Pd}(\text{NO}_2)_4$ .

Easily sol. in hot  $\text{H}_2\text{O}$ . (Lang.)

**Sodium** —,  $\text{Na}_2\text{Pd}(\text{NO}_2)_4$ .

(Fischer)

**Palladosamine bromide**,  $\text{Pd}(\text{NH}_2\text{Br})_2$ .

Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$  Easily sol. in  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{KOH}$ ,  $\text{NH}_4\text{OH}$ , or alkali carbonates +  $\text{Aq.}$  (Müller, A. 86. 341.)

— carbonate,  $\text{Pd}(\text{NH}_2)_2\text{CO}_3$ .

Moderately sol. in  $\text{H}_2\text{O}$ .

— chloride,  $\text{Pd}(\text{NH}_2\text{Cl})_2$ .

Insol. in  $\text{H}_2\text{O}$ , but very gradually decomp. by boiling therewith.

Sol. in warm  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$  Sol. in cold  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in  $\text{KOH} + \text{Aq.}$  without evolution of  $\text{NH}_3$ .

+  $2\text{H}_2\text{O}$  Efflorescent. Insol. in  $\text{H}_2\text{O}$ . (Baubigny, A. Suppl. 4. 253.)

— cyanide,  $\text{Pd}(\text{NH}_2\text{CN})_2$ .

Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$

— fluoride.

Known only in solution.

— hydroxide,  $\text{Pd}(\text{NH}_2\text{OH})_2$

Easily sol. in  $\text{H}_2\text{O}$ . Slowly decomp. by boiling with  $\text{H}_2\text{O}$ . (Müller, A. 86. 341.)

**Palladosamine iodide,  $\text{Pd}(\text{NH}_3\text{I})_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in boiling  $\text{HNO}_3$  with evolution of  $\text{I}_2$  (Fehling, A 39. 106.)

— nitrate.

Known only in solution, which decomp on evaporation

— nitrite,  $\text{Pd}(\text{NH}_3\text{NO}_2)_2$ .

Moderately sol in  $\text{H}_2\text{O}$ . (Lang.)

— palladous nitrite,  $\text{Pd}(\text{NH}_3\text{NO}_2)_2$ ,  
 $\text{Pd}(\text{NO}_2)_2$ .

Slowly sol. in cold, easily in hot  $\text{H}_2\text{O}$  (Lang.)

— sulphate,  $\text{Pd}(\text{NH}_3)_2\text{SO}_4$ .

Moderately sol in  $\text{H}_2\text{O}$ . (Müller)

— sulphite,  $\text{Pd}(\text{NH}_3)_2\text{SO}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Müller.)

**Pentamine chromium compounds.**

See—

Bromopurpleochromium compounds.

Chloropurpleochromium compounds.

Iodopurpleochromium compounds.

Xanthochromium compounds.

Roseochromium compounds.

**Pentamine cobaltic compounds.**

See—

Bromopurplecobaltic compounds,

Chloropurplecobaltic compounds.

Nitratopurplecobaltic compounds.

Nitritocobaltic compounds,

Purplecobaltic compounds.

Rosecobaltic compounds.

Sulphatopurplecobaltic compounds.

Xanthocobaltic compounds.

**Pentamine dicobaltic sulphite.**

See Rosecobaltic cobaltic sulphite.

**Pentamine iridium compounds.**

See Iridopentamine, and Iridoquopentamine compounds.

**Pentamine rhodium compounds.**

See—

Bromopurpleorhodium compounds.

Chloropurpleorhodium compounds.

Iodopurpleorhodium compounds.

Nitratopurpleorhodium compounds.

Roseorhodium compounds

Xanthorhodium compounds.

**Pentathionic acid,  $\text{H}_2\text{S}_5\text{O}_6$ .**

Known only in aqueous solution

Conc. solution is decomp by boiling, but made stable by addition of acids

Sp. gr of aqueous solution of pentathionic acid at 22°:

Sp gr.	1 233	1 320	1 474	1 506
% $\text{H}_2\text{S}_5\text{O}_6$	32 1	41 7	53	59 7

(Kessler, Pogg. 74. 279.)

Does not exist. (Spring, Bull Acad. roy. Belg.)

Existence proven by Smith (Chem. Soc. 43. 355.)

**Barium pentathionate,  $\text{BaS}_5\text{O}_6 + 2\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution is precipitated by alcohol.

Contains  $3\text{H}_2\text{O}$ . (Lewes, C. N. 43. 41.)

**Barium pentathionate tetrathionate,  $\text{BaS}_5\text{O}_6$ ,  $\text{BaS}_4\text{O}_6 + 6\text{N}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Not precipitated from aqueous solution by two vols. alcohol. (Ludwig, Arch. Pharm. (2) 51. 264.)

**Cupric pentathionate,  $\text{CuS}_5\text{O}_6 + 4\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Debus, Chem. Soc. 53. 360.)

**Lead pentathionate,  $\text{PbS}_5\text{O}_6 + 4\text{H}_2\text{O}$ .**

Ppt.

**Potassium pentathionate,  $\text{K}_2\text{S}_5\text{O}_6$ .**

Sol. in  $\text{H}_2\text{O}$  (Rammelsberg, J. B. 1857. 136.)

Solution decomposes very quickly when neutral, but is more stable in presence of salts or acids.

Sol. in about 2 pts.  $\text{H}_2\text{O}$ .

Insol in alcohol. (Debus, Chem. Soc. 53. 295.)

+ $\text{H}_2\text{O}$ . (Shaw, Chem. Soc. 43. 351.)

+ $1\frac{1}{2}\text{H}_2\text{O}$ . (Debus, A 244. 76 )

+ $2\text{H}_2\text{O}$  (Lewes, C N 43. 41 )

**Perarsenic acid.****Sodium perarsenate,  $\text{NaAsO}_4$ .**

(Alvarez, C. N 1906, 94. 270 )

**Perboric acid.****Ammonium perborate,  $\text{NH}_4\text{BO}_3$ .**

(Constam and Bennett, Z. anorg. 1900, 25. 265.)

+ $\frac{1}{2}\text{H}_2\text{O}$  Stable in dry air 100 pts.  $\text{H}_2\text{O}$  at 17.5° dissolve 1 55 g anhydrous salt.

Decomp. in aqueous solution at ord. temp.

Decomp. by dil and conc.  $\text{H}_2\text{SO}_4$  and by  $\text{HCl}$ . (Melikoff, B 1898, 31. 953 )

+ $\text{H}_2\text{O}$ . (Bruhat, C R. 1905, 140 508 )

Much more sol. in  $\text{H}_2\text{O}$  than the Na salt.

(Tanatar, Z. phys. Ch 1898, 26. 133.)

+ $3\text{H}_2\text{O}$ . (Melikoff, B. 1898, 31. 954.)

$\text{NH}_4\text{BO}_3$ ,  $\text{NH}_4\text{BO}_3 + \text{H}_2\text{O}$  (Petrenko, C. C. 1902, I 1192.)

**Barium perborate**,  $\text{Ba}(\text{BO}_2)_2 + 7\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$  (Mehkoff, B. 1898, 31. 951.)

**Cæsium perborate**,  $\text{CsBO}_2 + \text{H}_2\text{O}$ .

As  $\text{NH}_4$  salt. (Christensen.)

**Calcium perborate**.

Sl. sol. in  $\text{H}_2\text{O}$  Decomp. in water much more rapidly than the Ba salt. (Mehkoff, B. 1898, 31. 954.)

**Copper perborate**.

Very unstable. Insol. in  $\text{H}_2\text{O}$  (Mehkoff, B. 1898, 31. 954.)

**Nickel perborate**.

Very unstable. Insol. in  $\text{H}_2\text{O}$  (Mehkoff)

**Potassium perborate**,  $2\text{KBO}_2 + \text{H}_2\text{O}$ .

1.25 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ ; 2.5 pts., at  $15^\circ$ .

Insol. in alcohol and ether. (Girsewald, B. 1900, 42. 867.)

**Potassium perborate hydrogen peroxide**,  $2\text{KBO}_2, \text{H}_2\text{O}_2$ .

0.70 pt. is sol. in 100 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Girsewald, B. 1900, 42. 868.)

**Potassium perkborate**,  $\text{KB}_2\text{O}_5 + 2\text{H}_2\text{O}$

Ppt. (Bruhat, C. R. 1905, 140. 508.)

**Rubidium perborate**,  $\text{RbBO}_2 + \text{H}_2\text{O}$

As Na salt. (Christensen.)

**Sodium perborate**,  $\text{Na}_2\text{B}_4\text{O}_8 + 10\text{H}_2\text{O}$ .

100 g.  $\text{H}_2\text{O}$  dissolve 4.2 g. at  $11^\circ$ ; 7.1 g. at  $22^\circ$ , 13.8 g. at  $32^\circ$  (Jaubert, C. R. 1904, 134. 700.)

+  $4\text{H}_2\text{O}$ . Slowly decomp. in cold solution, rapidly when boiled. (Tanatar, Z. phys. Ch. 1898, 26. 132.)

Sol. in  $\text{H}_2\text{O}$ . 100 g.  $\text{H}_2\text{O}$  dissolve 1.17 g. Aq. solution decomp. on warming. (Mehkoff, B. 1898, 31. 679.)

100 g.  $\text{H}_2\text{O}$  dissolve 2.55 g. at  $15^\circ$ , 2.69 g. at  $21^\circ$ ; 2.85 g. at  $26^\circ$ ; 3.78 g. at  $32^\circ$ . (Jaubert and Lion, Rev. gén. Chim. 1905, (7) 8. 163.)

**Uranyl perborate**,  $\text{UBO}_4$ .

(Bruhat, C. R. 1905, 140. 508.)

**Perbromic acid**,  $\text{HBrO}_4$ .

Known only in aqueous solution, which can be concentrated to a thick liquid on water bath. Not decomp. by  $\text{HCl}$ ,  $\text{SO}_2$ , or  $\text{H}_2\text{S}$ . (Kämmerer, J. pr. 85. 452; 90. 190.)

Does not exist. (Muir, C. N. 33. 256; MacIvor, C. N. 33. 35.)

**Barium perbromate**,  $\text{Ba}(\text{BrO}_4)_2$

Very sl. sol. in boiling  $\text{H}_2\text{O}$  (Kämmerer, J. pr. 90. 190.)

Does not exist. (Wolfiam, A. 198. 95.)

**Potassium perbromate**,  $\text{KBrO}_4$

Less sol. in  $\text{H}_2\text{O}$  than  $\text{KBrO}_3$ , but more sol. than  $\text{KClO}_4$ . (Kämmerer, J. pr. 90. 190.)

Does not exist (Wolfiam, A. 198. 95.)

**Silver perbromate**,  $\text{AgBrO}_4$ .

Sl. sol. in cold, more abundantly in hot  $\text{H}_2\text{O}$ . (Kämmerer, J. pr. 90. 190.)

Does not exist. (Wolfiam, A. 198. 95.)

**Perbromoplatinocyanhydric acid**,

$\text{H}_2\text{Pt}(\text{CN})_4\text{Br}_2 + x\text{H}_2\text{O}$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ , alcohol, and ether (Holst, Bull. Soc. (2) 22. 347.)

**Aluminium perbromoplatinocyanide**,

$\text{Al}_2\text{Pt}(\text{CN})_4\text{Br}_2 + 22\text{H}_2\text{O}$

Deliquescent. Very sol. in  $\text{H}_2\text{O}$

**Ammonium —**,  $(\text{NH}_4)_2\text{Pt}(\text{CN})_4\text{Br}_2$ .

Sol. in  $\text{H}_2\text{O}$

**Barium —**,  $\text{BaPt}(\text{CN})_4\text{Br}_2 + 5\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  or alcohol.

**Cadmium —**,  $\text{CdPt}(\text{CN})_4\text{Br}_2 + x\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ .

**Calcium —**,  $\text{CaPt}(\text{CN})_4\text{Br}_2 + 7\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Cobaltous —**,  $\text{CoPt}(\text{CN})_4\text{Br}_2 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  Sl. sol. in alcohol

**Glucinum —**,  $\text{GlPt}(\text{CN})_4\text{Br}_2$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ .

**Ferrous —**.

Very sl. sol. in  $\text{H}_2\text{O}$ .

**Lead —**,  $\text{PbPt}(\text{CN})_4\text{Br}_2 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ .

**Lithium —**,  $\text{Li}_2\text{Pt}(\text{CN})_4\text{Br}_2$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ .

**Magnesium —**,  $\text{MgPt}(\text{CN})_4\text{Br}_2 + x\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Nickel —**,  $\text{NiPt}(\text{CN})_4\text{Br}_2 + x\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$

**Potassium —**,  $\text{K}_2\text{Pt}(\text{CN})_4\text{Br}_2$ .

Sol. in  $\text{H}_2\text{O}$ .  
+  $2\text{H}_2\text{O}$ . Efflorescent.

Silver perbromoplatinocyanide,  
 $\text{Ag}_2\text{PtBr}_2(\text{CN})_4$ .

Ppt. (Miolata, Gazz. ch. it. 1900, 30, 588.)

Sodium —,  $\text{Na}_2\text{Pt}(\text{CN})_4\text{Br}_2$ .

Deliquescent Sol in  $\text{H}_2\text{O}$ .

Strontium —,  $\text{SrPt}(\text{CN})_4\text{Br}_2 \cdot 7\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ .

Zinc —,  $\text{ZnPt}(\text{CN})_4\text{Br}_2 \cdot 5\text{H}_2\text{O}$ .

Not very sol in  $\text{H}_2\text{O}$ .

### Percarbonic acid.

Ammonium percarbonate,  $(\text{NH}_4)_2\text{CO}_4 + 2\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  with evolution of  $\text{NH}_3$ . Insol. in alcohol and ether. (Kasanevsky, C. C 1902, I, 1263.)

Barium percarbonate,  $\text{BaCO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Merck, C. C 1906, II, 1743.)

Decomp. slowly in the air. Not rapidly decomp. by  $\text{H}_2\text{O}$ . Rapidly decomp. by acids (Wolfenstein, B. 1908, 41, 280.)

Potassium percarbonate,  $\text{K}_2\text{CO}_4$ .

Sol in  $\text{H}_2\text{O}$  with decomp. Sl. sol. in alcohol. (v. Hansen, Z. Elektrochem. 1897, 3, 448.)

$\text{K}_2\text{C}_2\text{O}_8$ . Sol in  $\text{H}_2\text{O}$  at  $0^\circ$  with only slight decomp. but is decomp. at ord. temp. Sl. sol. in alcohol. (Treadwell, Ch. Z. 1901, 25, 1008.)

Rubidium percarbonate,  $\text{Rb}_2\text{CO}_4 \cdot 2\text{H}_2\text{O}_2 + \text{H}_2\text{O}$ .

Hydroscopic; decomp. by  $\text{H}_2\text{O}$ ; pptd. by alcohol.

$\text{Rb}_2\text{CO}_4 \cdot \text{H}_2\text{O}_2 + 2\text{H}_2\text{O}$ . Hydroscopic; decomp. by  $\text{H}_2\text{O}$ ; pptd. by alcohol.

$\text{Rb}_2\text{CO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ . Hydroscopic; decomp. by  $\text{H}_2\text{O}$ ; pptd. by alcohol (Feltner, B. 1909, 42, 1782.)

$\text{Rb}_2\text{C}_2\text{O}_8$ . Very deliquescent (Constam and Hansen, Z. Elektrochem. 1897, 3, 144.)

Sodium percarbonate,  $\text{Na}_2\text{CO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  with gradual decomp. (Tanatar, B. 1899, 32, 1544.)

Sodium hydrogen percarbonate,  $4\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{CO}_3$ .

Ppt. (Merck, Chem. Soc 1908, 94, (2) 180.)

### Perchloric acid, $\text{HClO}_4$ .

Combines with  $\text{H}_2\text{O}$  with a hissing sound and evolution of much heat.

Solution in  $\text{H}_2\text{O}$  is very stable.

When dil.  $\text{HClO}_4 + \text{Aq}$  is distilled,  $\text{H}_2\text{O}$  and  $\text{HClO}_4$  distil off until a temp. of  $203^\circ$  is reached, when an acid of constant composition containing 71.6–72.2%  $\text{HClO}_4$  ( $=\text{HClO}_4 + 2\text{H}_2\text{O}$ ) is obtained. Forms hydrate  $\text{HClO}_4 \cdot \text{H}_2\text{O}$ , which is deliquescent, and dissolves in  $\text{H}_2\text{O}$  with evolution of much heat.  $\text{HClO}_4$  is very unstable,  $\text{HClO}_4 + \text{H}_2\text{O}$  more stable, and  $\text{HClO}_4 + 2\text{H}_2\text{O}$  is very stable. (Roscoe, A. 121, 346.)

Sp. gr. of  $\text{HClO}_4 + \text{Aq}$ . at  $15^\circ/4^\circ$ .

Sp gr	% $\text{HClO}_4$	Sp gr	% $\text{HClO}_4$	Sp gr	% $\text{HClO}_4$
1.005	1.00	1.235	33.29	1.465	54.50
1.010	1.90	1.240	33.85	1.470	54.89
1.015	2.77	1.245	34.40	1.475	55.18
1.020	3.61	1.250	34.95	1.480	55.56
1.025	4.43	1.255	35.49	1.485	55.95
1.030	5.25	1.260	36.03	1.490	56.32
1.035	6.07	1.265	36.56	1.495	56.69
1.040	6.88	1.270	37.08	1.500	57.06
1.045	7.68	1.275	37.60	1.505	57.44
1.050	8.48	1.280	38.10	1.510	57.81
1.055	9.28	1.285	38.60	1.515	58.17
1.060	10.06	1.290	39.10	1.520	58.54
1.065	10.83	1.295	39.60	1.525	58.91
1.070	11.58	1.300	40.10	1.530	59.28
1.075	12.33	1.305	40.59	1.535	59.66
1.080	13.08	1.310	41.08	1.540	60.04
1.085	13.83	1.315	41.56	1.545	60.41
1.090	14.56	1.320	42.03	1.550	60.78
1.095	15.28	1.325	42.49	1.555	61.15
1.100	16.00	1.330	42.97	1.560	61.52
1.105	16.72	1.335	43.43	1.565	61.89
1.110	17.45	1.340	43.89	1.570	62.26
1.115	18.16	1.345	44.35	1.575	62.63
1.120	18.88	1.350	44.81	1.580	63.00
1.125	19.57	1.355	45.26	1.585	63.37
1.130	20.26	1.360	45.71	1.590	63.74
1.135	20.95	1.365	46.16	1.595	64.12
1.140	21.64	1.370	46.61	1.600	64.50
1.145	22.32	1.375	47.05	1.605	64.88
1.150	22.99	1.380	47.49	1.610	65.26
1.155	23.65	1.385	47.93	1.615	65.63
1.160	24.30	1.390	48.37	1.620	66.01
1.165	24.94	1.395	48.80	1.625	66.39
1.170	25.57	1.400	49.23	1.630	66.76
1.175	26.20	1.405	49.68	1.635	67.13
1.180	26.82	1.410	50.10	1.640	67.51
1.185	27.44	1.415	50.51	1.645	67.89
1.190	28.05	1.420	50.91	1.650	68.26
1.195	28.66	1.425	51.31	1.655	68.64
1.200	29.26	1.430	51.71	1.660	69.02
1.205	29.86	1.435	52.11	1.655	69.40
1.210	30.45	1.440	52.51	1.670	69.77
1.215	31.04	1.445	52.91	1.675	70.15
1.220	31.61	1.450	53.31		
1.225	32.18	1.455	53.71		
1.230	32.74	1.460	54.11		

(Emster, Z. anorg. 1907, 52, 278.)

Sp. gr. of $\text{HClO}_4 + \text{Aq.}$			
% $\text{HClO}_4$	Sp. gr. at 15°/4°	Sp. gr. at 30°/4°	Sp. gr. at 50°/4°
11.14	1.0670	.. ..	1.0507
35.63	1.2569	1.2451	1.2202
55.63	1.4807	1.4637	1.4421
69.81	1.6708	.. ..	1.6284

(Emster, Z. anorg. 1907, 52. 279.)

Sp. gr. of $\text{HClO}_4 + \text{Aq.}$				
Sp. gr.				% by wt $\text{HClO}_4$ in the liquid
corrected		uncorrected		
20°	50°	20°	50°	
1.7876	1.7008	1.7716	1.7312	100
1.7817	1.7259	1.7858	1.7475	98.62
1.8059	1.7531	1.8100	1.7751	94.67
..	1.7690	..	1.7912	90.80
..	1.7755	..	1.7979	84.81
..	1.7619	..	1.7840	81.07
1.7386	1.7023	1.7425	1.7237	75.59
1.6471	1.6110	1.6508	1.6311	68.42
1.5353	1.5007	1.5386	1.5194	60.38
1.4078	1.3779	1.4103	1.3940	50.51
1.2901	1.2649	1.2927	1.2804	39.73
1.1778	1.1574	1.1800	1.1715	27.07

(v. Wyk, Z. anorg. 1905, 48. 45.)

Bpt. of  $\text{HClO}_4 + \text{Aq.}$  at atmospheric pressure.

% by wt $\text{HClO}_4$ in the liquid	% by wt $\text{HClO}_4$ in the vapor	Initial bpt
72.4	72.4	203°
70.06	40.11	198.7
65.2	6.06	181.2
61.2	0.9	162.3
56.65	..	148.0
50.67	..	132.4
38.90	..	114.8
24.23	..	105.8
0.0	0.0	100

(v. Wyk, Z. anorg. 1905, 48. 33.)

Bpt. of  $\text{HClO}_4 + \text{Aq.}$  at 18 mm. pressure.

% by wt $\text{HClO}_4$ in the liquid	Bpt
100	16.0°
94.8	24.8
92.0	35
84.8	70
79.8	92
70.5	107

(v. Wyk, Z. anorg. 1905, 48. 36.)

+ $\text{H}_2\text{O}$ . Deliquescent. (Roscoe, A. 121. 346.)+2 $\text{H}_2\text{O}$ .  $\text{HClO}_4 + 2\text{H}_2\text{O}$  has 1.65 sp. gr.

and boils at 200° (Serullas); has 1.72-1.82 sp. gr. and boils at 200° (Nativelle, J. p. 26. 405)

Sol. in alcohol with decomp.; often explosive

+2 $\frac{1}{2}\text{H}_2\text{O}$ . (v. Wyck.)+3 $\text{H}_2\text{O}$ . (v. Wyck.)+3 $\frac{1}{2}\text{H}_2\text{O}$ . (v. Wyck.)**Perchlorates.**

All perchlorates are sol in  $\text{H}_2\text{O}$ ,  $\text{KClO}_4$ ,  $\text{RbClO}_4$ , and  $\text{CsClO}_4$  somewhat difficultly. They are all deliquescent, and sol in alcohol, excepting  $\text{NH}_4\text{ClO}_4$ ,  $\text{KClO}_4$ ,  $\text{Pb}(\text{ClO}_4)_2$ , and  $\text{Hg}_2(\text{ClO}_4)_2$  (Serullas, A. ch. (2) 46. 296.)

Aluminum perchlorate,  $\text{Al}(\text{ClO}_4)_3 + 6\text{H}_2\text{O}$ .

Very deliquescent. (Weinland, Z. anorg. 1913, 84. 370.)

Aluminum sodium perchlorate,  $\text{AlNa}(\text{ClO}_4)_4 + 12\text{H}_2\text{O}$ .

Sl hygroscopic. (Weinland, Z. anorg. 1913, 84. 370.)

Sol. in acetone (Naumann, B 1904, 87. 4328.)

Ammonium perchlorate,  $\text{NH}_4\text{ClO}_4$ .Permanent. Sol. in 5 pts.  $\text{H}_2\text{O}$ ; somewhat sol. in alcohol. (Mitscherhoh, Pogg. 25. 800)Solubility of  $\text{NH}_4\text{ClO}_4$  in  $\text{H}_2\text{O}$  at t°.

t°	G per l. solution	Sp. gr.
0	115.63	1.059
20	208.45	1.098
40	305.77	1.128
60	390.50	1.158
80	481.86	1.193
100	570.06	1.216
107	591.15	1.221

(Carlson, Festsch. Stockholm. 1911. 262.)

100 g.  $\text{H}_2\text{O}$  dissolve 18.5 g.  $\text{NH}_4\text{ClO}_4$ . (Hofmann, Hübald and Quocq, A. 1912, 386. 304.)100 g. sat. solution in  $\text{H}_2\text{O}$  contain 1.735 (17.357) g.  $\text{NH}_4\text{ClO}_4$  at 14.2°. (Thin and Cumming, Chem. Soc. 1915, 107. 381.)Insol in conc.  $\text{HClO}_4 + \text{Aq.}$ 100 g. sat. solution in 98.8% ethyl alcohol contain 1.96 g.  $\text{NH}_4\text{ClO}_4$  at 25.2°. (Thin and Cumming.)

Sol. in acetone (Eidmann, C. C. 1899, II. 1014.)

Barium perchlorate,  $\text{Ba}(\text{ClO}_4)_2 + 4\text{H}_2\text{O}$ .Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol.

+3H<sub>2</sub>O. Solubility of Ba(ClO<sub>4</sub>)<sub>2</sub>+3H<sub>2</sub>O in H<sub>2</sub>O at t°.

t°	G. per 100 g H <sub>2</sub> O	Sp gr
0	206	1.782
20	289	1.912
40	358	2.009
60	432	2.070
80	497	2.114
100	564	2.155
120	645	2.195
140	758	2.230

(Carlson, Festsak. Stockholm, 1911. 262.)

Bismuth perchlorate, (BiO)ClO<sub>4</sub>.

Insol. in H<sub>2</sub>O. Easily sol in HCl or HNO<sub>3</sub>+Aq. less easily in H<sub>2</sub>SO<sub>4</sub>+Aq (Muir, C. N. 33. 15.)

Cadmium perchlorate, Cd(ClO<sub>4</sub>)<sub>2</sub>.

Very deliquescent. Sol. in H<sub>2</sub>O and alcohol. (Serullas, A. ch. 46. 305.)

+4H<sub>2</sub>O. (Salvadori, C. C. 1912, II. 414.)

+6H<sub>2</sub>O. (S)

Cadmium perchlorate ammonia, Cd(ClO<sub>4</sub>)<sub>2</sub>, 6NH<sub>3</sub>.

Cd(ClO<sub>4</sub>)<sub>2</sub>, 4NH<sub>3</sub>. (Salvadori, C. C. 1912, II. 414.)

Cæsium perchlorate, CsClO<sub>4</sub>.

Very sl. sol. in H<sub>2</sub>O. (Retgers, Z. phys. Ch. 8. 17.)

Solubility in H<sub>2</sub>O 100 g H<sub>2</sub>O dissolve at:  
8.5° 14° 33.7° 42° 50°  
0.91 1.19 2.99 4.09 5.47 g. CsClO<sub>4</sub>.

60° 70° 84° 99°  
7.30 9.79 16.51 28.57 g. CsClO<sub>4</sub>.

(Calzolari, Acc. Sc. Med. Ferrara, 1911, 85. 150)

Solubility in H<sub>2</sub>O at t°.

t°	G. per 100 g H <sub>2</sub> O	Sp gr
5	0.97	1.007
25	2.05	1.010
80	17.05	1.064

(Carlson, Festsak. Stockholm, 1911. 262.)

Calcium perchlorate, Ca(ClO<sub>4</sub>)<sub>2</sub>.

Very deliquescent. Very sol. in H<sub>2</sub>O and alcohol. (Serullas, A. ch. 46. 304)

Cerous perchlorate, Ce(ClO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O.

Very deliquescent. (Johm.)

Chromic perchlorate, Cr(ClO<sub>4</sub>)<sub>3</sub>+6H<sub>2</sub>O.

Very hygroscopic. (Weinland, Z. anorg. 1913, 84. 371.)

+9H<sub>2</sub>O. Can be cryst. from H<sub>2</sub>O. (Weinland.)

Cobaltous perchlorate, Co(ClO<sub>4</sub>)<sub>2</sub>+9H<sub>2</sub>O.

Solubility in H<sub>2</sub>O at t°.

t°	G anhydrous salt in 100 ccn	Sp gr of sat. solution at t°/4°
-30 7	83.14	..
-21 3	90.57	..
0	100.13	1.5639
+7.5	101.92	1.5658
18	103.80	1.5670
26	113.45	1.5811
45	115.10	1.5878

(Golblum and Terlikowsky, Bull. Soc. 1912, (4) 11. 146)

+6H<sub>2</sub>O. (Salvadori, Gazz. ch. it. 1912, 42. (1) 458.)

Cobalt perchlorate ammonia, Co(ClO<sub>4</sub>)<sub>2</sub>, 6NH<sub>3</sub>.

Co(ClO<sub>4</sub>)<sub>2</sub>, 5NH<sub>3</sub>

Co(ClO<sub>4</sub>)<sub>2</sub>, 4NH<sub>3</sub>, and +2H<sub>2</sub>O.

Co(ClO<sub>4</sub>)<sub>2</sub>, 3NH<sub>3</sub>, and +3H<sub>2</sub>O

Co(ClO<sub>4</sub>)<sub>2</sub>, 3NH<sub>3</sub>+2H<sub>2</sub>O.

(Salvadori, Gazz. ch. it. 1912, 42. (1) 458.)

Cupric perchlorate, basic, Cu(ClO<sub>4</sub>)<sub>2</sub>, Cu(OH)<sub>2</sub>.

Ppt. (Salvadori, C. C. 1912, II. 414.)

Cupric perchlorate, Cu(ClO<sub>4</sub>)<sub>2</sub>.

Deliquescent. Sol. in H<sub>2</sub>O and alcohol. (Serullas, A. ch. 46. 306.)

+4H<sub>2</sub>O (Salvadori, C. C. 1912, II. 414)

Cupric perchlorate ammonia, Cu(ClO<sub>4</sub>)<sub>2</sub>, 4NH<sub>3</sub>+2H<sub>2</sub>O.

Not deliquescent. Sol. in NH<sub>4</sub>OH+Aq. (Roscoe, A. 121. 346)

Cu(ClO<sub>4</sub>)<sub>2</sub>, NH<sub>3</sub>+H<sub>2</sub>O.

Cu(ClO<sub>4</sub>)<sub>2</sub>, 2CuO+2H<sub>2</sub>O, NH<sub>3</sub>.

Cu(ClO<sub>4</sub>)<sub>2</sub>, 2CuO+2H<sub>2</sub>O, 2NH<sub>3</sub>.

Cu(ClO<sub>4</sub>)<sub>2</sub>, Cu(OH)<sub>2</sub>+2H<sub>2</sub>O, 6NH<sub>3</sub>.

Cu(ClO<sub>4</sub>)<sub>2</sub>, Cu(OH)<sub>2</sub>+2H<sub>2</sub>O, 4NH<sub>3</sub>.

(Salvadori, C. C. 1912, II. 414.)

Didymium perchlorate, D<sub>2</sub>(ClO<sub>4</sub>)<sub>3</sub>+9H<sub>2</sub>O.

Very deliquescent. Very sol. in H<sub>2</sub>O and alcohol. (Cleve.)

Erbium perchlorate, Er(ClO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O.

Very deliquescent.

Gluccinum perchlorate, Gl(ClO<sub>4</sub>)<sub>3</sub>+4H<sub>2</sub>O.

Very deliquescent, and sol. in H<sub>2</sub>O. (Atterberg)

Hydrazine perchlorate, (N<sub>2</sub>H<sub>4</sub>)(HClO<sub>4</sub>)<sub>2</sub>+3H<sub>2</sub>O

1 l. of sat. solution in H<sub>2</sub>O contains 417.2 g. at 18°, sp. gr.=1.264, 669 g. at 35°, sp. gr.=1.391. (Carlson, Festsak. Stockholm, 1911. 262.)

**Indium perchlorate,  $\text{In}(\text{ClO}_4)_3 \cdot 8\text{H}_2\text{O}$** 

Deliquescent.  $\text{H}_2\text{O}$  solution decomp at  $40^\circ$  with separation of basic salt. Sol in  $\text{H}_2\text{O}$  and easily forms sat. solutions. Sol. in abs. alcohol, but much less sol in ether. (Mathers, J. Am. Chem. Soc. 1908, 30, 212.)

**Iodine perchlorate,  $\text{I}(\text{ClO}_4)_3 \cdot 2\text{H}_2\text{O}$** 

Decomp. by  $\text{H}_2\text{O}$ . Indifferent toward organic solvents (Fichter, Z. anorg. 1915, 91, 135.)

**Iron (ferrous) perchlorate,  $\text{Fe}(\text{ClO}_4)_2$** 

Tolerably permanent, sol. in  $\text{H}_2\text{O}$  (Seuillas, A. ch. 46, 335.)

**Iron (ferric) perchlorate,  $\text{Fe}(\text{ClO}_4)_3$** 

Sol. in  $\text{H}_2\text{O}$ . (Seuillas)

**Iron (ferric) sodium perchlorate,**

Hygroscopic. Can be cryst. from  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1913, 84, 366.)

**Lanthanum perchlorate,  $\text{La}(\text{ClO}_4)_3 \cdot 9\text{H}_2\text{O}$** 

Extremely deliquescent. Sol. in  $\text{H}_2\text{O}$  and absolute alcohol (Cleve)

**Lead perchlorate, basic,  $2\text{PbO}, \text{Cl}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$** 

Decomp. by  $\text{H}_2\text{O}$  into an insol. more basic salt, and sol.  $\text{Pb}(\text{ClO}_4)_2$ . (Marignac.)

**Lead perchlorate,  $\text{Pb}(\text{ClO}_4)_2 \cdot 3\text{H}_2\text{O}$** 

Permanent; extremely easily sol. in  $\text{H}_2\text{O}$ . (Roscoe, A. 121, 356.)

Sol. in about 1 pt.  $\text{H}_2\text{O}$ . (Seuillas.)

**Lithium perchlorate,  $\text{LiClO}_4$** 

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol (Seuillas)

+  $3\text{H}_2\text{O}$ . (Wyrnoff, Zeit. Kryst. 10, 620.)

**Magnesium perchlorate,  $\text{Mg}(\text{ClO}_4)_2$** 

Deliquescent, and sol. in  $\text{H}_2\text{O}$  and alcohol. (Seuillas)

+  $6\text{H}_2\text{O}$  (Weinland, Z. anorg. 1913, 84, 372.)

**Manganous perchlorate,  $\text{Mn}(\text{ClO}_4)_2$** 

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Seuillas, A. ch. 46, 335.)

+  $6\text{H}_2\text{O}$ . Sol. in 0.342 pts  $\text{H}_2\text{O}$ . (Salvadori, C. C. 1912, II, 414.)

**Manganous perchlorate ammonia,  $\text{Mn}(\text{ClO}_4)_2 \cdot 5\text{NH}_3 \cdot \text{H}_2\text{O}$** 

Sol. in  $\text{HCl}$ ; insol. in  $\text{HNO}_3$ . (Salvadori, C. C. 1912, II, 414.)

**Mercurous perchlorate,  $(\text{HgClO}_4)_2 \cdot 4\text{H}_2\text{O}$** 

Very sol. in  $\text{H}_2\text{O}$ . Gradually decomp. by

$\text{H}_2\text{O}$ . Decomp. by alcohol (Chikashigé, Chem. Soc. 1895, 67, 1016.)

+  $6\text{H}_2\text{O}$ . Very deliquescent (Roscoe, A. 121, 356.)

Permanent. (Seuillas.)

**Mercuric perchlorate, basic,  $\text{HgO}, 2\text{Hg}(\text{ClO}_4)_2$** 

Anhydrous Ppt. Insol. in either  $\text{HCl}$  or  $\text{HNO}_3$ . Decomp. and dissolved by a mixture of the two. (Chikashigé, Chem. Soc. 1905, 87, 824.)

+  $12\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  (Chikashigé.)

$2\text{HgO}, \text{Hg}(\text{ClO}_4)_2$ .

$\alpha$ -salt. Decomp. by  $\text{H}_2\text{O}$ . Sol. in acids. (Chikashigé, Chem. Soc. 1895, 67, 1015.)

$\beta$ -salt. Insol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{HCl}$  or  $\text{HNO}_3$ . (Chikashigé, Chem. Soc. 1905, 87, 825.)

**Mercuric perchlorate,  $\text{Hg}(\text{ClO}_4)_2$** 

Very deliquescent. Sol. in  $\text{H}_2\text{O}$ ; sl. sol. with decomp. in alcohol (Seuillas, A. ch. 34, 243.)

+  $6\text{H}_2\text{O}$ . Very hygroscopic. Very sol. in  $\text{H}_2\text{O}$ . Slowly decomp. by  $\text{H}_2\text{O}$ , more easily by alcohol. (Chikashigé, Chem. Soc. 1895, 67, 1014.)

**Mercuric perchlorate bromide,  $\text{HgClO}_4\text{Br}$** 

Decomp. by  $\text{H}_2\text{O}$  (Borelli, Gazz. ch. it 1908, 38, (2) 421.)

**Mercuric perchlorate cyanide,  $\text{Hg}(\text{ClO}_4)_2, \text{Hg}(\text{CN})_2$** 

Very sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol. (Borelli.)

**Mercuric perchlorate iodide,  $\text{Hg}(\text{ClO}_4)_2\text{I}$** 

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Sol. in much alcohol. Decomp. by  $\text{HNO}_3$ . Completely sol. in  $\text{KI}$  or  $\text{KCN} + \text{Aq.}$  (Borelli.)

**Mercuric perchlorate sulphocyanide,  $\text{Hg}(\text{ClO}_4)_2, \text{Hg}(\text{SCN})_2$** 

Insol. in  $\text{H}_2\text{O}$  and conc. acids. Sol. in aqua regia. (Borelli.)

+  $6\text{H}_2\text{O}$ . (Salvadori, C. C. 1912, II, 414.)

**Nickel perchlorate,  $\text{Ni}(\text{ClO}_4)_2$** 

Deliquescent, easily sol. in alcohol and  $\text{H}_2\text{O}$ . (Groth, Pogg. 133, 226.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G anhydrous salt in 100 ccm.	Sp. gr. of the sat. solution
-30	7	89.98
-21	3	92.48
0		104.55
+7	5	106.76
18		110.05
26		112.15
45		118.60
		1.5726
		1.5755
		1.5760
		1.5841
		1.5936

(Golblum and Terlikowsky, Bull. Soc. 1912, (4) 11, 147.)

- +5H<sub>2</sub>O. (Golblum and Terlikowsky.)  
 +6H<sub>2</sub>O. (Salvadori, C. C. 1912, II 414.)  
 +9H<sub>2</sub>O. (Golblum and Terlikowsky.)

Nickel perchlorate, ammonia, Ni(ClO<sub>4</sub>)<sub>2</sub>.  
 6NH<sub>3</sub>.  
 Ppt. (Salvadori.)

Nitrosyl perchlorate, NO.O.ClO<sub>4</sub>+H<sub>2</sub>O.  
 Ppt.; sl. hygroscopic; decomp. by H<sub>2</sub>O.  
 (Hofmann, B. 1909, 42. 2032.)

Platinum perchlorate, Pt<sub>2</sub>ClO<sub>4</sub>+15H<sub>2</sub>O.  
 Insol. in H<sub>2</sub>O (Prost, Bull. Soc. (2) 46.  
 156.)

Potassium perchlorate, KClO<sub>4</sub>.

Sol. in 57.9 pts. H<sub>2</sub>O at 21° (Longumme, A. 121  
 123), in 66 pts. H<sub>2</sub>O at 15° (Scurullas, A. ch. (2) 46 297),  
 in 88 pts. H<sub>2</sub>O at 10°, in 55 pts. H<sub>2</sub>O at 100° (Hutstein,  
 J. B. 1851 381)

Solubility in H<sub>2</sub>O.

1 pt. KClO<sub>4</sub> dissolves in 142.9 pts. H<sub>2</sub>O at  
 6°, and solution has sp. gr.=1.0005; in 52.5  
 pts. H<sub>2</sub>O at 25°, and solution has sp. gr.=  
 1.0123; in 15.5 pts. H<sub>2</sub>O at 50°, and solution  
 has sp. gr.=1.0181; in 5.04 pts. H<sub>2</sub>O at 100°,  
 and solution has sp. gr.=1.0660. (Muir, C.  
 N. 83. 15.)

1 l. H<sub>2</sub>O dissolves 78.07 millimols. KClO<sub>4</sub>  
 at 10°; 120.4 millimols. at 20°; 179.9 millimols.  
 at 30°. (Noyes and Sammet, Z. phys.  
 Ch. 1903, 43. 538.)

1 l. H<sub>2</sub>O dissolves 0.1475 mol. KClO<sub>4</sub> at  
 25°. (Rothmund, Z. phys. Ch. 1909, 69. 539.)

Solubility in H<sub>2</sub>O at t°

t°	G. KClO <sub>4</sub> in 100 g H <sub>2</sub> O	t°	G. KClO <sub>4</sub> in 100 g H <sub>2</sub> O
0	0.70	50	6.45
10	1.14	70	12.8
15	1.54	99	22.2
20.5	1.90		..

(Calzolari, Acc. Sci. Med. Ferrara, 1911, 85.  
 150.)

t°	G. per 100 g H <sub>2</sub> O	Sp. gr.
0	0.79	1.007
20	1.80	1.011
40	4.81	1.022
60	8.71	1.033
80	14.78	1.053
100	20.98	1.067

(Carlson, Festak. Stockholm, 1911 262)

1 l. H<sub>2</sub>O dissolves 0.1481 equivalents  
 KClO<sub>4</sub> at 25°. (Noyes and Boggs, J. Am.  
 Chem. Soc. 1911, 33. 1652.)

100 cc. of sat. solution of KClO<sub>4</sub> in H<sub>2</sub>O con-

tains 2.085 g. KClO<sub>4</sub> at 25.2°. (Thin and Cum-  
 ming, Chem. Soc. 1915, 107. 361.)

KClO<sub>4</sub> is sol. in 22.2 pts. H<sub>2</sub>O at ord. temp.,  
 and 4.00 pts. at 100°, in 29.6 pts. NH<sub>4</sub>OH +  
 Aq (conc.) at ord. temp., in 30.4 pts. NH<sub>4</sub>OH  
 + Aq (1 vol conc + 3 vols H<sub>2</sub>O) at ord.  
 temp.; in 22.4 pts. HNO<sub>3</sub> + Aq (1 vol conc. +  
 5 vols. H<sub>2</sub>O) at ord. temp., and 5.00 pts. at  
 100°; in 30.4 pts. HCl + Aq. (1 vol conc. +  
 4 vols H<sub>2</sub>O) at ord. temp., 45.2 pts. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>  
 + Aq (1 vol. commercial acid + 1 vol. H<sub>2</sub>O)  
 at ord. temp., in 24.4 pts. NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq.  
 (dil. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + dil. NH<sub>4</sub>OH + Aq) at ord.  
 temp., and 6.00 pts. at 100°, in 25.8 pts.  
 NH<sub>4</sub>Cl + Aq (1 pt. NH<sub>4</sub>Cl + 10 pts. H<sub>2</sub>O) at  
 ord. temp., and 6.00 pts. at 100°, in 16.0 pts.  
 NH<sub>4</sub>NO<sub>3</sub> + Aq (1 pt. NH<sub>4</sub>NO<sub>3</sub> + 10 pts. H<sub>2</sub>O)  
 at ord. temp., and 4.00 pts. at 100°; in 25.6  
 pts. NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq (conc. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> +  
 Na<sub>2</sub>CO<sub>3</sub> + 4 vols. H<sub>2</sub>O) at ord. temp., and  
 7.00 pts. at 100°, in 29.2 pts. Cu(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub> +  
 Aq (Stolba, Z. anal. 2. 390) at ord. temp.,  
 and 7.00 pts. at 100°; in 27.3 pts. cane sugar  
 (1 pt. + 10 pts. H<sub>2</sub>O) at ord. temp.; in 38.8  
 pts. grape sugar (1 pt. + 10 pts. H<sub>2</sub>O) at ord.  
 temp. (Approximate) (Pearson, Zeit. Chem.  
 1869. 662)

Solubility of KClO<sub>4</sub> in HClO<sub>4</sub> at 25.2°.

Normality of HClO <sub>4</sub>	% KClO <sub>4</sub>
0.01	1.999
0.10	1.485
1.00	0.527

(Thin and Cumming, Chem. Soc. 1915, 107.  
 361.)

Solubility in KCl + Aq at 25°.

Concentration of KCl Equivalents per litre	Solubility of KClO <sub>4</sub> Equivalents per litre
0.04973	0.1282
0.09933	0.1123

(Noyes and Boggs, J. Am. Chem. Soc. 1911,  
 33. 1652.)

Solubility in K<sub>2</sub>SO<sub>4</sub> + Aq at 25°

Concentration of K <sub>2</sub> SO <sub>4</sub> Equivalents per litre	Solubility of KClO <sub>4</sub> Equivalents per litre
0.04970	0.1315
0.09922	0.1181

(Noyes and Boggs)

Very sl. sol. in abs. alcohol, and insol. if  
 alcohol contains trace of an acetate. (Ros-  
 coe.) Insol. in alcohol of 0.835 sp. gr. (Schlö-  
 sing, C. R. 73. 1269.)

Sol. in 6400 pts. 97.2% alcohol; in 5000  
 pts. 95.3% alcohol, in 2500-3000 pts. 90%  
 alcohol, in 25,000 pts. alcohol-ether (2 pts.  
 97% alcohol + 1 pt ether) Practically insol.

in an alcoholic solution of  $\text{HClO}_4$ . (Wenze' Z. angew. Ch. 1891. 691.)

Solubility of  $\text{KClO}_4$  in ethyl alcohol + Aq at  $25.2^\circ$ .

Vol. % alcohol	G. $\text{KClO}_4$ sol. in 100 g alcohol
51.2	0.754
93.5	0.051
98.8	0.019

(Thun and Cumming, Chem. Soc. 1915, 107. 361.)

Solubility in organic compds. + Aq. at  $25^\circ$ .

Solvent	Mol $\text{KClO}_4$ vol in 1 litre
0.5-N methyl alcohol	0.1402
" ethyl alcohol	0.1356
" propyl alcohol	0.1343
" tert. amyl alcohol	0.1279
" acetone	0.1451
" ether	0.1336
" glycol	0.1416
" glycerine	0.1404
" urea	0.1510
" ammonia	0.1474
" diethylamine	0.1342
" pyridine	0.1410
" urethane	0.1400
" formamide	0.1539
" acetamide	0.1447
" acetic acid	0.1462
" phenol	0.1362
" methylal	0.1400
" methyl acetate	0.1429

(Rothmund, Z. phys. Ch. 1909, 69. 539.)

Insol in methyl acetate. (Naumann, B. 1909, 43. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Potassium rubidium perchlorate,  $\text{KRb}_2(\text{ClO}_4)_2$ .

15.5 g. are contained in 1 l solution sat. at  $20^\circ$ ; sp. gr. = 1.013. (Carlson.)

Rubidium perchlorate,  $\text{RbClO}_4$ .

Sol. in 92.1 pts.  $\text{H}_2\text{O}$  at  $21.3^\circ$  (Longunne, A. 121. 123.)

1 pt. sol. in 92.1 pts.  $\text{H}_2\text{O}$  at  $21^\circ$  as compared with 1 pt.  $\text{KClO}_4$  sol. in 57.9 pts.  $\text{H}_2\text{O}$  at  $21^\circ$ . (Erdmann, Arch. Pharm. 1894, 232. 23.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{RbClO}_4$ in 100 g. $\text{H}_2\text{O}$	$t^\circ$	G. $\text{RbClO}_4$ in 100 g. $\text{H}_2\text{O}$
0	2.46	42.2	14.94
8	3.50	50	19.40
19.8	6.28	77	41.65
30	9.53	99	76.5

(Calzolari, Acc. Sci. Med. Ferrara, 1911, 86. 150.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. in 100 g. $\text{H}_2\text{O}$	Sp. gr.
0	1.10	1.007
20	1.56	1.010
40	3.26	1.017
60	6.27	1.028
80	11.04	1.050
100	15.75	1.070

(Carlson, Festsch. Stockholm, 1911. 262.)

Scandium perchlorate.

(Crookes, Roy Soc Proc 1908, 80. A, 518.)

Silver perchlorate,  $\text{AgClO}_4$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Serullas, A. ch. 46. 307.)

Sodium perchlorate,  $\text{NaClO}_4$ .

Deliquescent, and very sol. in  $\text{H}_2\text{O}$  and alcohol. (Serullas.)

Not deliquescent. (Potilitsin, J. russ. Soc. 1889, 1. 258.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. in 1 l. of solution	Sp. gr.
15	1076	1.666
50	1234	1.731
143	1414	1.789

(Carlson, Festsch. Stockholm, 1911. 262.)

+  $\text{H}_2\text{O}$  Not deliquescent. (Potilitsin.)

Strontium perchlorate,  $\text{Sr}(\text{ClO}_4)_2$ .

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Serullas, A. ch. 46. 304.)

Terbium perchlorate.

Very sol. in  $\text{H}_2\text{O}$  and in alcohol. (Potratz, C. N. 1905, 92. 3.)

Thallous perchlorate,  $\text{TlClO}_4$ .

1 pt. salt dissolves in 10 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 0.6 pt. at  $100^\circ$ . (Roscoe, Chem. Soc. (2) 4. 504.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. per 100 g. $\text{H}_2\text{O}$	Sp. gr.
0	6.00	1.060
10	8.04	1.075
30	19.72	1.146
50	39.62	1.251
70	65.32	1.430
80	81.49	1.520

(Carlson, Festsch. Stockholm, 1911. 262.)

Sl. sol. in alcohol (Roscoe.)

**Thallie perchlorate,  $\text{Tl}(\text{ClO}_4)_3 \cdot 6\text{H}_2\text{O}$** 

Very hygroscopic, sol in  $\text{H}_2\text{O}$ . Decomp. in moist air (Gewecke, Z. anorg. 1912, 75, 274.)

**Uranyl perchlorate,  $(\text{UO}_2)(\text{ClO}_4)_2 \cdot 4\text{H}_2\text{O}$** 

(Salvadori, Ch. Z 1912, 36, 513.)  
+  $6\text{H}_2\text{O}$  (Salvadori.)

**Yttrium perchlorate,  $\text{Y}(\text{ClO}_4)_3 \cdot 8\text{H}_2\text{O}$** 

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol (Cleve.)

**Zinc perchlorate,  $\text{Zn}(\text{ClO}_4)_2$** 

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol (Serullas, A. ch 46, 302.)  
+  $4\text{H}_2\text{O}$ , and  $6\text{H}_2\text{O}$ . (Salvadori, C. C 1912, II 414.)

**Zinc perchlorate, ammonia,  $\text{Zn}(\text{ClO}_4)_2 \cdot 4\text{NH}_3$** 

Ppt. (Salvadori, C. C 1912, II 414.)  
 $\text{Zn}(\text{ClO}_4)_2 \cdot 6\text{NH}_3$ . (Ephraim, B 1915, 48, 643.)

**Perchromic acid.**

Sol. in ethyl acetate and valerate; in amyl chloride, formate, acetate, butyrate, and valerate. (All give blue solutions.)

Insol. in  $\text{CS}_2$ ,  $\text{C}_2\text{H}_4$ ,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_5\text{NH}_2$ ,  $\text{C}_6\text{H}_5\text{NO}_2$  and toluene (Grosvenor, J. Am. Chem. Soc 1895, 17, 41-43.)  
 $\text{H}_2\text{CrO}_5 + 2\text{H}_2\text{O}$ . Decomp. above  $-30^\circ$  (Riesenfeld, B. 1914, 47, 552.)

**Ammonium perchromate,  $(\text{NH}_4)_2\text{CrO}_5$** 

Very unstable. Sl. sol in cold  $\text{H}_2\text{O}$ . Decomp. by conc  $\text{H}_2\text{SO}_4$ . Insol. in pure alcohol and pure ether. Decomp. by boiling alcohol containing more than 50%  $\text{H}_2\text{O}$ . (Wohlers, B. 1905, 38, 1888.)

$\text{CrO}_5 \cdot 3\text{NH}_4$ . Sol. in 10%  $\text{NH}_4\text{OH} + \text{Aq}$ ; sol. in  $\text{H}_2\text{O}$  with decomp., insol. in other solvents. (Wiede, B 1897, 30, 2181.)

$\text{NH}_4\text{CrO}_5 \cdot \text{H}_2\text{O}_2$ . Decomp. in the air. Sol. in ice cold  $\text{H}_2\text{O}$ , decomp. when warmed. Insol. in alcohol, ether, ligroin and  $\text{CHCl}_3$ . (Wiede, B. 1895, 31, 515.)

**Ammonium hydrogen perchromate,  $\text{CrO}_5(\text{O} \cdot \text{O} \cdot \text{NH}_4)(\text{O} \cdot \text{OH})$** 

Sol. in  $\text{H}_2\text{O}$  with decomp. Difficultly sol. in cold abs alcohol. (Hofmann, B. 1904, 37, 3406.)

**Barium perchromate,  $\text{BaCr}_2\text{O}_8$** 

(Byers and Reid, Am. Ch. J. 1904, 32, 513.)

**Calcium perchromate,  $\text{CaCr}_2\text{O}_8$** 

Very sol. in  $\text{H}_2\text{O}$ . (Mylus, B. 1900, 33, 3689; Byers and Reid, Am. Ch. J. 1904, 32, 513.)

**Lithium perchromate,  $\text{Li}_2\text{Cr}_2\text{O}_8$** 

(Byers and Reid, Am. Ch. J. 1904, 32, 511.)

**Magnesium perchromate,  $\text{MgCr}_2\text{O}_8$** 

(Byers and Reid.)

**Potassium perchromate,  $\text{K}_2\text{Cr}_2\text{O}_8$** 

Sl. sol in cold  $\text{H}_2\text{O}$ . Decomp. by conc.  $\text{H}_2\text{SO}_4$ . Insol. in pure alcohol and pure ether. Decomp. by boiling alcohol containing more than 50%  $\text{H}_2\text{O}$ . (Wohlers, B. 1905, 38, 1888.)

+  $\tau\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  at  $0^\circ$  without decomp. (Riesenfeld and Kutsch, B. 1908, 41, 3948.)

$\text{K}_2\text{Cr}_2\text{O}_8$ . Sol. in  $\text{H}_2\text{O}$ . Decomp. in the air. (Byers and Reid, Am. Ch. J. 1904, 32, 505.)

$\text{KCrO}_5 \cdot \text{H}_2\text{O}_2$  or  $\text{KH}_2\text{CrO}_7$ . Sol. in ice cold  $\text{H}_2\text{O}$ , decomp. when warmed, explosive. (Wiede, B 1898, 31, 520.)

**Sodium perchromate,  $\text{Na}_2\text{Cr}_2\text{O}_8$** 

Sl. sol in cold  $\text{H}_2\text{O}$ . Decomp. by conc.  $\text{H}_2\text{SO}_4$ . Insol. in pure alcohol and pure ether. Decomp. by boiling with alc. containing more than 50%  $\text{H}_2\text{O}$ . (Wohlers, B. 1905, 38, 1888.)

$\text{Na}_2\text{Cr}_2\text{O}_8 + 28\text{H}_2\text{O}$ . Efflorescent. Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ , with decomp. Not decomp. by  $\text{NaOH} + \text{Aq}$ . (Haussenmann, J. pr. (2) 48, 70.)

$\text{Na}_2\text{Cr}_2\text{O}_8$ . (Byers and Reid, Am. Ch. J. 1904, 32, 511.)

**Perchloroplatinocyanhydric acid,**

$\text{H}_2\text{Pt}(\text{CN})_4\text{Cl}_2 + 4\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$  and alcohol

**Ammonium perchloroplatinocyanide,**

$(\text{NH}_4)_2\text{Pt}(\text{CN})_4\text{Cl}_2 + 2\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ .

**Barium —,  $\text{BaPt}(\text{CN})_4\text{Cl}_2 + 5\text{H}_2\text{O}$** 

Very sol. in  $\text{H}_2\text{O}$ .

**Calcium —,  $\text{CaPt}(\text{CN})_4\text{Cl}_2$** 

Sol. in  $\text{H}_2\text{O}$ .

**Magnesium —,  $\text{MgPt}(\text{CN})_4\text{Cl}_2 + \tau\text{H}_2\text{O}$** 

Sol. in  $\text{H}_2\text{O}$ .

**Manganous —,  $\text{MnPt}(\text{CN})_4\text{Cl}_2 + 5\text{H}_2\text{O}$** 

Sol. in  $\text{H}_2\text{O}$  and alcohol.

**Potassium —,  $\text{K}_2\text{Pt}(\text{CN})_4\text{Cl}_2 + 2\text{H}_2\text{O}$** 

Very efflorescent, and sol in  $\text{H}_2\text{O}$  and alcohol.

**Percolumbic acid,  $\text{HClbO}_4 \cdot n\text{H}_2\text{O}$** 

Insol. in  $\text{H}_2\text{O}$ . Sol. with decomp. in warm  $\text{H}_2\text{SO}_4$ . (Melikoff, Z. anorg. 1899, 20, 341.)

**Cæsium percolumbate,  $\text{Cs}_2\text{C}_2\text{O}_8$** 

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, 30, 1658.)

**Cæsium magnesium percolumbate,** .  
 $\text{MgCsCbO}_8 + 8\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$  without decomp (E. F. Smith.)

**Calcium potassium percolumbate,**  
 $\text{CaKCbO}_8 + 4\text{H}_2\text{O}$ .  
 Difficultly sol in  $\text{H}_2\text{O}$  (E. F. Smith.)

**Calcium sodium percolumbate,**  $\text{CaNaCbO}_8 + 4\text{H}_2\text{O}$ .  
 Difficultly sol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Magnesium potassium percolumbate,**  
 $\text{MgKCbO}_8 + 7\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$  without decomp (E. F. Smith.)

**Magnesium rubidium percolumbate,**  
 $\text{MgRbCbO}_8 + 7\frac{1}{2}\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$  without decomp (E. F. Smith.)

**Magnesium sodium percolumbate,**  
 $\text{MgNaCbO}_8 + 8\text{H}_2\text{O}$ .  
 Sol in  $\text{H}_2\text{O}$  without decomp. (E. F. Smith.)

**Potassium percolumbate,**  $\text{K}_2\text{CbO}_8$ .  
 Sol in  $\text{H}_2\text{O}$ . Ppt. from aq solution by alcohol. (E. F. Smith.)  
 $\text{K}_2\text{CbO}_8 + 3\text{H}_2\text{O}$  Sol. with decomp. in  $\text{H}_2\text{O}$  Ppt. by alcohol. Sol. in  $\text{KOH} + \text{H}_2\text{O}_2 + \text{Aq}$  (Mehkoff, Z anorg 1899, 20. 342.)

**Rubidium percolumbate,**  $\text{Rb}_2\text{CbO}_8$ .  
 Sol. in  $\text{H}_2\text{O}$ . Insol in alcohol (E. F. Smith.)

**Sodium percolumbate,**  $\text{Na}_2\text{CbO}_8$ .  
 Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol (E. F. Smith.)

### Perferricyanhydric acid.

**Potassium perferricyanide,**  $\text{K}_3\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$  (?).

Very hygroscopic, and sol in  $\text{H}_2\text{O}$ . Nearly insol. in absolute alcohol. Decomp. by hot  $\text{H}_2\text{O}$ . (Skraup, A. 189. 368.)

### Periodic acid, $\text{H}_5\text{IO}_6$ .

Deliquescent in moist air, very sol. in  $\text{H}_2\text{O}$ . (Bengieser, A. 17. 254.)

Rather easily sol in alcohol and ether. (Bengieser.)

Rather easily sol. in alcohol, less in ether. (Langtoch.)

Sl. sol. in alcohol, still less in ether. (Langlois, J. pr. 56. 36.)

Sp. gr. of  $\text{H}_5\text{IO}_6 + \text{Aq}$ .  
 $\text{H}_5\text{IO}_6 + 20\text{H}_2\text{O} = 1.4008$ .  
 $\text{H}_5\text{IO}_6 + 40\text{H}_2\text{O} = 1.2165$ .  
 $\text{H}_5\text{IO}_6 + 80\text{H}_2\text{O} = 1.1121$ .  
 $\text{H}_5\text{IO}_6 + 160\text{H}_2\text{O} = 1.0570$ .  
 $\text{H}_5\text{IO}_6 + 320\text{H}_2\text{O} = 1.0288$ .  
 (Thomsen, B. 7. 71.)

### Periodates.

Most periodates are insol or sl. sol in  $\text{H}_2\text{O}$ , all are insol. or very sl. sol in alcohol, but they all dissolve in dil  $\text{HNO}_3 + \text{Aq}$ . (Bengieser.)

**Aluminum metaperiodate,**  $\text{Al}(\text{IO}_4)_3 + 3\text{H}_2\text{O}$ .  
 Stable in solution containing  $\text{HNO}_3$ . (Eakle, C. C. 1896. II, 649.)

**Ammonium metaperiodate,**  $\text{NH}_4\text{IO}_4$ .  
 Sl. sol in  $\text{H}_2\text{O}$ . Cryst with  $3\text{H}_2\text{O}$  (Ihre, B. 3. 316),  $2\text{H}_2\text{O}$  (Langlois, A. ch (3) 34. 257).  
 Stable in solution containing free ammonia. (Eakle, Zeit Kryst. 1896, 26. 258-88.)  
 100 pts  $\text{H}_2\text{O}$  dissolve 27 pts  $\text{NH}_4\text{IO}_4$  at  $16^\circ$ ; sp. gr. of sat. solution at  $16^\circ/4^\circ = 1.0178$  (Barker, Chem. Soc. 1908, 93. 17.)

**Ammonium dimesoperiodate,**  $(\text{NH}_4)_2\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$ .  
 Sol in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 134. 379.)

Stable in solution containing free ammonia. Two modifications. (Eakle, Zeit Kryst. 1896, 26. 558-88; C. C. 1896. II, 649.)

**Ammonium lithium dimesoperiodate,**  
 $(\text{NH}_4)_2\text{Li}_2\text{I}_2\text{O}_9 + 7\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Ihre.)

**Ammonium magnesium mesoperiodate,**  
 $\text{NH}_4\text{MgI}_2\text{O}_9 + 3\text{H}_2\text{O}$ .  
 Precipitate. (Rammelsberg, Pogg. 134. 510.)

**Barium metaperiodate,**  $\text{Ba}(\text{IO}_4)_2$ .  
 Known only in solution

**Barium dimesoperiodate,**  $\text{Ba}_2\text{I}_2\text{O}_9$ .  
 Sl. sol. in  $\text{H}_2\text{O}$ , easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg, Pogg. 134. 391.)  
 Cryst also with  $3\text{H}_2\text{O}$ ,  $5\text{H}_2\text{O}$ , and  $7\text{H}_2\text{O}$ .

**Barium mesoperiodate,**  $\text{Ba}_2(\text{IO}_4)_3 + 6\text{H}_2\text{O}$ .  
 (Ihre.)

**Barium orthoperiodate,**  $\text{Ba}_4(\text{IO}_3)_2$ .  
 Insol in  $\text{H}_2\text{O}$ . Sol in  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg.)

**Barium dimesodiperoxide,**  $\text{Ba}_2\text{I}_2\text{O}_{10} + 5\text{H}_2\text{O}$ .  
 Precipitate. Sol. in dil.  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg, Pogg. 134. 395.)

**Barium periodate tungstate.**  
 See Tungstoperoxide, barium.

**Cæsium metaperiodate,**  $\text{CsIO}_4$ .  
 Sl. sol. in cold  $\text{H}_2\text{O}$ ; readily sol in hot  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1901, 26. 279.)  
 2.15 pts. are sol in 100 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ .  
 Sp. gr. of the sat aq solution at  $15^\circ/4^\circ = 1.0166$ . (Barker, Chem. Soc. 1908, 93. 17.)

**Cæsium periodate hydrogen fluoride,  $2\text{CsIO}_4$ ,  $3\text{HF} + \text{H}_2\text{O}$** 

Sol in 40–60% HF + Aq. Decomp. by  $\text{H}_2\text{O}$ . Efflorescent. (Weinland, Z anorg 1899, 22. 263.)

**Cadmium metaperiodate,  $\text{Cd}(\text{IO}_3)_2$ .**

Ppt. (Rammelsberg, Pogg. 134. 516)

**Cadmium dmesoperiodate,  $\text{Cd}_2\text{I}_2\text{O}_9 + 9\text{H}_2\text{O}$ .**

Insol in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Cadmium mesoperiodate,  $\text{Cd}_3(\text{IO}_3)_2 + 5\text{H}_2\text{O}$ .**

Ppt  
 $\text{CdHIO}_6$ . (Kimmins, Chem Soc 55. 151.)

**Cadmium dimeriodate,  $\text{Cd}_4\text{I}_2\text{O}_{11} + 3\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Cadmium periodate,  $\text{Cd}_{12}\text{I}_4\text{O}_{31} + 15\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  (Rammelsberg)

**Calcium metaperiodate,  $\text{Ca}(\text{IO}_3)_2$ .**

Sol in  $\text{H}_2\text{IO}_6$  + Aq and acids (Rammelsberg, Pogg. 134. 405)

**Calcium dmesoperiodate,  $\text{Ca}_2\text{I}_2\text{O}_9 + 7\text{H}_2\text{O}$ , and  $9\text{H}_2\text{O}$** 

Sl sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)  
+  $3\text{H}_2\text{O}$ . (Langlois)

**Calcium orthoperiodate,  $\text{Ca}_3(\text{IO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  + Aq (Rammelsberg, Pogg. 44. 577.)

**Cobaltous periodate,  $7\text{CoO}$ ,  $2\text{I}_2\text{O}_7 + 18\text{H}_2\text{O}$ .**

Attacked by HCl, and sol. on warming. Slowly but completely sol. in  $\text{NH}_3$  (Lautsch, J. pr. 100. 89)

Could not be obtained by Rammelsberg.

**Cupric dmesoperiodate,  $\text{Cu}_2\text{I}_2\text{O}_9 + 6\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  without dissolving. (Rammelsberg.)

**Cupric orthoperiodate,  $\text{Cu}_2\text{HIO}_6$ .**

Very sol. in  $\text{HNO}_3$  + Aq. (Kimmins, Chem. Soc. 55. 150)

**Cupric dimeriodate,  $\text{Cu}_4\text{I}_2\text{O}_{11} + \text{H}_2\text{O}$ .**

Insol in  $\text{H}_2\text{O}$ , sol. in dil  $\text{HNO}_3$  + Aq. (Rammelsberg.)  
+  $7\text{H}_2\text{O}$ . (R)

**Cupric periodate,  $5\text{CuO}$ ,  $\text{I}_2\text{O}_5 + 5\text{H}_2\text{O}$ .**

Wholly insol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 1. 73)

**Didymium peroidate,  $\text{Dy}_2\text{O}_3(\text{IO}_3)_2$ .**

Precipitate.  
 $\text{DyIO}_6 + 4\text{H}_2\text{O}$ . Ppt. (Cleve, Bull. Soc. (2) 43. 362.)

**Erbium periodate.**

Sol. in  $\text{H}_2\text{O}$  (Hoglund)

**Glucinum periodate,  $\text{Gl}_2(\text{IO}_3)_2 + 11\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  without dissolving. Easily sol. in  $\text{HNO}_3$  + Aq  
+  $13\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Atterberg, B. 7. 474.)

**Iron (ferrous) orthoperiodate,  $\text{Fe}_2(\text{IO}_3)_2$ .**

(Kimmins, Chem. Soc. 55. 150)

$\text{FeH}_2\text{IO}_6$  (Kimmins)

**Iron (ferric) periodate,  $2\text{Fe}_2\text{O}_3$ ,  $\text{I}_2\text{O}_7 + 21\text{H}_2\text{O}$ .**

Ppt (Rammelsberg.)

**Iron (ferric) dmesoperiodate,  $\text{FeH}_2\text{IO}_6$ .**

Insol in dil  $\text{HNO}_3$  + Aq. (Kimmins, Chem. Soc. 55. 149)

**Iron (ferric) metaperiodate,  $\text{Fe}(\text{IO}_3)_2$ .**

(Kimmins)

**Lanthanum periodate,  $\text{La}(\text{IO}_3)_3 + 2\text{H}_2\text{O}$ .**

Precipitate. (Cleve)

**Lead metaperiodate,  $\text{Pb}(\text{IO}_3)_2$ .**

Sol. in  $\text{HNO}_3$  + Aq. (Kimmins)

**Lead orthoperiodate,  $\text{Pb}_2\text{H}_4(\text{IO}_3)_2$ .**

Sol in  $\text{HNO}_3$  + Aq. (Kimmins, Chem. Soc. 55. 149.)

**Lead mesoperiodate,  $\text{Pb}_2(\text{IO}_3)_2 + 2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  or excess of periodic acid + Aq. Decomp. by dil.  $\text{H}_2\text{SO}_4$  + Aq. (Bengieser, A. 17. 254)

**Lithium metaperiodate,  $\text{LiIO}_4$ .**

Difficultly sol in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 1. 132.)

Somewhat deliquescent.

+  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{O}$ . (Barker, Chem. Soc. 1911, 99. 1326)

**Lithium dmesoperiodate,  $\text{Li}_4\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 134. 387.)

**Lithium orthoperiodate,  $\text{Li}_3\text{IO}_6$ .**

$\text{H}_2\text{O}$  dissolves out a slight amount of  $\text{LiI}$ . Easily sol. in  $\text{HNO}_3$  + Aq. (Rammelsberg, Pogg. 137. 313)

**Magnesium metaperiodate,  $\text{Mg}(\text{IO}_3)_2 + 10\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Magnesium dimeriodate,  $\text{Mg}_4\text{I}_2\text{O}_{11} + 6\text{H}_2\text{O}$ , or  $9\text{H}_2\text{O}$** 

Sl efflorescent Insol. in  $\text{H}_2\text{O}$  (Rammelsberg.)

**Magnesium dimesoperiodate**,  $Mg_3I_2O_8 + 3H_2O$ .

(Rammelsberg, Pogg. 134. 499.)  
+15H<sub>2</sub>O. Insol. in H<sub>2</sub>O. Sol. in periodic acid + Aq. (Langlois.)

**Manganic periodate.**

See Manganiperiodic acid.

**Mercurous dimerperiodate**,  $5Hg_2O, I_2O_7$ , or  $4Hg_2O, I_2O_7 = Hg_4I_2O_{11}$ .

Insol. in H<sub>2</sub>O. Easily sol. in HNO<sub>3</sub> + Aq and in HCl + Aq. (Lautsch, J. pr. 100. 86.)

**Mercuric orthoperiodate**,  $Hg_2(IO_6)_2$

Insol. in H<sub>2</sub>O. Easily sol. in HCl. Sl. sol. in HNO<sub>3</sub>. (Lautsch)

**Mercuric potassium periodate**,  $10HgO, 5K_2O, 6I_2O_7$ .

Insol. in H<sub>2</sub>O. Difficultly sol. in warm HNO<sub>3</sub> without decomp. (Rammelsberg, Pogg. 134. 526)

**Nickel dimesoperiodate**,  $Ni_2I_2O_8$ .

(Kinnus, Chem. Soc. 55. 151.)

**Nickel mesoperiodate**,  $Ni_2(IO_6)_2$ .

(Kinnus)

**Nickel periodate**,  $7NiO, 4I_2O_7 + 63H_2O$ .

Insol. in H<sub>2</sub>O. Easily sol. in H<sub>2</sub>IO<sub>6</sub> + Aq. (Rammelsberg, Pogg. 134. 514.)

**Potassium metaperiodate**,  $KIO_4$ .

Sl. sol. in H<sub>2</sub>O. Sol. in 290 pts. cold H<sub>2</sub>O. (Rammelsberg, Pogg. 134. 320.)

Almost insol. in KOH + Aq.

0.65 pt. is sol. in 100 pts H<sub>2</sub>O at 13°. Sp. gr. of the sat. sol. at 13°/4° = 1.0051. (Barker, Chem. Soc. 1908, 93. 16.)

Insol. in methyl acetate. (Naumann, B. 1900, 42. 3790.)

**Potassium mesoperiodate**,  $K_3IO_8 + 4H_2O$ .

Deliquescent. Easily sol. in H<sub>2</sub>O. (Ihre.)

**Potassium dimesoperiodate**,  $K_4I_2O_8 + 9H_2O$

Sol. in 9.7 pts. cold H<sub>2</sub>O. (Rammelsberg, Pogg. 134. 320.)

Sol. in KOH + Aq.

+3H<sub>2</sub>O.

**Potassium hydrogen dimesoperiodate**,

$K_2HI_2O_8$ .

Less sol. in H<sub>2</sub>O than KIO<sub>4</sub>. (Kinnus, Chem. Soc. 51. 355)

**Potassium manganic periodate.**

See Manganiperiodate, potassium.

**Potassium zinc periodate**,  $K_2O, 4ZnO, 2I_2O_7 + 4H_2O$ .

Ppt. (Rammelsberg, Pogg. 134. 368.)

**Potassium periodate tungstate.**

See Tungstoperiodate, potassium.

**Rubidium periodate**,  $RbIO_4$ .

0.65 pt. is sol. in 100 pts H<sub>2</sub>O at 13°. Sp. gr. of the sat. aq. solution at 13°/4° = 1.0052. (Barker, Chem. Soc. 1908, 93. 16.)

**Samarium periodate**,  $Sm(IO_6)_2 + 4H_2O$ .

Precipitate. (Cleve.)

**Silver metaperiodate**,  $AgIO_4$ .

Decomp. by cold H<sub>2</sub>O into  $Ag_4I_2O_8 + 3H_2O$ , and by warm H<sub>2</sub>O into  $Ag_4I_2O_8 + H_2O$ . (Ammermüller and Magnus, Pogg. 28. 516.)

+H<sub>2</sub>O. Insol ppt (Kinnus)

**Silver mesoperiodate**,  $Ag_3IO_8$

(Fornlund, J. pr. 100. 99.)

$Ag_3HIO_8$ . Insol. ppt. (Kinnus, Chem. Soc. 51. 358)

Ppt by dil. HNO<sub>3</sub>; sol. in HNO<sub>3</sub>. (Rosenheim, A. 1899, 308. 57.)

**Silver dimesoperiodate**,  $Ag_4I_2O_8 + H_2O$ , or  $3H_2O$

Insol ppt. (Kinnus.)

Decomp. by boiling H<sub>2</sub>O into  $Ag_3IO_8$  (Rammelsberg.)

**Silver orthoperiodate**,  $Ag_2IO_6$ .

Sol. in HNO<sub>3</sub> or NH<sub>4</sub>OH + Aq. (Rammelsberg, Pogg. 134. 386)

Sol. in excess NH<sub>4</sub>OH + Aq; pptd. by HNO<sub>3</sub>. (Rosenheim, A. 1899, 308. 56)

$Ag_2H_2IO_6$ . Insol ppt (Kinnus, Chem. Soc. 51. 358.)

$Ag_2H_2IO_6$ . As above (Kinnus.)

Sol. in dil. HNO<sub>3</sub>. (Rosenheim, A. 1899, 308. 53)

**Silver dimerperiodate**,  $Ag_5I_2O_{11}$ .

Sl. sol. in HNO<sub>3</sub> + Aq; insol. in NH<sub>4</sub>OH + Aq. (Lautsch, J. pr. 100. 75.)

**Silver dimesodimerperiodate**,  $Ag_{10}I_4O_{19}$ .

HNO<sub>3</sub> + Aq dissolves out Ag<sub>2</sub>O. Insol. in NH<sub>4</sub>OH + Aq. (Lautsch.)

**Sodium metaperiodate**,  $NaIO_4$

Easily sol. in H<sub>2</sub>O

+2H<sub>2</sub>O. (Langlois.)

+3H<sub>2</sub>O. Efflorescent; sol. in 12 pts H<sub>2</sub>O at ord. temp. (Rammelsberg, J. pr. 103. 278.)

**Sodium dimesoperiodate**,  $Na_4I_2O_8 + 3H_2O$

Scarcely sol in cold, sl. sol. in hot H<sub>2</sub>O. (Magnus and Ammermüller, Pogg. 28. 514.)

Very sol. in dil. HNO<sub>3</sub> + Aq. (Langlois)

Sol. in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq with decomp. (Bengesser, A. 17. 254.)

Insol. in methyl acetate. (Naumann, B. 1900, 42. 3790)

+4H<sub>2</sub>O.

Sodium *mesoperiodate*,  $\text{Na}_4\text{IO}_6 + \frac{1}{4}\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Ther.)  
 $+\text{H}_2\text{O} = \text{Na}_3\text{H}_2\text{IO}_6$ . Less sol. in  $\text{H}_2\text{O}$  than  
 $\text{Na}_4\text{I}_2\text{O}_7 + 3\text{H}_2\text{O} (= \text{Na}_3\text{H}_2\text{IO}_6)$ . (Kimmmins,  
 Chem. Soc. 51. 357.)

Sodium *orthoperiodate*,  $\text{Na}_4\text{IO}_6$

$\text{Na}_3\text{H}_2\text{IO}_6$ . Correct composition for  
 $\text{Na}_4\text{I}_2\text{O}_7 + 3\text{H}_2\text{O}$ . (Kimmmins.)  
 $\text{Na}_3\text{H}_2\text{IO}_6$ . Correct composition for  $\text{Na}_4\text{IO}_6$   
 $+\text{H}_2\text{O}$ . (Kimmmins.)

Strontium *metaperiodate*,  $\text{Sr}(\text{IO}_4)_2 + 6\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ .

Strontium *dimesoperiodate*,  $\text{Sr}_2\text{I}_2\text{O}_8$ .

Decomp. by  $\text{H}_2\text{O}$ .  
 $+3\text{H}_2\text{O}$ .

Strontium *mesoperiodate*,  $\text{Sr}_3(\text{IO}_6)_2$ .

Precipitate.

Strontium *orthoperiodate*,  $\text{Sr}_2(\text{IO}_6)_2$ .

(Rammelsberg, Pogg. 44. 577.)

Thallic periodate,  $3\text{Ti}_2\text{O}_3, \text{I}_2\text{O}_5 + 30\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ . Decomp. by alkalis.  
 (Rammelsberg, B. 3. 361.)

Thorium periodate.

Precipitate Sol. in  $\text{HNO}_3 + \text{Aq}$ .

Uranous periodate.

Precipitate, which quickly decomposes.

Ytterbium periodate,  $\text{YbIO}_3 + 2\text{H}_2\text{O}$ .

Hydrosopic. (Cleve, Z. anorg. 1902, 32.  
 136.)

Yttrium periodate,  $\text{Y}_2(\text{IO}_4)_2 + 8\text{H}_2\text{O}$ .

Very slightly sol. (Cleve.)  
 $3\text{Y}_2\text{O}_3, 2\text{I}_2\text{O}_5 + 6\text{H}_2\text{O}$ . Precipitate. (Cleve)

Zinc *dimesoperiodate*,  $\text{Zn}_2\text{I}_2\text{O}_8 + 6\text{H}_2\text{O}$ .

(Rammelsberg, Pogg. 134. 513.)

Zinc periodate,  $3\text{ZnO}, 2\text{I}_2\text{O}_5 + 7\text{H}_2\text{O}$ .

(Langlois)

Zinc *disperiodate*,  $\text{Zn}_4\text{I}_4\text{O}_{11} + \text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$ , sl. acid with  $\text{HNO}_3$ .  
 (Langlois, A. ch. (3) 34. 257.)

Zinc *dimesodisperiodate*,  $\text{Zn}_2\text{I}_4\text{O}_{19} + 14\text{H}_2\text{O} (?)$ .

(Rammelsberg.)

Zinc periodate,  $9\text{ZnO}, 2\text{I}_2\text{O}_5 + 12\text{H}_2\text{O}$ .

(Rammelsberg)

Periodoplatinocyanhydric acid.

Barium periodoplatinocyanide,  $\text{BaPt}(\text{CN})_4\text{I}_2$   
 $+ 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  or alcohol (Holst, Bull.  
 Soc. (2) 22. 347.)

Potassium periodoplatinocyanide,

$\text{K}_2\text{Pt}(\text{CN})_4\text{I}_2$

Permanent Easily sol. in  $\text{H}_2\text{O}$  or alcohol

Permanganic acid,  $\text{HMnO}_4$ .

Known only in solution, which decomposes  
 by evaporation or warming.

Permanganates.

All permanganates are sol. in  $\text{H}_2\text{O}$ , except-  
 ing  $\text{AgMnO}_4$ , which is sl. sol

Ammonium permanganate,  $\text{NH}_4\text{MnO}_4$ .

Sol in 12.6 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Aschoff.)  
 Sol in  $\text{H}_2\text{O}$  with decomp. (Christensen,  
 Z. anorg. 1900, 24. 206.)

Barium permanganate,  $\text{Ba}(\text{MnO}_4)_2$

Sol in  $\text{H}_2\text{O}$ .

Cadmium permanganate,  $\text{Cd}(\text{MnO}_4)_2 + 8\text{H}_2\text{O}$ .

Stable. (Klobb, Bull. Soc. 1894, (3) 11  
 607.)

Cadmium permanganate ammonia,

$\text{Cd}(\text{MnO}_4)_2, 4\text{NH}_3$ .

Sol in  $\text{H}_2\text{O}$  with decomp. (Klobb, Bull.  
 Soc. (3) 3. 510.)

Cesium permanganate,  $\text{CsMnO}_4$

Sl. sol. in cold, somewhat more easily sol.  
 in hot  $\text{H}_2\text{O}$ . (Muthmann, B. 1893, 26. 1018.)  
 Solubility in  $\text{H}_2\text{O}$ .

100 ccm. of the sat. solution contain at

$1^\circ$   $19^\circ$   $59^\circ$   
 0.097 0.23 1.25 g.  $\text{CsMnO}_4$ .

(Patterson, J. Am. Chem. Soc. 1906, 28.  
 1735.)

Calcium permanganate,  $\text{Ca}(\text{MnO}_4)_2 + 5\text{H}_2\text{O}$ .

Deliquescent.

Cupric permanganate.

Deliquescent.

Cupric permanganate ammonia,  $\text{Cu}(\text{MnO}_4)_2 \cdot 4\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$  with slow decomp (Klobb, Bull. Soc. (3) 3. 509.)

Didymium permanganate,  $\text{Di}(\text{MnO}_4)_2 + 2\text{H}_2\text{O}$ .

Sl sol. in  $\text{H}_2\text{O}$ . (Frerichs and Smith, A 191. 331.)

Has not been prepared. (Cleve, B. 11. 912.)

Lanthanum permanganate,  $\text{La}(\text{MnO}_4)_3 + 2\text{H}_2\text{O}$ .

Ppt. (Frerichs and Smith, A 191. 331.)

Has not been prepared (Cleve, B 11. 910.)

Lead permanganate.

Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Forchhammer)

Lithium permanganate,  $\text{LiMnO}_4 + 3\text{H}_2\text{O}$

Sol. in 14 pts  $\text{H}_2\text{O}$  at  $16^\circ$ . (Aschoff)

Magnesium permanganate,  $\text{Mg}(\text{MnO}_4)_2$

Insol. in  $\text{CHCl}_3$ ,  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_6$ , toluene, nitrobenzene, ligroin, ether and  $\text{CS}_2$ . Sol in methyl alcohol, acetone, pyridine, and readily sol. in glacial acetic acid. Only pyridine and glacial acetic acid are sufficiently stable toward the salt to be of any practical use for oxidation purposes (Michael and Garner, Am. Ch. J. 1906, 35. 268)  
+  $6\text{H}_2\text{O}$ . Easily deliquescent

Nickel permanganate ammonia,  $\text{Ni}(\text{MnO}_4)_2 \cdot 4\text{NH}_3$

Sol in  $\text{H}_2\text{O}$  with decomp (Klobb, Bull. Soc. (3) 3. 509)

Potassium permanganate,  $\text{KMnO}_4$ .

Sol. in 16 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Mitscherlich)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{KMnO}_4$
0	2.83
9.8	4.31
19.8	6.34
24.8	7.59
29.8	9.03
34.8	10.67
40.0	12.56
45.0	14.58
50.0	16.89
55.0	19.33
65.0	25.03

(Baxter, J. Am. Chem. Soc. 1906, 28. 1343.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

p = pts.  $\text{KMnO}_4$  sol. in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	p	$t^\circ$	p	$t^\circ$	p	$t^\circ$	p
0	2.76	19	6.26	38	11.74	57	20.29
1	2.90	20	6.48	39	12.12	58	20.83
2	3.06	21	6.70	40	12.51	59	21.39
3	3.23	22	6.94	41	12.91	60	21.96
4	3.38	23	7.18	42	13.31	61	22.55
5	3.54	24	7.42	43	13.72	62	23.15
6	3.70	25	7.68	44	14.14	63	23.76
7	3.86	26	7.94	45	14.56	64	24.38
8	4.04	27	8.20	46	15.00	65	25.01
9	4.23	28	8.48	47	15.44	66	25.67
10	4.40	29	8.77	48	15.88	67	26.34
11	4.58	30	9.07	49	16.32	68	27.03
12	4.78	31	9.37	50	16.77	69	27.84
13	4.98	32	9.69	51	17.23	70	28.56
14	5.18	33	10.01	52	17.71	71	29.30
15	5.38	34	10.34	53	18.21	72	30.05
16	5.60	35	10.68	54	18.71	73	30.81
17	5.82	36	11.02	55	19.23	74	31.57
18	6.04	37	11.38	56	19.75	75	31.95

(Worden, J. Soc. Chem. Ind. 1907, 28. 453.)

Solubility in  $\text{H}_2\text{O}$

100 ccm. of the sat. solution contain at.

$0^\circ$   $15^\circ$   $15.3^\circ$   $30^\circ$

2.84 5.22 5.30 8.69 g.  $\text{KMnO}_4$ .

Sp. gr. of sat. solution at  $15^\circ = 1.035$   
(Patterson, J. Am. Chem. Soc. 1906, 28. 1735)

1 l. sat.  $\text{KMnO}_4 + \text{Aq}$  contains at.

$0^\circ$   $10^\circ$   $20^\circ$   $30^\circ$   $40^\circ$

0.176 0.278 0.411 0.573 0.792 mol.  $\text{KMnO}_4$ .

$53^\circ$   $63^\circ$   $70^\circ$   $75^\circ$   
1.154 1.429 1.812 2.047 mol.  $\text{KMnO}_4$ .  
(Sackur, Z. Elektrochem. 1912, 18. 723)

Solubility of  $\text{KMnO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

Grams $\text{KMnO}_4$ sol. in 100 grams $\text{H}_2\text{O}$	$t^\circ$
0.58	— 0.18
1.01	— 0.27
2.02	— 0.48
2.91	— 0.58
4.22	+10
5.20	+15
7.53	+25
11.61	+40
16.75	+50

(Voerman, C. C. 1906, I. 125.)

Sol. in conc.  $\text{H}_2\text{SO}_4$ . Deliquesces in liquid  $\text{HCl}$ , but does not dissolve (Gore.)  
Slowly sol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ . (Chevillot and Edwards.)

Solubility in KOH+Aq at t° expressed in mol. per l. of the sat. solution.

t°	H <sub>2</sub> O	1-n KOH	2-n KOH	4-n KOH	6-n KOH	8-n KOH	10-n KOH
0	0.176	0 050	0.031	0 027	0 023	0 017	0 012
10	0 278	0 112	0 068	0.048	0 042	0.028	0 016
20	0 411	0 179	0 119	0.079	19° 0.074	0.032	0 029
30	0 573	32° 0 316	32° 0 213	32° 0 149	0 114	32° 0.062	0 040
40	0 792	0 439	0 306	0 211	0 161	0 084	0 052
50	53° 1.154	50° 0 638	0.462	0 304	0 219	0 111	
63	1 429	61° 0 904	60° 0 639	0 427	0 291	61° 0 143	0 071
70	1 812	1 172	0 869	0 572	0 390	0 188	0 082
75	2 047			0 651			0 089
80		1.513	1 190		0 500	0 231	
84		1 655	1 352	83° 0 808	85° 0 572		
90					0 649	0 297	

(Sackur, Z Elektrochem. 1912, 18. 723)

Solubility in salts+Aq. at t°

Solvent	t°	Mol KMnO <sub>4</sub> in 1 l of sat solution
0 1-n $\frac{K_2CO_3}{2}$	0 25 40	0 1462 0 4375 0 7380
1-n $\frac{K_2CO_3}{2}$	0 25 40	0.0629 0 2589 0 5007
2-n $\frac{K_2CO_3}{2}$	0 40	0 0446 0 3519
4-n $\frac{K_2CO_3}{2}$	0 25	0 0270 0 0930
6-n $\frac{K_2CO_3}{2}$	0	0 0156
0 1-n KCl	0 25 40	0 1395 0 4315 0 7380
0 5-n KCl	0 25 40	0.0760 0 3060 0.5840
1-n KCl	0 25 40	0 0532 0 220 0 444
2-n KCl	0 25 40	0 0379 0 1432 0 288

(Sackur, Z Elektrochem 1912, 18 723.)

 Very sol. in liquid NH<sub>3</sub>. (Moissan, A. ch. 1895 (7) 6. 428; Franklin, Am Ch J 1898, 20. 829.)

Decomp immediately by alcohol Sol in acetone. (Eidmann, C. C. 1899. II, 1014, Naumann, B 1904, 37. 4328.)

Solubility in acetone+Aq. at 13°

 A = cem. acetone in 100 cem acetone+Aq.  
 $\frac{1}{2}$  KMnO<sub>4</sub> = millimole KMnO<sub>4</sub> in 100 cem  
 of the solution.

A	$\frac{1}{2}$ KMnO <sub>4</sub>
0	148 5
10	162 2
20	177 3
30	208 2
40	257.4
50	289 7
60	316 8
70	328.0
80	312 5
90	227.0
100	67.6

(Herz and Knoch, Z. anorg. 1904, 41. 317.)

Sol. in benzonitrile (Naumann, B 1914, 47. 1369)

Difficultly sol in methyl acetate. (Naumann, B. 1909, 42. 3795)

Sol. in ethyl acetate. (Naumann, B 1904, 37. 3601)

 Rubidium permanganate, RbMnO<sub>4</sub>.

 Solubility in H<sub>2</sub>O lies between K and Cs salts (Muthmann, B. 1893, 26. 1018)

 Solubility in H<sub>2</sub>O.  
 100 cem of the sat solution contain at.

2°	19°	60°
0 46	1 06	4 68 g. RbMnO <sub>4</sub> .

 (Patterson, J Am. Chem. Soc 1906, 28. 1735.)

 Silver permanganate, Ag<sub>2</sub>MnO<sub>4</sub>

 Sol in 109 pts cold H<sub>2</sub>O and much less hot H<sub>2</sub>O. Decomp. by boiling (Mitscherlich, Pogg. 25. 301)

Silver permanganate ammonia.

 Sl. sol. in cold, more easily in hot H<sub>2</sub>O (Klobb, C. R. 103. 384)

**Sodium permanganate,  $\text{NaMnO}_4 + 3\text{H}_2\text{O}$ .**

Deliquescent. Extremely sol in  $\text{H}_2\text{O}$

Moderately sol in liquid  $\text{NH}_3$ . (Franklin, *Am. Ch. J.* 1898, 20, 829)

**Strontium permanganate,  $\text{Sr}(\text{MnO}_4)_2 + 4\text{H}_2\text{O}$**

Deliquescent. Sol in  $\text{H}_2\text{O}$ . (Fronherz)

**Thalious permanganate,  $\text{TIMnO}_4$ .**

Sol in  $\text{H}_2\text{O}$  with decomp. (R. Meyer, *Z. anorg.* 1899, 22, 188)

**Zinc permanganate,  $\text{Zn}(\text{MnO}_4)_2 + 6\text{H}_2\text{O}$ .**

Deliquescent. Very sol in  $\text{H}_2\text{O}$  (Martenson, *J. B.* 1873, 274.)

**Zinc permanganate ammonia,**

$\text{Zn}(\text{MnO}_4)_2 \cdot 4\text{NH}_3$

Sol. in  $\text{H}_2\text{O}$  with decomp. (Klobb, *Bull. Soc.* (3) 3, 509)

**Permanganomolybdic acid,  $\text{MnO}_2$ ,**

$12\text{MoO}_3 + 10\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Decomp. by alkalis. Sol. in alcohol. (Péchar, *C. R.* 1897, 125, 31)

**Ammonium permanganomolybdate,**

$2(\text{NH}_4)_2\text{O}, \text{MnO}_2, 7\text{MoO}_3 + 5\text{H}_2\text{O}$ .

(Friedheim and Samelson, *Z. anorg.* 1900, 24, 73)

$3(\text{NH}_4)_2\text{O}, \text{MnO}_2, 9\text{MoO}_3 + 6\text{H}_2\text{O}$ . (Friedheim and Allemann, *Mitt. d. Nat. Ges. Bern.* 1904, 23)

$+7\text{H}_2\text{O}$ . (Friedheim and Samelson, *Z. anorg.* 1900, 24, 70)

$4(\text{NH}_4)_2\text{O}, \text{MnO}_2, 11\text{MoO}_3 + 7\text{H}_2\text{O}$ . (Friedheim and Samelson.)

$3(\text{NH}_4)_2\text{O}, \text{MnO}_2, 12\text{MoO}_3 + 5\text{H}_2\text{O}$ . Sol in cold  $\text{H}_2\text{O}$ . Decomp. by alkalis. Insol. in alcohol. (Péchar, *C. R.* 1897, 125, 30.)

**Ammonium manganous permanganomolybdate,  $3[(\text{NH}_4)_2, \text{Mn}]\text{O}, \text{MnO}_2, 9\text{MoO}_3 + 6\text{H}_2\text{O}$  and  $+7\text{H}_2\text{O}$**

(Friedheim and Allemann, *Mitt. d. Nat. Ges. Bern.* 1904, 23.)

$3[(\text{NH}_4)_2, \text{Mn}]\text{O}, \text{MnO}_2, 10\text{MoO}_3 + 10\text{H}_2\text{O}$  (Friedheim and Samelson, *Z. anorg.* 1900, 24, 91.)

$4[(\text{NH}_4)_2, \text{Mn}]\text{O}, \text{MnO}_2, 10\text{MoO}_3 + 6\text{H}_2\text{O}$ . (Friedheim and Samelson, *Z. anorg.* 1900, 24, 75.)

$4[(\text{NH}_4)_2, \text{Mn}]\text{O}, \text{MnO}_2, 11\text{MoO}_3 + 8\text{H}_2\text{O}$  (Friedheim and Samelson, *Z. anorg.* 1900, 24, 72.)

**Ammonium manganous potassium permanganomolybdate,  $2(\text{NH}_4)_2\text{O}, \text{MnO}, \text{K}_2\text{O}, \text{MnO}_2, 10\text{MoO}_3 + 5\text{H}_2\text{O}$ .**

Very sl. sol. in cold, easily sol. in  $\text{H}_2\text{O}$  at 79° (Z. anorg. 1898, 16, 79.)

$3[(\text{NH}_4)_2, \text{Mn}]\text{O}, \text{MnO}_2, 9\text{MoO}_3 + 11\text{H}_2\text{O}$ . (Friedheim and Allemann, *Mitt. d. Nat. Ges. Bern.* 1904, 23.)

$4[(\text{NH}_4)_2, \text{K}_2, \text{Mn}]\text{O}, \text{MnO}_2, 10\text{MoO}_3 + 5\text{H}_2\text{O}$ . (Friedheim and Samelson, *Z. anorg.* 1900, 24, 97.)

$3[(\text{NH}_4)_2, \text{K}_2, \text{Mn}]\text{O}, \text{MnO}_2, 10\text{MoO}_3 + 6\text{H}_2\text{O}$ , and  $+10\text{H}_2\text{O}$  (Friedheim and Samelson, *Z. anorg.* 1900, 24, 92)

**Ammonium potassium permanganomolybdate,  $3[(\text{NH}_4)_2, \text{K}_2]\text{O}, \text{MnO}_2, 8\text{MoO}_3 + 4\text{H}_2\text{O}$ .**

(Friedheim and Samelson)

**Barium permanganomolybdate,  $3\text{BaO}, \text{MnO}_2, 9\text{MoO}_3 + 12\text{H}_2\text{O}$**

Ppt. (Hall, *J. Am. Chem. Soc.* 1907, 29, 700.)

**Manganous potassium permanganomolybdate,  $2\text{K}_2\text{O}, \text{MnO}, \text{MnO}_2, 9\text{MoO}_3 + 8\text{H}_2\text{O}$**

True formula for  $5\text{K}_2\text{O}, \text{Mn}_2\text{O}_3, 16\text{MoO}_3 + 12\text{H}_2\text{O}$  of Stauv. (Friedheim and Samelson, *Z. anorg.* 1900, 24, 86.)

$3[\text{K}_2, \text{Mn}]\text{O}, \text{MnO}_2, 9\text{MoO}_3 + 6\text{H}_2\text{O}$ . (Friedheim and Allemann, *Mitt. d. Nat. Ges. Bern.* 1904, 23)

$2\text{K}_2\text{O}, 0.4\text{MnO}, \text{MnO}_2, 9\text{MoO}_3 + 7\text{H}_2\text{O}$ . Ppt. (Hall, *J. Am. Chem. Soc.* 1907, 29, 700)

$4[\text{K}_2, \text{Mn}]\text{O}, \text{MnO}_2, 11\text{MoO}_3 + 7\text{H}_2\text{O}$ . (Friedheim and Samelson, *Z. anorg.* 1900, 24, 80)

**Manganous potassium sodium permanganomolybdate,  $3[\text{K}_2, \text{Na}_2, \text{Mn}]\text{O}, \text{MnO}_2, 8\text{MoO}_3 + 4\text{H}_2\text{O}$ .**

(Friedheim and Allemann, *Mitt. d. Nat. Ges. Bern.* 1904, 48)

**Manganous sodium permanganomolybdate,  $3[\text{Na}_2, \text{Mn}]\text{O}, \text{MnO}_2, 9\text{MoO}_3 + 15\text{H}_2\text{O}$ .**

(Friedheim and Allemann.)

**Potassium permanganomolybdate,  $3\text{K}_2\text{O}, \text{MnO}_2, 8\text{MoO}_3 + 3\text{H}_2\text{O}$ .**

Much less sol. in  $\text{H}_2\text{O}$  than  $\text{NH}_4$  comp. (Friedheim and Samelson, *Z. anorg.* 1900, 24, 78.)

$+5\text{H}_2\text{O}$ . Nearly insol. in cold or hot  $\text{H}_2\text{O}$ . (Rosenheim and Itzig, *Z. anorg.* 1893, 16, 81)

$3\text{K}_2\text{O}, \text{MnO}_2, 9\text{MoO}_3 + 5\text{H}_2\text{O}$ . (Friedheim and Samelson, *Z. anorg.* 1900, 24, 81.)

$+6\text{H}_2\text{O}$ . (Hall, *J. Am. Chem. Soc.* 1907, 29, 700)

$3\text{K}_2\text{O}, \text{MnO}_2, 12\text{MoO}_3 + 4\text{H}_2\text{O}$ . Nearly insol. in cold  $\text{H}_2\text{O}$ . Decomp. by alkalis. Insol. in alcohol. (Péchar, *C. R.* 1897, 125, 31.)

**Silver permanganomolybdate,  $3\text{Ag}_2\text{O}, \text{MnO}_2, 9\text{MoO}_3 + 6\text{H}_2\text{O}$ .**

Ppt. (Hall, *J. Am. Chem. Soc.* 1907, 29, 700)

**Sodium permanganomolybdate**,  $3\text{Na}_2\text{O}$ ,  $\text{MnO}_2$ ,  $12\text{MoO}_3 + 13\text{H}_2\text{O}$ .

Efflorescent. Very sol in  $\text{H}_2\text{O}$ . Decomp by alkalis. Insol in alcohol. (Péchar, C R. 125. 31.)

**Permanganotungstic acid.**

**Ammonium manganous permanganotungstate**,  $4(\text{NH}_4)_2\text{O}$ ,  $\text{MnO}$ ,  $\text{MnO}_2$ ,  $12\text{WO}_3 + 23\text{H}_2\text{O}$

Readily sol in  $\text{H}_2\text{O}$ . Can be cryst therefrom (Rogers and Smith, J Am Chem. Soc. 1904, 26. 1475)

**Sodium permanganotungstate**,  $3\text{Na}_2\text{O}$ ,  $\text{MnO}_2$ ,  $5\text{WO}_3 + 13\text{H}_2\text{O}$ .

Rather easily sol. in hot  $\text{H}_2\text{O}$ . Solution decomp on long boiling with separation of manganese peroxide (Just, B 1903, 36. 3621)

**Permolybdic acid**,  $\text{Mo}_2\text{O}_7$ ,  $5\text{H}_2\text{O} = \text{HMoO}_4 + 2\text{H}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$ , and not decomp. by boiling (Péchar, A. ch. (6) 28. 550.)

$\text{H}_2\text{MoO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$  "Oxo-molybdic acid." Only very sl. sol. in  $\text{H}_2\text{O}$  after being dried in the air. Sol in fairly conc.  $\text{H}_2\text{SO}_4$ . (Muthmann, B. 1898, 31. 1838.)

$\text{H}_2\text{MoO}_7$ ,  $\text{H}_2\text{O}_2$  Sl. sol in cold, more easily sol in hot  $\text{H}_2\text{O}$ , but does not separate on cooling. Sol. in dil. acids, also in  $\text{H}_3\text{PO}_4$ . (Cammerer, Ch Z. 1891, 16. 957.)

**Ammonium permolybdate**,  $\text{NH}_4\text{MoO}_4 + 2\text{H}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$ , sl sol in alcohol, but alcohol extracts it from  $\text{H}_2\text{O}$ , forming a very conc supersat. solution, which is pptd. by a crystal of  $\text{NH}_4\text{MoO}_4$ , and only a sl. amount remains in solution. (Péchar)

$3(\text{NH}_4)_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{MoO}_4 + 6\text{H}_2\text{O}$ . (Muthmann, B 1898, 31. 1837.)

$3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_4 + 12\text{H}_2\text{O}$  Ppt. (Muthmann, Z. anorg. 1898, 17. 78.)

$3(\text{NH}_4)_2\text{O}$ ,  $5\text{MoO}_4 + 6\text{H}_2\text{O}$ . Ppt (Muthmann.)

**Ammonium nickel permolybdate ammonia**,  $(\text{NH}_4)_2\text{Ni}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$ .

Decomp by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NH}_4\text{OH}$  (Briggs, Chem. Soc. 1904, 85. 674.)

**Barium permolybdate**,  $\text{Ba}(\text{MoO}_4)_2 + 2\text{H}_2\text{O}$ .

(Péchar, A. ch. 1893, (6) 28. 537.)

$8\text{BaO}$ ,  $16\text{MoO}_3$ ,  $2\text{H}_2\text{O}_2 + 13\text{H}_2\text{O}$ . (Baerwald, Dissert 1885.)

**Cæsium permolybdate**,  $\text{Cs}_2\text{O}$ ,  $4\text{MoO}_4 + 6\text{H}_2\text{O}$ .

Sol. hot  $\text{H}_2\text{O}$ . (Muthmann, B. 1898, 31. 1841.)

$3\text{Cs}_2\text{O}$ ,  $7\text{MoO}_3$ ,  $3\text{MoO}_4 + 4\text{H}_2\text{O}$  Ppt. (Muthmann.)

**Copper permolybdate**,  $\text{Cu}(\text{MoO}_4)_2 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ ; easily sol. in acids. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp. (Péchar)

**Magnesium permolybdate**,  $\text{Mg}(\text{MoO}_4)_2 + 10\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , sl. sol in alcohol. (Péchar.)

**Mercurous permolybdate.**

Insol in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Péchar.)

**Potassium permolybdate**,  $\text{KMoO}_4 + 2\text{H}_2\text{O}$ .

Sl sol in cold, more in hot  $\text{H}_2\text{O}$ . Sl. sol. in alcohol (Péchar)

$\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $\text{MoO}_4 + 3\text{H}_2\text{O}$ . Ppt. (Muthmann, Z. anorg. 1898, 17. 77)

$\text{K}_2\text{O}$ ,  $\text{MoO}_4$ ,  $\text{H}_2\text{O}_2$  Decomp by  $\text{H}_2\text{O}$ . (Melikoff and Pissarjewsky, B. 1898, 31. 2449.)

$\text{K}_2\text{MoO}_4 + 3\text{H}_2\text{O}$  Nearly insol in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Mazzuchelli and Zangrilli, Gazz. ch. it. 1910, 40. (2) 56)

**Rubidium permolybdates.**

"Rubidium oxo-molybdate"

$3\text{Rb}_2\text{O}$ ,  $10\text{MoO}_4 + 14\text{H}_2\text{O}$  Ppt

$\text{Rb}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $\text{MoO}_4 + 3\text{H}_2\text{O}$ . May be recryst. from  $\text{H}_2\text{O}_2 + \text{Aq}$ .

$3\text{Rb}_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{MoO}_4 + 6\text{H}_2\text{O}$  Ppt

$\text{Rb}_2\text{O}$ ,  $3\text{MoO}_4$ ,  $\text{MoO}_4 + 4\text{H}_2\text{O}$  Ppt. (Muthmann, B 1898, 31. 1830-41.)

**Silver permolybdate**,  $\text{AgMoO}_4$ .

(Péchar.)

**Sodium permolybdate**,  $\text{NaMoO}_4 + 3\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol, but behaves similarly to K salt. (Péchar)

**Thalious permolybdate.**

Insol. in  $\text{H}_2\text{O}$ . (Péchar, A. ch 1893, (6) 28. 559)

**Pernitric acid**,  $\text{NO}_3$ .

See Nitrogen hexoxide.

**Silver pernitrate**, basic,  $3\text{Ag}_2\text{O}_3$ ,  $\text{AgNO}_3$ .

Decomp.  $\text{H}_2\text{O}$ . (Mulder, R. t c 1898, 17. 142.)

**Perosmic acid.**

**Potassium perosmate (?)**.

Sol. in  $\text{H}_2\text{O}$ , but very easily decomp.

**Peroxyntic acid.**

**Silver peroxyntate.**

Analysis of the black compound formed, under certain circumstances, in a silver voltameter when an aqueous solution of  $\text{AgNO}_3$

is electrolyzed, points to the composition  $3\text{Ag}_2\text{O}$ ,  $5\text{O}$ ,  $\text{AgNO}_3$ , perhaps  $2\text{Ag}_2\text{O}_4$ ,  $\text{AgNO}_3$  or  $3\text{Ag}_2\text{O}_2$ ,  $\text{AgNO}_3$ . (Mulder, Chem. Soc 1896, 70. (2) 561)

### Peroxyaminesulphonic acid.

Potassium peroxyaminesulphonate,  
 $\text{N}_2\text{O}_7(\text{SO}_3\text{K})_4$ .

Very unstable in  $\text{H}_2\text{O}$ . Very sl sol. in cold  $\text{H}_2\text{O}$ . More stable in  $\text{N}/10$   $\text{KOH} + \text{Aq}$ .

100 pts  $\text{N}/10$   $\text{KOH} + \text{Aq}$  dissolve 0.62 pt of the salt at  $3^\circ$ ; 6.6 pts. at  $29^\circ$  (Haga, Chem Soc 1904, 85. 86)

### Perstannic acid, $\text{H}_2\text{Sn}_2\text{O}_7$ .

Known in colloidal state, sol in  $\text{H}_2\text{O}$  (Spring, Bull Soc (2) 51. 180.)

Potassium perstannate,  $\text{KSnO}_4 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  Insol in alcohol. (Tanatar, B. 1905, 38. 1185)

Sodium perstannate,  $\text{NaSnO}_4 + 2\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$  with decomp (Tanatar)

### Persulphuric acid, $\text{S}_2\text{O}_8$

See Sulphur heptoxide.

$\text{H}_2\text{S}_2\text{O}_8$

Sp gr. of  $\text{H}_2\text{S}_2\text{O}_8 + \text{Aq}$ .

Sp gr $15^\circ/15^\circ$	% $\text{H}_2\text{S}_2\text{O}_8$	g $\text{H}_2\text{S}_2\text{O}_8$ per l
1.042	7.2	75
1.096	15.4	169
1.154	23.6	272
1.246	35.2	438

(Elbs and Schonherr, Z. Elektrochem. 1896, 2. 245)

Ammonium persulphate,  $(\text{NH}_4)_2\text{S}_2\text{O}_8$

Very sol in  $\text{H}_2\text{O}$ . 100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 58.2 pts.  $(\text{NH}_4)_2\text{S}_2\text{O}_8$  (Marshall, Chem. Soc 59. 771.)

Solubility in  $\text{H}_2\text{O}$  equals 58% at  $8^\circ$  (Moreau, C. C. 1901, II. 56)

100 pts.  $\text{H}_2\text{O}$  dissolve 65 pts. at ord temp. (Elbs, J pr. 1893, (2) 48. 185.)

Ammonium lead persulphate,

$(\text{NH}_4)_2\text{Pb}(\text{SO}_4)_3$

Decomp. by  $\text{H}_2\text{O}$ . Almost insol in cold  $\text{H}_2\text{SO}_4$  of sp. gr.=1.7. Sl. sol. in  $\text{H}_2\text{SO}_4$  (sp. gr.=1.7) at  $50^\circ$ . Sol. in fuming  $\text{H}_2\text{SO}_4$ , and in cold conc  $\text{HCl}$ . Sol. in acetic acid, in Na acetate +  $\text{Aq}$  acidified with acetic acid and in excess of cold 20%  $\text{NaOH} + \text{Aq}$ . (Elbs, Z. Elektrochem. 1900, 7. 346)

Ammonium mercurous persulphate ammonia,  $(\text{NH}_4)_2\text{HgS}_2\text{O}_8 \cdot 2\text{NH}_3$ .

Decomp by  $\text{H}_2\text{O}$  Insol. in dil or conc., hot or cold  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ . Sol. in  $\text{HCl}$ . (Taupp, Gazz ch. it. 1903, 33. (1) 131.)

Barium persulphate,  $\text{BaS}_2\text{O}_8 + 4\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . 100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 39.1 pts.  $\text{BaS}_2\text{O}_8$ , or 52.2 pts.  $\text{BaS}_2\text{O}_8 + 4\text{H}_2\text{O}$ . Sol. in absolute alcohol with pptn. of  $\text{BaS}_2\text{O}_8 + \text{H}_2\text{O}$  Insol. in alcohol (Marshall)

Cadmium persulphate ammonia,  $\text{CdS}_2\text{O}_8 \cdot 6\text{NH}_3$

Sol. in  $\text{H}_2\text{O}$  (Barbieri, Z. anorg. 1911, 71. 350)

Cæsium persulphate,  $\text{Cs}_2\text{S}_2\text{O}_8$

Sol. in  $\text{H}_2\text{O}$ . 8.71–8.98 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ . (E. F. Smith, J. Am. Chem. Soc. 1899, 21. 935.)

Calcium persulphate.

Very sol. in  $\text{H}_2\text{O}$  (Marshall, J Soc Chem. Ind. 1897, 16. 396.)

Copper persulphate ammonia,  $\text{CuS}_2\text{O}_8 \cdot 4\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$  (Barbieri, Z anorg 1911, 71. 351)

Lead persulphate,  $\text{PbS}_2\text{O}_8$

Decomp by  $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{SO}_4$ , and in pyrosulphuric acid Sol. in cold conc.  $\text{HCl}$  Insol or sol. with decomp in all ord solvents. (Elbs, Z Elektrochem 1900, 7. 345)

Solubility of  $\text{Pb}(\text{SO}_4)_2$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . at  $22^\circ$ .  
v = moles of  $\text{H}_2\text{SO}_4$  per mole of  $\text{H}_2\text{O}$ ;  
c = millimols  $\text{Pb}(\text{SO}_4)_2$  in 1 l.

v	c	v	c
0.304	0.00	0.558	37.2
0.348	1.8	0.699	40.5
0.387	3.0	0.917	23.3
0.407	3.9	1.11	23.7
0.435	5.3	1.54	49.6
0.477	14.4	2.08	83.5
0.515	23.3	2.13	88.2

(Dolezalek and Finckh, Z. anorg. 1906, 51. 321.)

+  $3\text{H}_2\text{O}$ . Deliquescent Very sol. in  $\text{H}_2\text{O}$ . (Marshall.)

Lead potassium persulphate,  $\text{K}_2\text{Pb}(\text{SO}_4)_3$

Decomp. by  $\text{H}_2\text{O}$  Almost insol in cold  $\text{H}_2\text{SO}_4$  of sp. gr.=1.7. Sl. sol. in  $\text{H}_2\text{SO}_4$  (sp. gr.=1.7) at  $50^\circ$ . Sol. in fuming  $\text{H}_2\text{SO}_4$ , cold conc.  $\text{HCl}$ , excess of cold 20%  $\text{NaOH} + \text{Aq}$ , acetic acid, and in Na acetate +  $\text{Aq}$  acidified with acetic acid (Elbs, Z. Elektrochem. 1900, 7. 346.)

Nickel persulphate ammonia,  $\text{NiS}_2\text{O}_8 \cdot 6\text{NH}_3$ .

Unstable in the air Sol in  $\text{H}_2\text{O}$  with decomp. (Barbieri, Z. anorg. 1911, 71. 351)

Potassium persulphate,  $\text{K}_2\text{S}_2\text{O}_8$

100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 1.77 pts  $\text{K}_2\text{S}_2\text{O}_8$ ; more sol in hot  $\text{H}_2\text{O}$  with very sl. decomp. Less sol. in  $\text{H}_2\text{O}$  than any other persulphate. (Marshall.)

Rubidium persulphate,  $\text{Rb}_2\text{S}_2\text{O}_8$

Sol. in  $\text{H}_2\text{O}$ . 3.32-3.49 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $22.5^\circ$ . (E. F. Smith, J. Am. Chem. Soc. 1899, 21. 934.)

Silver persulphate, basic,  $5\text{Ag}_2\text{O}_3 \cdot 2\text{Ag}_2\text{SO}_7$

Decomp. by  $\text{H}_2\text{O}$  and acids (Mulder, C. C. 1899, I, 16)

Sodium persulphate,  $\text{Na}_2\text{S}_2\text{O}_8$

Very sol. in  $\text{H}_2\text{O}$  (Lowenherz)

Strontium persulphate.

Very sol in  $\text{H}_2\text{O}$ . (Marshall, J. Soc. Chem. Ind 1897, 16. 396)

Thallium persulphate,  $\text{Tl}_2\text{S}_2\text{O}_8$ .

Very sol in  $\text{H}_2\text{O}$  (Smith, J. Am. Chem. Soc. 1898, 21. 936)

Zinc persulphate ammonia,  $\text{ZnS}_2\text{O}_8 \cdot 4\text{NH}_3$

Sol. in  $\text{H}_2\text{O}$ . (Barbieri, Z. anorg. 1911, 71. 350.)

Persulphomolybdic acid.

See Persulphomolybdic acid.

Pertantallic acid,  $\text{HTaO}_4 \cdot n\text{H}_2\text{O}$ .

Ppt. (Mehkoff, Z. anorg. 1899, 20. 345)

Cæsium pertantalate,  $\text{Cs}_2\text{TaO}_6$ .

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1908, 30. 1667)

Calcium potassium pertantalate,  $\text{CaKTaO}_6 + \frac{1}{2}\text{H}_2\text{O}$ .

Insol in cold  $\text{H}_2\text{O}$ ; decomp by hot  $\text{H}_2\text{O}$ . (Mehkoff, Z. anorg 1899, 20. 347.)

Calcium sodium pertantalate,  $\text{CaNaTaO}_6 + \frac{1}{2}\text{H}_2\text{O}$ .

Difficultly sol in  $\text{H}_2\text{O}$ . (E. F. Smith, J. Am. Chem. Soc. 1908, 30. 1668.)

Magnesium potassium pertantalate,

$\text{MgKTaO}_6 + 7\text{H}_2\text{O}$ .

Somewhat sol in  $\text{H}_2\text{O}$ . (E. F. Smith.)

Magnesium rubidium pertantalate,

$\text{MgRbTaO}_6 + 9\text{H}_2\text{O}$ .

Somewhat sol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

Magnesium sodium pertantalate,  $\text{MgNaTaO}_6 + 8\text{H}_2\text{O}$

Somewhat sol in  $\text{H}_2\text{O}$ . (E. F. Smith)

Potassium pertantalate,  $\text{K}_4\text{TaO}_6 + \frac{1}{2}\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  with decomp; sol in  $\text{KOH} + \text{H}_2\text{O}_2 + \text{Ag}$ ; pptd by alcohol. (Mehkoff, Z. anorg. 1899, 20. 346)

Rubidium pertantalate,  $\text{Rb}_4\text{TaO}_6$ .

Somewhat sol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

Sodium pertantalate,  $\text{Na}_4\text{TaO}_6 + \text{H}_2\text{O}$ .

Pptd by alcohol. Sl. sol. in  $\text{H}_2\text{O}$ , decomp on heating with  $\text{H}_2\text{O}$ . (Mehkoff, Z. anorg 1899, 20. 348)

$\text{NaTaO}_4 + \text{NaOTaO}_4 + 13\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}_2 + \text{Ag}$ , pptd by alcohol. (Mehkoff, Z. anorg 1899, 20. 349)

Pertitanic acid.

Ammonium pertitanate,  $(\text{NH}_4)_2\text{O}_3 \cdot \text{TiO}_3 + \text{H}_2\text{O}_2$

Fairly stable; decomp. rapidly in aq. solution. (Mehkoff, B. 1898, 31. 955.)

Barium pertitanate,  $\text{BaO}_3 \cdot \text{TiO}_3 + 5\text{H}_2\text{O}$

Sl. sol. in  $\text{H}_2\text{O}$ . (Mehkoff and Pissarjewsky, Z. anorg 1898, 18. 59.)

Potassium pertitanate,  $\text{K}_2\text{O}_3 \cdot \text{TiO}_3 \cdot \text{K}_2\text{O}_4 + 10\text{H}_2\text{O}$

Stable at zero; deliquesces and decomp. at ordinary temp. (Mehkoff, B. 1898, 31. 650.)

Sodium pertitanate,  $\text{Na}_2\text{O}_3 \cdot \text{TiO}_3 + 3\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . Pptd. in alcohol. (Mehkoff, B. 1898, 31. 955)

$4\text{Na}_2\text{O}_3 \cdot \text{Ti}_2\text{O}_7 + 10\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mehkoff)

Pertungstic acid.

Barium pertungstate,  $\text{BaO} \cdot 2\text{WO}_3 \cdot \text{O} + 6\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ . Decomp. by acids (Kellner, Dissert. 1909.)

Cæsium pertungstate,  $3\text{Cs}_2\text{O} \cdot 12\text{WO}_3 \cdot 20 + 12\text{H}_2\text{O}$ .

Sl. sol. in cold, easily sol. in warm  $\text{H}_2\text{O}$ . (Kellner)

$5\text{Cs}_2\text{O} \cdot 12\text{WO}_3 \cdot 240 + 11\text{H}_2\text{O}$ .

Sl sol in  $\text{H}_2\text{O}$  (Kellner)

Calcium pertungstate,  $3\text{CaO} \cdot 6\text{WO}_3 \cdot 80 + 8\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Kellner)

Lithium pertungstate,  $\text{Li}_2\text{O} \cdot 2\text{WO}_3 \cdot 20 + 6\text{H}_2\text{O}$

Sl. sol in  $\text{H}_2\text{O}$ . (Kellner.)

$3\text{Li}_2\text{O} \cdot 4\text{WO}_3 \cdot \text{O} + 9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Kellner.)

**Magnesium pertungstate**,  $2\text{MgO}$ ,  $4\text{WO}_3$ ,  $6\text{O} + 9\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Kellner.)

**Potassium pertungstate**,  $\text{K}_2\text{O}_4$ ,  $\text{WO}_4 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.; explodes in the air at  $80^\circ$  (Melikoff, B. 1898, 31. 634.)

$\text{K}_2\text{O}$ ,  $2\text{WO}_3$ ,  $4\text{O} + 4\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  from which it is ppt. by alcohol and ether (Kellner.)

$7\text{K}_2\text{O}$ ,  $10\text{WO}_3$ ,  $5\text{O} + 22\text{H}_2\text{O}$  Very sl. sol. in  $\text{H}_2\text{O}$ . (Kellner.)

**Rubidium pertungstate**,  $2\text{Rb}_2\text{O}$ ,  $4\text{WO}_3$ ,  $\text{O} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with slow decomp. (Kellner.)  $5\text{Rb}_2\text{O}$ ,  $12\text{WO}_3$ ,  $3\text{O} + 12\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ . (Kellner.)

**Sodium pertungstate**,  $\text{Na}_2\text{WO}_4 + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Péchar, C. R. 112. 1060.)

$+2\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  but easily decomp. (Kellner.)

$\text{Na}_2\text{WO}_4 + 6\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  and can be cryst. therefrom (Pissarjewsky, Z. anorg. 1900, 24. 113.)

$\text{Na}_2\text{O}_2$ ,  $\text{WO}_4 + \text{H}_2\text{O}_2$ ,  $(\text{Na}_2\text{O}_2)\text{WO}_4 + 7\text{H}_2\text{O}$  Decomp. in the air Sol. in  $\text{H}_2\text{O}$  with decomp (Melikoff, B. 1898, 31. 633.)

$\text{Na}_2\text{O}_2$ ,  $\text{WO}_4$ ,  $\text{H}_2\text{O}_2$  Very unstable. Decomp. in the air and by  $\text{H}_2\text{O}$ . (Melikoff.)

**Strontium pertungstate**,  $\text{SrO}$ ,  $2\text{WO}_3$ ,  $\text{O} + 6\text{H}_2\text{O}$ .

(Kellner.)

**Peruranic acid**,  $\text{UO}_5$ ,  $x\text{H}_2\text{O}$  (?).

Known only in its salts

**Ammonium peruranate**,  $(\text{NH}_4)_2\text{O}_2$ ,  $(\text{UO}_4)_2 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; decomp. by acids and by  $\text{Al}(\text{OH})_3$  in aq. solution. (Melikoff, B. 1897, 30. 2904.)

**Ammonium uranyl peruranate**,

$(\text{NH}_4)_2(\text{UO}_2)\text{UO}_5 + 8\text{H}_2\text{O}$  (?).

Easily sol. in  $\text{H}_2\text{O}$ . (Fairley, Chem. Soc. (2) 31. 134.)

**Barium peruranate**,  $\text{BaUO}_4$ .

As K salt. (de Coninck, C. C. 1909, I. 1870.)

$(\text{BaO}_2)_2\text{UO}_4 + 8\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{CO}_3$ . (Melikoff, B. 1897, 30. 2905.)

$\text{BaO}_2(\text{UO}_4)_2 + 9\text{H}_2\text{O}$  Ppt. (Melikoff.)

**Calcium peruranate**,  $\text{CaUO}_4$ .

As K salt. (de Coninck.)

**Calcium peruranate**,  $(\text{CaO}_2)_2\text{UO}_4 + 10\text{H}_2\text{O}$ .

Ppt. (Melikoff, B. 1897, 30. 2906.)

**Copper peruranate**,  $(\text{CuO}_2)_2\text{UO}_4$ .

Ppt. (Melikoff.)

**Lead peruranate**,  $(\text{PbO})_2\text{UO}_4$ ,  $\text{PbO}$ ,  $\text{UO}_3$

Ppt (Melikoff)

**Lithium peruranate**,  $(\text{Li}_2\text{O}_2)(\text{UO}_4)_2 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; decomp. by acids and by  $\text{Al}(\text{OH})_3$  in aq. solution; very unstable. (Melikoff.)

**Nickel peruranate**,  $(\text{NiO})_2\text{UO}_4$

Ppt (Melikoff)

**Potassium peruranate**,  $\text{K}_4\text{UO}_6 + 10\text{H}_2\text{O}$  (?).

Unstable. (Fairley.)

$\text{K}_2\text{UO}_6$  (de Coninck, C. R. 1909, 148. 1769)

$+3\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ ,  $\text{HCl}$  and dil.  $\text{HNO}_3$  (Aloy, Bull. Soc. 1903, (3) 29. 293.)

**Silver peruranate**,  $\text{Ag}_5\text{U}_2\text{O}_{11}$  (?).

(Guyard, Bull. Soc. (2) 1. 95.)

Does not exist. (Alibegoff, A. 233. 117.)

**Sodium peruranate**,  $\text{Na}_4\text{UO}_6 + 8\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Fairley.)  $\text{Na}_2\text{UO}_6$  As K salt. (de Coninck, C. C. 1909, I. 1970.)

$+5\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$  and  $\text{HCl}$ . (Aloy, Bull. Soc. 1903, (3) 29. 293.)

$(\text{Na}_2\text{O}_2)_2\text{UO}_4 + 8\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ ; decomp. by dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and by  $\text{Al}(\text{OH})_3$  in aq. solution. (Melikoff, B. 1897, 30. 2903.)

**Sodium uranyl peruranate**,  $\text{Na}_2(\text{UO}_2)\text{UO}_5 + 6\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Fairley.)

**Pervanadic acid**,  $\text{HVO}_4$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Pissarjewsky, C. C. 1902, II. 505.)

**Ammonium pervanadate**,  $\text{NH}_4\text{VO}_4$ .

Sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ ; insol. in alcohol. (Scheuer Z. anorg. 1898, 16. 294.)

$(\text{NH}_4)_2\text{VO}_6 + 2\frac{1}{2}\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol (Melikoff, B. 1909, 42. 2202.)

$(\text{NH}_4)_2\text{V}_2\text{O}_{11}$  Sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ ; ppt. from aq. solution by alcohol (Melikoff, Z. anorg. 1899, 19. 406.)

**Barium pervanadate**,  $\text{Ba}_2(\text{VO}_4)_2$ .

Sl. sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$  free from  $\text{H}_2\text{SO}_4$ ; insol. in alcohol. (Scheuer, Z. anorg. 1898, 16. 288.)

**Cadmium pervanadate**,  $\text{Cd}(\text{VO}_4)_2$ .

Sl. sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ ; insol. in alcohol. (Scheuer.)

**Calcium pervanadate**,  $\text{Ca}(\text{VO}_4)_2$ .

Sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ ; insol. in alcohol. (Scheuer.)

**Lead pervanadate,  $\text{Pb}(\text{VO}_4)_2$** 

Sl sol in  $\text{H}_2\text{O}_2 + \text{Aq}$  free from  $\text{H}_2\text{SO}_4$ ; insol in alcohol (Scheuer)

**Lithium pervanadate,  $\text{LiVO}_4$** 

Sol in  $\text{H}_2\text{O}_2 + \text{Aq}$ ; insol. in alcohol (Scheuer)

**Potassium pervanadate,  $\text{KVO}_4$** 

Sol in  $\text{H}_2\text{O}_2 + \text{Aq}$  acidified with  $\text{H}_2\text{SO}_4$ , insol in alcohol (Scheuer)

$\text{K}_2\text{VO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , insol. in alcohol (Melikoff, B. 1909, 42, 2293)

$3\text{K}_2\text{O}_3\text{VO}_4 + 2\text{KVO}_4 + 2\text{H}_2\text{O}$  0.855 g. is sol in 100 g.  $\text{H}_2\text{O}$  at  $19^\circ$ ; sl. sol. in  $\text{KOH} + \text{Aq}$ , very stable in the air. (Melikoff and Pissarewsky, Z. anorg. 1899, 19, 408.)

$\text{K}_4\text{V}_2\text{O}_{11} + 2\text{H}_2\text{O}$  (Melikoff and Pissarewsky, Z. anorg. 1899, 19, 411.)

$\text{K}_4\text{V}_2\text{O}_{11} + 3\frac{1}{2}\text{H}_2\text{O}$  Moderately sol. in  $\text{H}_2\text{O}$  with slow decomp. (Melikoff and Pissarewsky, Z. anorg. 1899, 19, 410)

**Silver pervanadate,  $\text{AgVO}_4$** 

Sl sol in  $\text{H}_2\text{O}_2 + \text{Aq}$  free from  $\text{H}_2\text{SO}_4$ ; sol in alcohol (Scheuer.)

**Sodium pervanadate,  $\text{NaVO}_4$** 

Sol. in  $\text{H}_2\text{O}$ , acidified with  $\text{H}_2\text{SO}_4$ , insol. in alcohol. (Scheuer.)

**Strontium pervanadate,  $\text{Sr}(\text{VO}_4)_2$** 

Sl. sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$  free from  $\text{H}_2\text{SO}_4$ , insol in alcohol (Scheuer.)

**Philippium,  $\text{Ph} (?)$** 

(Deiafontaine, C. R. 87, 559)

Consists of terbium and yttrium. (Roscoe, B. 15, 1274.)

**Phosgene,  $\text{CoCl}_2$** 

See Carbonyl chloride.

**Phosphame,  $\text{PN}_2\text{H} (?)$** 

Insol. in  $\text{H}_2\text{O}$  Insol in dil  $\text{HNO}_3 + \text{Aq}$ ; gradually decomp. by conc  $\text{HNO}_3$ . (Rose, Pogg. 24, 308.)

Insol. in conc  $\text{HNO}_3$  (Faub, A. 123, 236.) Sol. in  $\text{H}_2\text{SO}_4$  with decomp. (Rose.)

Insol in dil, but decomp. by conc  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$

Insol. in alcohol or ether.

Formula is perhaps  $\text{P}_2\text{N}_2\text{H}_4$ . (Salzmann, B. 6, 494.)

**Phosphamic acid,  $\text{PO} \begin{smallmatrix} \diagup \text{NH} \\ \diagdown \text{OH} \end{smallmatrix}$** 

(Schiff.)

Does not exist, but was impure *pyrophosphamic acid* (Gladstone.) Also Mente (A. 248, 245).

***Pyrophosphamic acid*,  $\text{P}_2\text{NH}_2\text{O}_4 =$** 

$\text{P}_2\text{O}_3(\text{OH})_2\text{NH}_2$ .

Deliquescent in moist air, easily sol. in  $\text{H}_2\text{O}$  or alcohol, sl. sol. in ether (Gladstone, Chem. Soc. 3, 152)

Correct composition is imido-diphosphoric acid,  $\text{P}_2\text{NH}_2\text{O}_4 = \text{HO}-\text{PO} < \begin{smallmatrix} \text{O} \\ \text{NH} \end{smallmatrix} > \text{PO}-\text{OH}$ . (Mente, A. 248, 232.)

**Barium *pyrophosphamate*,  $\text{Ba}_2(\text{P}_2\text{NH}_2\text{O}_4)_2$** 

Sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ , not in  $\text{HCl} \cdot \text{H}_2\text{O}_2 + \text{Aq}$ . (Gladstone and Holmes, Chem. Soc. (2) 2, 233.)

**Cupric —,  $\text{Cu}_2(\text{P}_2\text{NH}_2\text{O}_4)_2 + 2\text{H}_2\text{O}$** 

Ppt. Decomp. by cold  $\text{KOH} + \text{Aq}$ . (Gladstone, Chem. Soc. 3, 135)

**Ferric —,  $\text{Fe}_2(\text{P}_2\text{NH}_2\text{O}_4)_2 + 2\text{H}_2\text{O}$** 

Insol. in dil. acids. Sol in conc.  $\text{H}_2\text{SO}_4$ , and decomp. by warming Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp. by  $\text{KOH} + \text{Aq}$ . (Gladstone, Chem. Soc. 3, 142)

**Lead —,  $\text{Pb}_2(\text{P}_2\text{NH}_2\text{O}_4)_2 + 4\text{H}_2\text{O}$** 

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Potassium —,  $\text{K}_2\text{P}_2\text{NH}_2\text{O}_4$** 

Deliquescent Sol in  $\text{H}_2\text{O}$ . Insol. in alcohol (Gladstone, A. 76, 85)

**Silver —,  $\text{Ag}_2\text{P}_2\text{NH}_2\text{O}_4 + 5\text{H}_2\text{O}$** 

Ppt

**Zinc —,  $\text{Zn}_2(\text{P}_2\text{NH}_2\text{O}_4)_2$** 

(Gladstone and Holmes, Chem. Soc. (2) 2, 225.)

**Phosphamide,  $\text{PON}$ .**

See Phosphoryl nitride.

$\text{PN}_2\text{H}_2\text{O}$ .

See Phosphoryl imidoamide.

**Triphosphamide,  $\text{PON}_3\text{H}_4$** 

See Phosphoryl triamide.

**Trimetaphosphimic acid,  $\text{P}_3\text{N}_3\text{H}_3\text{O}_6$** 

Sol. in  $\text{H}_2\text{O}$ ; aq solution does not coagulate albumen. (Stokes, Am. Ch. J. 1895, 17, 275.)

**Ammonium trimetaphosphimate,**

$(\text{NH}_4)_3\text{P}_3\text{N}_3\text{O}_6\text{H}_3$ .

Sol. in  $\text{H}_2\text{O}$ , insol. in alcohol, unstable. (Stokes, Am. Ch. J. 1896, 18, 643.)

**Barium trimetaphosphimate,  $\text{Ba}_3(\text{P}_3\text{N}_3\text{O}_6\text{H}_3)_2 + 4\text{H}_2\text{O}$** 

+  $6\text{H}_2\text{O}$ . Sl. sol in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  and in  $\text{NaCl} + \text{Aq}$  (Stokes.)

**Barium sodium trimetaphosphimate**,  
 $P_3N_3O_6H_2NaBa + 1\frac{1}{2}H_2O$

Almost insol. in  $H_2O$ , easily sol. in  $NH_4Cl + Aq$  and in  $NaCl + Aq$ . (Stokes.)

**Magnesium trimetaphosphimate**,  
 $(P_3N_3O_6H_2)_2Mg_3 (?)$ .

Sol. in  $H_2O$ ; insol. in alcohol; aq. solution decomp. on boiling. (Stokes.)

**Potassium trimetaphosphimate**,  $K_3P_3N_3O_6H_2$ .  
 Sol. in  $H_2O$ ; insol. in alcohol. (Stokes.)

**Silver trimetaphosphimate**,  $Ag_3P_3N_3O_6H_2$

Ppt.; sol. in  $NH_4OH + Aq$ , insol. in  $H_2O$ ; sl. sol. in  $HNO_3 + Aq$ . (Stokes.)

$\alpha$  **Sodium trimetaphosphimate**,  $P_3N_3O_6H_2Na_3 + 1\frac{1}{2}H_2O$

18.3 pts. are sol. in 100 pts.  $H_2O$  at  $20^\circ$ ; very sol. in hot  $H_2O$ ; decomp. by alkali on long boiling. (Stokes.)

$\beta$  **Sodium trimetaphosphimate**,  $P_3N_3O_6H_2Na_3 + 1\frac{1}{2}H_2O$ .

Sol. in  $H_2O$ , insol. in alcohol. (Stokes.)

**Tetrametaphosphimic acid**,  
 $P_4N_4O_8H_4 + 2H_2O$ .

Very sl. sol. in  $H_2O$ , decomposes the sol. salts of  $HCl$ ,  $H_2SO_4$  and  $HNO_3$  (Stokes, Am. Ch. J. 1895, 17, 290.)

100 pts.  $H_2O$  at  $20^\circ$  dissolve 0.04 pt. crystallized acid. Somewhat more sol. in boiling  $H_2O$ . (Stokes.)

100 pts. 10%  $HNO_3 + Aq$  at  $20^\circ$  dissolve 0.26 pt. of crystallized acid. (Stokes.)

Not decomp. by boiling alkalis +  $Aq$ . (Stokes, Am. Ch. J. 1896, 18, 785.)

Insol. in alcohol (Stokes, Am. Ch. J. 1896, 18, 784.)

**Ammonium tetrametaphosphimate**,  
 $P_4N_4O_8H_4(NH_4)_2$ .

Only sl. sol. in boiling  $H_2O$ , sol. in excess of hot 5%  $HNO_3$ . (Stokes.)

$P_4N_4O_8H_4(NH_4)_4 + 4H_2O$ . Readily sol. in  $H_2O$ ; sl. sol. in  $NH_4OH + Aq$ . (Stokes.)

**Barium tetrametaphosphimate**,  $P_4N_4O_8H_4Ba_2 + 2H_2O$

Ppt.; insol. in  $H_2O$ . (Stokes.)

**Potassium tetrametaphosphimate**,  
 $P_4N_4O_8H_4K_2$ .

Sl. sol. in boiling  $H_2O$ ; sol. in cold dil.  $KOH + Aq$ . (Stokes.)

$P_4N_4O_8H_4K_4 (?)$ . Very sol. in  $H_2O$ . (Stokes.)

**Silver tetrametaphosphimate**,  $P_4N_4O_8H_4Ag_4$

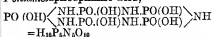
Ppt.; insol. in  $H_2O$ ; sl. sol. in  $HNO_3 + Aq$ . (Stokes.)

$P_4N_4O_8Ag_8$  Ppt., sol. in  $NH_4NO_3 + Aq$ . (Stokes.)

**Sodium tetrametaphosphimate**,  $P_4N_4O_8H_4Na_4 + 2\frac{1}{2} (?) H_2O$

Sl. sol. in cold  $H_2O$ . Easily sol. in hot  $H_2O$ . Ppt. from aqueous solution by excess of alkali. (Stokes.)

**Pentametaphosphimic acid**,



Sol. in  $H_2O$ , pptd. by alcohol. (Stokes, Am. Ch. J. 1898, 20, 748.)

**Magnesium pentametaphosphimate**,  
 $(P_5N_5O_{18}H_8Mg)_2Mg$ .

Ppt. (Stokes.)

$P_5N_5O_{18}H_8Mg_2 + 5H_2O$ . Ppt., insol. in alcohol, almost insol. in  $H_2O$ , sl. sol. in conc acetic acid. (Stokes.)

**Silver pentametaphosphimate**,  $P_5N_5O_{18}H_8Ag_8$ .

Ppt., sol. in cold  $KOH + Aq$  with decomp. (Stokes.)

**Sodium pentametaphosphimate**,  
 $P_5N_5O_{18}H_8Na_8 + 2H_2O$ .

Sol. in  $H_2O$ , insol. in alcohol. (Stokes.)

$P_5N_5O_{18}H_8Na_4 + 2H_2O$ . Sol. in 80% acetic acid; pptd. by alcohol. (Stokes.)

**Hexametaphosphimic acid**.

**Silver hexametaphosphimate**,  $P_6N_6O_{24}H_{12}Ag_{12}$ .

Ppt., decomp. by cold  $KOH + Aq$  (Stokes, Am. Ch. J. 1898, 20, 757.)

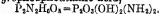
**Sodium hexametaphosphimate**,  $P_6N_6O_{24}H_{12}Na_{12} + 2H_2O$ .

Sol. in  $H_2O$ ; pptd. by alcohol. (Stokes.)

**Phosphine**.

See Hydrogen phosphide.

**Pyrophosphodiamic acid**,



Deliquescent. Easily sol. in  $H_2O$ , alcohol, or ether. Sol. in cold conc.  $H_2SO_4$  without decomp. (Gladstone, Chem. Soc. 3, 353.)

Correct composition is dimidodiphosphoric acid,  $P_2N_2H_4O_4 + H_2O = HO-PO = (NH)_2 = PO-OH$ . (Mente.)

**Aluminum pyrophosphodiamate**.

Precipitate. Sol. in  $NH_4OH + Aq$ . Insol. in acids. (Gladstone, A. 76, 82.)

**Ammonium** —,  $P_2O_2(ONH_4)_2$   
 $P_2O_2(NH_2)_2$ .

Very deliquescent in moist air. Sol. in  $H_2O$ . (Schiff, A. 103, 168.)

**Barium pyrophosphodiamate**,  
 $\text{BaP}_2\text{O}_6(\text{NH}_2)_2$ .  
 Precipitate. Sol in  $\text{H}_2\text{O}$  Sol in  
 $\text{NH}_4\text{OH} + \text{Aq.}$  (Gladstone)

**Calcium —**,  $\text{CaP}_2\text{O}_6(\text{NH}_2)_2$ .  
 Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in  $\text{NH}_4\text{Cl} +$   
 $\text{Aq.}$  and acids (Gladstone and Holmes.)

**Lead —**  
 Ppt Decomp by  $\text{H}_2\text{O}$

**Magnesium —**  
 Ppt. (Gladstone and Holmes)

**Silver —**,  $\text{Ag}_3\text{P}_2\text{O}_6(\text{NH}_2)_2$   
 Sol. in  $\text{H}_2\text{O}$ . Sol in  $\text{HNO}_3 + \text{Aq.}$  (Glad-  
 stone and Holmes)

**Strontium —**.  
 Sol. in acids and  $\text{NH}_4\text{Cl} + \text{Aq.}$  Insol in  
 $\text{NH}_4\text{OH} + \text{Aq.}$  (Gladstone and Holmes,  
 Chem. Soc. (2) 4. 295.)

**Zinc —**,  $\text{ZnP}_2\text{O}_6(\text{NH}_2)_2$   
 Ppt. (Gladstone and Holmes)

**Pyrophosphodiamic acid**,  $\text{P}_2\text{N}_2\text{H}_7\text{O}_4 =$   
 $\text{P}_2\text{O}_6(\text{NH}_2)_2$   
 Decomp. by boiling  $\text{H}_2\text{O}$  or  $\text{HCl}$  Sol. in  
 conc.  $\text{H}_2\text{SO}_4$  upon heating. (Gladstone and  
 Holmes.)

Correct formula is  $\text{HO}-\text{PO} < \frac{\text{NH}}{\text{NH}} > \text{PO}-$   
 $\text{NH}_2 = \text{diamidodiphosphomonamic acid.}$   
 (Mente, A. 248. 241.)

**Ammonium pyrophosphotriamete**,  
 $\text{P}_2\text{O}_6(\text{NH}_2)_3$   
 Insol. in  $\text{H}_2\text{O}$ . (Gladstone and Holmes.)

**Barium —**,  $\text{BaP}_2\text{N}_2\text{H}_5\text{O}_4$ .  
 $\text{BaH}_4(\text{P}_2\text{N}_2\text{H}_5\text{O}_4)_2$  Decomp by  $\text{HCl} + \text{Aq.}$   
 (Gladstone, Chem Soc 4. 6.)

**Cobaltous —**,  $\text{CoP}_2\text{N}_2\text{H}_5\text{O}_4$   
 Slowly decomp by dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  not by  
 $\text{HCl} + \text{Aq.}$  (Gladstone and Holmes, Chem.  
 Soc. (2) 4. 1.)

**Cupric —**,  $\text{CuP}_2\text{N}_2\text{H}_5\text{O}_4$ .  
 Insol in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Gladstone  
 and Holmes, Chem. Soc. (2) 4. 1.)

**Ferrous —**,  $\text{FeH}_2(\text{P}_2\text{N}_2\text{H}_5\text{O}_4)_2$ .  
 Insol in dil acids (Gladstone, Chem Soc  
 (2) 4. 1.)

**Lead —**,  $\text{H}_2\text{Pb}_2(\text{P}_2\text{N}_2\text{H}_5\text{O}_4)_2$ .  
 Ppt (Gladstone and Holmes, Chem. Soc.  
 (2) 4. 1)

$\text{H}_4\text{Pb}_2(\text{P}_2\text{N}_2\text{H}_5\text{O}_4)_2$  Ppt (G. and H.)  
 $\text{H}_4\text{Pb}(\text{P}_2\text{N}_2\text{H}_5\text{O}_4)_2$  (G and H.)

**Mercuric pyrophosphotriamete**,  
 $\text{Hg}_3\text{P}_2\text{N}_2\text{H}_5\text{O}_4$ .  
 Insol. in  $\text{H}_2\text{O}$  or dil.  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$   
 (Gladstone and Holmes, Chem. Soc. (2) 4. 1.)

**Platinum —**,  $\text{Pt}_2\text{P}_2\text{N}_2\text{H}_5\text{O}_4$ .  
 Decomp by  $\text{H}_2\text{O}$  when freshly pptd (G.  
 and H)

**Potassium —**,  $\text{KP}_2\text{N}_2\text{H}_5\text{O}_4$ .  
 Almost insol. in  $\text{H}_2\text{O}$ . (Gladstone, Chem.  
 Soc 4. 10.)

**Silver —**,  $\text{Ag}_3\text{P}_2\text{N}_2\text{H}_5\text{O}_4$ .  
 Ppt Sol attacked by  $\text{HCl}, \text{H}_2\text{O}_2$ ; decomp.  
 by  $\text{HNO}_3$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  into—  
 $\text{AgH}_2\text{P}_2\text{N}_2\text{H}_5\text{O}_4$  Insol in  $\text{H}_2\text{O}$  Decomp.  
 by  $\text{HCl}$  (Gladstone, Chem. Soc. (2) 4. 1)

**Zinc —**.  
 Insol in  $\text{H}_2\text{O}$  (Gladstone and Holmes)

**Tetraphosphodiamic acid**,  $\text{P}_4\text{N}_2\text{H}_5\text{O}_{11} =$   
 $\text{P}_4\text{O}_{17}(\text{OH})_4$   
 $\text{P}_4\text{O}_{17}(\text{NH}_2)_2$ .  
 Known only as  $\text{NH}_4$  salt

**Ammonium tetraphosphodiamete**,  
 $\text{P}_4\text{O}_{17} \cdot \text{O}_4\text{H}(\text{NH}_4)_2$   
 $(\text{NH}_2)_2$ .  
 Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Glad-  
 stone.)

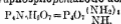
**Ammonium dihydrogen tetraphosphodiamete**,  
 $\text{P}_4\text{N}_4\text{H}_{10}\text{O}_{13} = \text{P}_4\text{O}_{17} \cdot \text{O}_4\text{H}_2(\text{NH}_4)_2 (?)$ .  
 $(\text{NH}_2)_2$   
 Insol in cold, easily sol in hot  $\text{H}_2\text{O}$  and dil  
 acids. (Gladstone)

**Tetraphosphotetramic acid**,  
 $\text{P}_4\text{N}_4\text{H}_{10}\text{O}_8 = \text{P}_4\text{O}_{17}(\text{OH})_4$ .  
 Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Gladstone.)

**Ammonium tetraphosphotetramete**,  
 $\text{P}_4\text{O}_{17}(\text{O}_2\text{HNH}_4)_4$   
 $\text{P}_4\text{O}_{17}(\text{NH}_2)_4$ .  
 Sol in  $\text{H}_2\text{O}$ , and precipitated from solution  
 by alcohol (Gladstone)

**Silver —**,  $\text{Ag}_3\text{P}_4\text{N}_4\text{H}_4\text{O}_8$ .  
 Ppt  
 $\text{Ag}_3\text{H}_4\text{P}_4\text{N}_4\text{H}_4\text{O}_8$  Ppt.

**Ammonium phosphoarseniovanadico-  
 vanadiotungstate.**  
 See Arseniovanadicovanadiotung-  
 state, ammonium.

**Tetraphosphopentazotic acid,**

Insol. in  $H_2O$ . Decomp. gradually by boiling with  $H_2O$  (Gladstone)

**Ammoniolethaphosphopentazotic acid (?),**

Decomp. by  $H_2O$  (Gladstone)

**Cupric tetraphosphopentazotate.**

(Gladstone, Chem. Soc. (2) 6. 261)

**Lead —.**

(Gladstone, Chem. Soc. (2) 6. 261)

**Potassium —,  $KOP_3N_3H_3O_6$** 

Insol. in  $H_2O$ . (Gladstone, Chem. Soc. (2) 6. 268.)

**Phosphoboric acid,  $H_3BO_3$ ,  $H_3PO_4 = BPO_4 + 3H_2O$ .**

Not decomp. by boiling  $H_2O$  or conc. acids. Sol. in boiling solution of caustic alkalis. (Vogel, N. Repeat. Pharm. 18. 611.)

**Phosphochloroplatinous acid,**

See Chloroplatinophosphoric acid.

**Phosphochromic acid.****Ammonium phosphochromate,  $3(NH_4)_2O$ ,  $P_2O_5$ ,  $8CrO_3 + H_2O$ .**

Sol. in  $H_2O$  with decomp. (Friedheim, Z. anorg. 1894, 6. 284.)

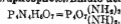
**Potassium phosphochromate,  $2K_2O$ ,  $P_2O_5$ ,  $4CrO_3 + H_2O$ .**

Sol. in  $H_2O$  but cannot be cryst. therefrom without decomp. Can be cryst. without decomp. from  $H_2O$  containing phosphoric acid (Friedheim.)

$3K_2O$ ,  $P_2O_5$ ,  $8CrO_3$ . Sol. in  $H_2O$  but cannot be cryst. therefrom without decomp. (Blondel, C. R. 1894, 118. 194.)

**Phosphohypophosphotungstic acid.****Potassium sodium phosphohypophosphotungstate,  $9K_2O$ ,  $Na_2O$ ,  $4P_2O_5$ ,  $2PO_2H_2$ ,  $20WO_3 + 23H_2O$ .**

Precipitate. Easily sol. in hot  $H_2O$ . (Gibbs, Am. Ch. J. 7. 313.)

**Tetraphosphotetrimidic acid,**

Known only in its salts. (Gladstone.)

**Silver tetraphosphotetrimidate.**

Ppt. (Gladstone.)

**Phosphoiodic acid,  $P_2O_5$ ,  $18I_2O_5 + 4H_2O$ .**

Decomp. by  $H_2O$  (Chrétien, A. ch. 1898, (7) 16. 389.)

**Ammonium phosphoiodate,  $4(NH_4)_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 12H_2O$** 

Sol. in  $H_2O$ . Sl. sol. in conc.  $H_3PO_4 + Aq$ . (Chrétien.)

**Lithium phosphoiodate,  $3Li_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 11H_2O$ .**

Sol. in  $H_2O$ . Sl. sol. in conc.  $H_3PO_4 + Aq$ . (Chrétien.)

**Potassium phosphoiodate,  $4K_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 5H_2O$ .**

Decomp. by a small amt of  $H_2O$ ; sol. in a large amt. Sl. sol. in conc.  $H_3PO_4 + Aq$ . (Chrétien.)

**Sodium phosphoiodate,  $6Na_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 5H_2O$** 

Sol. in  $H_2O$ . Sl. sol. in conc.  $H_3PO_4 + Aq$ . (Chrétien.)

**Phosphoiridic acid.**

See Chlorophosphoiridic acid.

**Phospholuteotungstic acid,  $H_4PW_9O_{26}$ .**

See under Phosphotungstic acid.

**Phosphomolybdic acid,  $P_2O_5$ ,  $18MoO_3 + 7H_2O$ .**

"Phospholuteomolybdic acid."

Deliquescent. Sol. in  $H_2O$  in all proportions. (Kehrmann, Z. anorg. 1894, 7. 418.)

$3H_2O$ ,  $P_2O_5$ ,  $20MoO_3 + 21H_2O$ . Very sol. in  $H_2O$ . Sol. in ether. By evaporation of  $H_2O$  solution crystals with  $44H_2O$ , or from a strong solution in conc.  $HNO_3 + Aq$ , with  $19H_2O$ , are obtained; also crystals with 38, and  $48H_2O$  are known (Debray, C. R. 66. 704.)

According to Rammelsberg (B. 10. 1776) formula is  $3H_2O$ ,  $P_2O_5$ ,  $22MoO_3$ .

According to Gibbs (Am. Ch. J. 3. 317) formula is  $3H_2O$ ,  $P_2O_5$ ,  $24MoO_3 + 59H_2O$ .

Fuokener (B. 11. 1638) gives the formula as  $3H_2O$ ,  $P_2O_5$ ,  $24MoO_3 + 58H_2O$ , also with  $29H_2O$ .

$P_2O_5$ ,  $20MoO_3 + 52H_2O$ . Sol. in dry ether with evolution of heat, and subsequent separation into two layers, the upper consisting of pure ether, and lower of a solution of acid in ether. Sp. gr. of lower layer, when sat. at  $13^\circ$ , is 1.3. On warming lower layer, ether separates out and forms an upper layer. This redissolves on cooling and shaking. The lower layer is insol. in  $H_2O$  and miscible with alcohol.

100 pts. either thus dissolve 80.6 pts. acid at 0°; 84.7 pts at 8.1°; 96.7 pts at 19.3°, 103.9 pts at 27.4°; 107.9 pts. at 32.9° (Parnmentier, C. R. 104. 688.)

$P_2O_5$ ,  $22MoO_3 + 57H_2O$ , and  $+58H_2O$ .

(Pohl, Dissert. 1906.)

$P_2O_5$ ,  $23MoO_3 + 61H_2O$ . (Pohl.)

$P_2O_5$ ,  $24MoO_3 + 61H_2O$ . (Miolati, C. C. 1903, II. 789)

$+64H_2O$ . (Pohl)

#### Diphosphomolybdic acid,

$H_2P_2Mo_5O_{11} = 3H_2O$ ,  $P_2O_5$ ,  $5MoO_3$

Not known in free state

#### Ammonium phosphomolybdate, $(NH_4)_2O$ ,

$P_2O_5$ ,  $2MoO_3 + 2H_2O$

(Miescher, Dissert. 1894.)

$2(NH_4)_2O$ ,  $P_2O_5$ ,  $4MoO_3 + 5H_2O$ . (Friedheim, Z. anorg. 1894, 6. 33)

$+6H_2O$ . (Perlberger, Dissert. 1904.)

$(NH_4)_2PO_4$ ,  $11MoO_3 + 6H_2O$ .

Formula is  $(NH_4)_2PO_4$ ,  $10MoO_3 + 1\frac{1}{2}H_2O$ , according to the older authorities.

Scarcely sol. in  $H_2O$  or aqueous acid solutions. Easily sol. in ammonia, and alkalies + Aq. (Svanberg and Struve, J. pr. 44. 291.)

It is almost completely insol. in a mixture of  $(NH_4)_2MoO_4 + Aq$ , and dil.  $HNO_3 + Aq$ . Absolutely insol. in a dil. nitric acid solution of ammonium nitrate (Richters, Z. anal. 10. 471.)

Solubility is increased even in presence of ammonium molybdate and free  $HNO_3$  by  $HCl$ , ammonium, and other chlorides, tartaric acid, or large quantities of ammonium oxalate or nitrate. Not precipitated in presence of excess of  $H_3PO_4$ . (Fresenius, Z. anal. 3. 446.)

Sol. in 10,000 pts.  $H_2O$  at 16°, in 6600 pts.  $H_2O$  containing 1 vol %  $HNO_3$ , in 550 pts.  $HCl + Aq$  of 1.12 sp. gr.; in 620 pts. alcohol of 0.80 sp. gr., in 190 pts.  $HNO_3 + Aq$  (sp. gr. = 1.2) at 50°, in 5 pts. conc.  $H_2SO_4$  at 100°; in 3 pts.  $NH_4OH + Aq$  of 0.95 sp. gr. (Eggertz, J. pr. 79. 496.)

Sol. in 21,186 pts.  $H_2O$ , 38,117 pts. dil. alcohol, and 13,513 pts. strong alcohol (Fehner, Analyst, 1879. 23.)

According to Sonnenschein, the solubility is increased by much  $H_2O$  or alcohol, alkaline hydroxides, carbonates, ortho-, pyro-, and metaphosphates, sodium borate, hyposulphate, thiosulphate, acetate, arsenate, and arsenite; potassium sodium tartrate, ammonium oxalate, orthophosphoric acid, and sulphuric acid. It is not increased by ammonium molybdate or sulphate, potassium sulphate, acid tartrate, acid oxalate, nitrate, or chlorate, iodide, chloride, or bromide; sodium bromide or nitrate; nitric, hydrochloric, boric, tartaric, oxalic, and dilute sulphuric acids (Sonnenschein, J. pr. 53. 342.)

Sol. in hot  $H_2O$ . Sol. in cold caustic alkalies, alkali carbonates, and phosphates,

$NH_4Cl$ , and  $(NH_4)_2C_2O_4 + Aq$ ; sl. sol. in  $(NH_4)_2SO_4$ ,  $KNO_3$ , and  $KCl + Aq$ ; very sl. sol. in  $NH_4NO_3 + Aq$ . Sol. in  $K_2SO_4$ ,  $Na_2SO_4$ ,  $NaCl$ ,  $MgCl_2$ ,  $H_2SO_4$ ,  $HCl$ , and conc. or dil.  $HNO_3 + Aq$

Presence of  $(NH_4)_2MoO_4$  totally changes the effect of acid liquids; insol. in dil.  $HNO_3$ , or  $H_2SO_4 + Aq$  containing  $(NH_4)_2MoO_4$ , but somewhat sol. in  $HCl + Aq$ , even in presence of that salt. Tartaric acid and similar organic substances totally prevent the precipitation of this salt (Eggertz in Fresenius' Quant. anal.)

$5(NH_4)_2O$ ,  $48MoO_3$ ,  $2P_2O_5 + 17H_2O = 3(NH_4)_2O$ ,  $24MoO_3$ ,  $P_2O_5 + 2(NH_4)_2O$ ,  $H_2O$ ,  $24MoO_3$ ,  $P_2O_5 + 16H_2O$  Formula of above salt according to Gibbs

$3(NH_4)_2O$ ,  $22MoO_3$ ,  $P_2O_5 + 9H_2O$ , or  $12H_2O$

$8(NH_4)_2O$ ,  $H_2O$ ,  $60MoO_3$ ,  $3P_2O_5 + 11H_2O$  Sl. sol. in  $H_2O$

$3(NH_4)_2O$ ,  $16MoO_3$ ,  $P_2O_5 + 14H_2O$ . Insol. in cold, sol. with decomp. in hot  $H_2O$ . Sol. in  $NH_4OH + Aq$  (Gibbs, Am. Ch. J. 3. 317.)

$5(NH_4)_2O$ ,  $P_2O_5$ ,  $16MoO_3$ . (Miescher, Dissert. 1894.)

$3(NH_4)_2O$ ,  $P_2O_5$ ,  $18MoO_3 + 14H_2O$  Sol. in  $H_2O$ . The aqueous solution is stable at ordinary temp. for several days, but when warmed ordinary ammonium phosphomolybdate separates. (Kehrmann, Z. anorg. 1894, 7. 414)

$3(NH_4)_2O$ ,  $P_2O_5$ ,  $28MoO_3 + 8H_2O$  100 g  $H_2O$  dissolve 0.0233 g. at 15°. 1 pt. is sol. at 15° in 4206 pts.  $H_2O$ , 7300 pts. 5%  $NH_4NO_3 + Aq$ ; 4930 pts. 1%  $HNO_3 + Aq$ . (de Lucchi, Rass. Min. 1910, 32. 21.)

$9(NH_4)_2O$ ,  $2P_2O_5$ ,  $28MoO_3 + 8H_2O$  (Miescher, Dissert. 1894.)

#### Ammonium diphosphomolybdate,

$2(NH_4)_2PO_4$ ,  $5MoO_3 + 7H_2O = 3(NH_4)_2O$ ,  $5MoO_3$ ,  $P_2O_5 + 7H_2O$ .

Easily sol. in hot, less in cold  $H_2O$ . (Zenker, J. pr. 58. 256.)

$5(NH_4)_2O$ ,  $H_2O$ ,  $10MoO_3$ ,  $2P_2O_5 + 6H_2O = 3(NH_4)_2O$ ,  $5MoO_3$ ,  $P_2O_5 + 2(NH_4)_2O$ ,  $H_2O$ ,  $5MoO_3$ ,  $P_2O_5 + 6H_2O$ . Sol. in  $H_2O$  (Gibbs, Am. Ch. J. 1895, 17. 87.)

$+8H_2O$ . (Perlberger.)

$+18H_2O$ . (Mazzuchelli and Zangrilli, Gazz. ch. it. 1910, 40. (2) 55.)

$5(NH_4)_2O$ ,  $P_2O_5$ ,  $10MoO_3 + 13H_2O$ , and  $+14H_2O$ . (Perlberger, Dissert. 1904.)

#### Ammonium barium phosphomolybdate,

$3(NH_4)_2O$ ,  $30BaO$ ,  $P_2O_5$ ,  $30MoO_3$ .

Insol. precipitate. (Selgsohn, J. pr. 67. 478.)

#### Ammonium cadmium phosphomolybdate,

$5(NH_4)_2O$ ,  $CdO$ ,  $P_2O_5$ ,  $6MoO_3 + 8H_2O$ .

(Perlberger, Dissert. 1904.)

$3(NH_4)_2O$ ,  $2CdO$ ,  $2P_2O_5$ ,  $9MoO_3 + 14H_2O$ . (Perlberger)

- Ammonium cobaltous phosphomolybdate**,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 10\text{H}_2\text{O}$ .  
Decomp. by cold  $\text{H}_2\text{O}$ . Sol in acids and hot  $\text{H}_2\text{O}$ . (Arnfeld, Dissert. 1898.)  
 $4(\text{NH}_4)_2\text{O}$ ,  $\text{CoO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$   
Sl sol in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Arnfeld.)
- Ammonium manganous phosphomolybdate**,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 20\text{H}_2\text{O}$ .  
Decomp. by  $\text{H}_2\text{O}$ , but dissolves clear on heating. (Arnfeld.)  
 $1(\text{NH}_4)_2\text{O}$ ,  $\text{MnO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 13\text{H}_2\text{O}$ . (Arnfeld.)  
 $5(\text{NH}_4)_2\text{O}$ ,  $10\text{MnO}$ ,  $2\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 10\text{H}_2\text{O}$ . Very sl. sol in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 1895, 17, 87.)
- Ammonium nickel phosphomolybdate**,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 10\text{H}_2\text{O}$ .  
Decomp. by cold, but sol. in hot  $\text{H}_2\text{O}$ . (Arnfeld.)  
 $(\text{NH}_4)_2\text{O}$ ,  $\text{NiO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$ . (Arnfeld.)
- Ammonium potassium phosphomolybdate**,  $6(\text{NH}_4)_2\text{O}$ ,  $15\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $60\text{MoO}_3 + 12\text{H}_2\text{O}$   
Sol. in  $\text{H}_2\text{O}$ . Insol in alcohol. (Seligsohn, J. pr. 67, 477.)
- Ammonium sodium phosphomolybdate**,  $6(\text{NH}_4)_2\text{O}$ ,  $15\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $60\text{MoO}_3 + 18\text{H}_2\text{O}$   
Sol. in much boiling  $\text{H}_2\text{O}$ . Insol. in alcohol (Seligsohn, J. pr. 67, 474.)
- Barium phosphomolybdate**,  $3\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + x\text{H}_2\text{O}$   
Moderately sol in cold, very easily sol in hot  $\text{H}_2\text{O}$ . Decomp in aqueous solution at ordinary temp on standing (Kehrmann, Z. anorg. 1894, 7, 414)
- Cæsium phosphomolybdate**,  $3\text{Cs}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $6\text{MoO}_3 + 8\text{H}_2\text{O}$ .  
Ppt. (Ephraim, Z. anorg. 1910, 65, 240)  
 $2\text{Cs}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $14\text{MoO}_3 + 3\text{H}_2\text{O}$  Difficultly sol. in  $\text{H}_2\text{O}$ . (Ephraim.)  
 $3\text{Cs}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $21\text{MoO}_3 + 4\text{H}_2\text{O}$  (?). (Ephraim.)
- Calcium potassium phosphomolybdate**,  $2\text{CaO}$ ,  $3\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 22\text{H}_2\text{O}$ .  
(Friedheim, Z. anorg. 1893, 4, 203.)
- Cobaltous phosphomolybdate**,  $2\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $1\text{MoO}_3 + x\text{H}_2\text{O}$   
(Arnfeld, Dissert. 1898.)  
 $3\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 16\frac{1}{2}\text{H}_2\text{O}$ , and  $+17\frac{1}{2}\text{H}_2\text{O}$ . Extremely sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)  
 $3\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 38\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)  
 $3\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 58\text{H}_2\text{O}$ , and  $+60\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)
- Cobaltous potassium phosphomolybdate**,  $\text{K}_2\text{O}$ ,  $2\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 15\text{H}_2\text{O}$  (Arnfeld.)  
 $4\text{K}_2\text{O}$ ,  $\text{CoO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$  Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Arnfeld.)
- Croceocobaltic phosphomolybdate**,  $24\text{MoO}_3$ ,  $\text{P}_2\text{O}_5$ ,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]_2\text{O}$ ,  $2\text{H}_2\text{O} + 21\text{H}_2\text{O}$ .  
Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 3, 317.)
- Gold phosphomolybdate ammonia**,  $12\text{Au}_2\text{O}_3$ ,  $7\text{P}_2\text{O}_5$ ,  $3\text{MoO}_3$ ,  $24\text{NH}_3 + 21\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 1895, 17, 172.)
- Gold sodium phosphomolybdate ammonia**,  $5\text{Au}_2\text{O}_3$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $11\text{MoO}_3$ ,  $15\text{NH}_3 + 10\text{H}_2\text{O}$   
Sol. in dil.  $\text{HCl}$ . Almost insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Gibbs.)
- Lead phosphomolybdate**,  $23\text{PbMoO}_4$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{PbPO}_4 + 7\text{H}_2\text{O}$   
Sol in 500,000 pts.  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{HNO}_3 + \text{Aq}$ ; somewhat less sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Beuf, Bull. Soc. (3) 3, 852.)
- Lithium phosphomolybdate**,  $12\text{Li}_2\text{O}$ ,  $4\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 18\text{H}_2\text{O}$ .  
Partially sol. in  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64, 233.)  
 $3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 16\text{H}_2\text{O}$  Ppt. (Ephraim, Z. anorg. 1910, 65, 233-6.)  
 $3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 17\text{H}_2\text{O}$ . Ppt. (E.)  
 $5\text{Li}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $8\text{MoO}_3 + 28\text{H}_2\text{O}$ . Easily sol in  $\text{H}_2\text{O}$ . (E.)  
 $3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{MoO}_3 + 18\text{H}_2\text{O}$ . Ppt. (E.)  
 $3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 27\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (E.)
- Manganous phosphomolybdate**,  $3\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 20\text{H}_2\text{O}$ .  
Very sol in  $\text{H}_2\text{O}$ . Sl. sol in alcohol (Arnfeld.)  
 $3\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 38\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)  
 $3\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 58\text{H}_2\text{O}$ , and  $+60\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$ . (Arnfeld.)
- Manganous potassium phosphomolybdate**,  $2\text{MnO}$ ,  $3\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 30\text{H}_2\text{O}$ .  
Sol. in hot  $\text{H}_2\text{O}$ . (Arnfeld.)
- Manganous sodium phosphomolybdate**,  $7\text{MnO}$ ,  $9\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $22\text{MoO}_3 + 57\text{H}_2\text{O}$   
Nearly insol. in cold  $\text{H}_2\text{O}$ . Sol. in boiling  $\text{H}_2\text{O}$  but decomp. thereby (Gibbs, Am. Ch. J. 1895, 17, 85.)
- Nickel phosphomolybdate**,  $2\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{MoO}_3 + x\text{H}_2\text{O}$ .  
Ppt. (Arnfeld.)  
 $3\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 20\text{H}_2\text{O}$ . Decomp by  $\text{H}_2\text{O}$ . (Arnfeld.)

$3\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 34\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$  (Arnfeld.)

$3\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 58\text{H}_2\text{O}$ , and  $+60\text{H}_2\text{O}$  Efflorescent Sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)

**Nickel potassium phosphomolybdate**,  $\text{K}_2\text{O}$ ,  $2\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 13\text{H}_2\text{O}$ .

Decomp. by cold  $\text{H}_2\text{O}$ , but goes into solution by boiling (Arnfeld.)

$4\text{K}_2\text{O}$ ,  $\text{NiO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$  (Arnfeld.)

**Potassium phosphomolybdate**,  $\text{K}_3\text{PO}_4$ ,  $11\text{MoO}_3 + 1\frac{1}{2}\text{H}_2\text{O} = 3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{MoO}_3 + 3\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ . Easily sol in alkalis (Svanberg and Struve.)

100 g.  $\text{H}_2\text{O}$  dissolve 0.007 g. at  $30^\circ$ , 100 g. 10%  $\text{HNO}_3 + \text{Aq}$  dissolve 0.204 g. at  $30^\circ$  (Donk, Bull. 90, Bur. of Chem., U. S. Dept. of Agric. 1906.)

According to older authorities the formula is  $\text{K}_3\text{PO}_4$ ,  $10\text{MoO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

$+6\text{H}_2\text{O}$  (Rammelsberg.)  
 $2\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $24\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$  Sl. sol. in cold  $\text{H}_2\text{O}$

$5\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $44\text{MoO}_3$ ,  $2\text{P}_2\text{O}_5 + 21\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 3. 317.)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 11\text{H}_2\text{O}$ , and  $+15\text{H}_2\text{O}$  (Elias.)

$+14\text{H}_2\text{O}$ . Sl. sol. in cold, very easily sol. in hot  $\text{H}_2\text{O}$ . Can be cryst. from hot  $\text{H}_2\text{O}$  (Kehrmann, Z. anorg. 1894, 7. 416.)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $17\text{MoO}_3 + 12\text{H}_2\text{O}$ . Moderately sol. in  $\text{H}_2\text{O}$  (Elias, Dissert. 1906.)

$5\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $17\text{MoO}_3 + 2\text{H}_2\text{O}$  Aqueous solution decomp. rapidly in the cold (Kehrmann, Z. anorg. 1894, 7. 423.)

$4\text{K}_2\text{O}$ ,  $2\text{H}_2\text{O}$ ,  $9\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 18\text{H}_2\text{O}$ . (Zenkner.)

$5\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $10\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 19\text{H}_2\text{O}$  Easily sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 10. 1776.)

$6\text{K}_2\text{O}$ ,  $15\text{MoO}_3$ ,  $\text{P}_2\text{O}_5$ . Insol in  $\text{H}_2\text{O}$  Sol in  $\text{KOH} + \text{Aq}$ . (Rammelsberg.)

$\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{MoO}_3 + 13\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  (Friedheim, Z. anorg. 4. 287.)

$2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{MoO}_3 + 8\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

**Potassium diphosphopentamolybdate**,  $3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 7\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , precipitated by  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ . (Zenkner, J. pr. 68. 261.)

$2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 6\text{H}_2\text{O}$  (Friedheim.)

**Potassium diphosphopentamolybdate nitrate**,  $2\text{K}_3\text{PO}_4$ ,  $5\text{MoO}_3$ ,  $6\text{KNO}_3 + 9\text{H}_2\text{O}$

(Debray, C. R. 66. 706.)

**Rubidium phosphomolybdates:**

$7\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{MoO}_3 + 12\text{H}_2\text{O}$ ;  $3\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 12\text{H}_2\text{O}$ ,  $6\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 10\text{H}_2\text{O}$ ;  $5\text{Rb}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $9\text{MoO}_3 + 13\text{H}_2\text{O}$ ;  $7\text{Rb}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 15\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1910, 65. 237-9.)

**Silver phosphomolybdate**,  $7\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 24\text{H}_2\text{O}$ .

Ppt Sol in dil  $\text{HNO}_3 + \text{Aq}$ , forming—  
 $2\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 7\text{H}_2\text{O}$ . Sl sol in  $\text{H}_2\text{O}$  (Rammelsberg.)

Formula of first salt is—  
 $7\text{Ag}_2\text{O}$ ,  $22\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 14\text{H}_2\text{O}$  Sol. in hot  $\text{H}_2\text{O}$ , but solution is quickly decomp. (Gibbs, Am. Ch. J. 3. 317.)

$7\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3$  Ppt. (Miciati, J. pr. 1908 (2) 77. 451.)

**Silver diphosphopentamolybdate**,  $\text{Ag}_5\text{Mo}_5\text{P}_2\text{O}_{12} + 7\text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$ . (Debray, C. R. 66. 705.)

**Sodium phosphomolybdate.**

Sol in  $\text{H}_2\text{O}$  and  $\text{HNO}_3 + \text{Aq}$ . (Sonnen-schein, A. 104. 45.)

$\text{Na}_2\text{O}$ ,  $5\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 2\text{H}_2\text{O}$   
 $2\text{Na}_2\text{O}$ ,  $4\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 2\text{H}_2\text{O}$ .

$3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 26\text{H}_2\text{O}$  (Friedheim.)

$3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 42\text{H}_2\text{O}$ . (Rosenheim and Pinsker, Z. anorg. 1911, 70. 79.)

**Sodium diphosphopentamolybdate**,  $3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 14\text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$  (Debray.)

**Sodium auramine phosphomolybdate**,  $\text{Na}_2\text{O}$ ,  $5\text{Au}_2\text{O}_3$ ,  $2\text{P}_2\text{O}_5$ ,  $11\text{MoO}_3$ ,  $15\text{NH}_3$ .

Sol in hot  $\text{H}_2\text{O}$ . Very sol in hot  $\text{HCl}$ . (Gibbs, Am. Ch. J. 1895, 17. 171.)

**Metaphosphomolybdic acid.**

**Ammonium monometaphosphomolybdate**,  $3(\text{NH}_4)_2\text{O}$ ,  $4\text{NH}_4\text{PO}_3$ ,  $10\text{MoO}_3 + 9\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Gibbs, Am. Ch. J. 7. 392.)

**Barium hexametaphosphomolybdate**,  $\text{BaO}$ ,  $\text{Ba}_3(\text{PO}_3)_6$ ,  $14\text{MoO}_3 + 55\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ . (Gibbs.)

**Pyrophosphonitrylic acid**,  $\text{P}_2\text{HNO}_3 =$   
 $\text{P}_2\text{O}_5 \cdot \text{OH}$   
 $\text{N}$ .

Not known in free state

**Ammonium pyrophosphonitrylate**,  $\text{P}_2\text{O}_5 \cdot \text{ONH}_4$   
 $\text{N}$ .

Insol but gradually decomp. by  $\text{H}_2\text{O}$ . (Gladstone.)

**Potassium —**,  $\text{KP}_2\text{NO}_4$

Insol. in  $\text{H}_2\text{O}$  (Gladstone.)

**Silver —**,  $\text{AgP}_2\text{NO}_4$ .

Ppt

**Triphosphonitrilic chloramide,**

Sol. in  $H_2O$  without decomp.; sol. in ether, alcohol; sl. sol. in benzene. (Stokes, Am. Ch. J. 1895, 17. 287.)

**Triphosphonitrilic tetrachlorhydrin,**

Sol. in ether, alcohol, and  $H_2O$ ; insol. in benzene and  $CS_2$ . (Stokes, Am. Ch. J. 1895, 17. 286.)

**Triphosphonitrilic chloride,  $P_3N_3Cl_4$** 

Sol. in glacial acetic acid and  $H_2SO_4$ . 100 pts. ether dissolve 46.5 pts. at  $20^\circ$ . (Liebig.)

Insol. in light petroleum, sol. in benzene. (Stokes, Am. Ch. J. 1897, 19. 783.)

**Tetraphosphonitrilic chloride,  $P_4N_4Cl_4$** 

Sol. in alcohol, ether, benzene,  $H_2SO_4$ . Sl. sol. in  $H_2O$  with decomp. 100 pts. ether dissolve 12.3 pts. at  $20^\circ$ . (Stokes, Am. Ch. J. 1895, 17. 281.)

**Pentaphosphonitrilic chloride,  $(PNCl_2)_5 = P_5N_5Cl_{10}$** 

Sol. in benzene, light petroleum, acetic acid, ether,  $CS_2$ ; insol. in  $H_2O$ . (Stokes, Am. Ch. J. 1897, 19. 790.)

**Hexaphosphonitrilic chloride,  $(PNCl_2)_6 = P_6N_6Cl_{12}$** 

Sol. in benzene, light petroleum, ether,  $CS_2$ ; insol. in  $H_2O$ . (Stokes.)

**Heptaphosphonitrilic chloride,  $(PNCl_2)_7 = P_7N_7Cl_{14}$** 

Sol. in benzene, light petroleum, ether,  $CS_2$ , insol. in  $H_2O$ ; sol. in alcohol with decomp. (Stokes.)

**Polyphosphonitrilic chloride,  $(PNCl_2)_x$** 

Depolymerizes on distillation; insol. in benzene and light petroleum and all neutral solvents; sol. in  $H_2O$  with decomp. (Stokes.)

**Phosphonitrilochloramide,  $P_2N_2Cl_3(NH_2)$** 

Slowly sol. in  $H_2O$  with decomp. Insol. in ether and  $CS_2$ . Sl. sol. in boiling  $CCl_4$ . (Besson and Rosset, C. R. 1908, 146. 1149.)

**Phosphonium bromide,  $PH_4Br$** 

Decomp. violently by  $H_2O$ .

**Phosphonium chloride,  $PH_4Cl$** 

(Ogier, Bull. Soc. (2) 32. 483.)

**Phosphonium titanium chloride,  $2PH_4Cl, 3TiCl_4$** 

Decomp. by  $H_2O$ ,  $HCl$ , or alkalis + Aq R. use.)

**Phosphonium iodide,  $PH_4I$** 

Decomp. by  $H_2O$ , alkalis, alcohol, etc. (Rose, Pogg. 46. 636.)

Decomp. by  $PCl_5$ . (Wilde, B. 16. 217.)

**Phosphonium sulphate (?)**

Deliquescent; very unstable. (Besson, C. R. 109. 644.)

**Phosphoramidate,  $P(NH_2)_3$** 

Insol. in  $NH_4Br, 3NH_3$ ; sol. in  $NH_4I, 3NH_3$ . (Hugot, C. R. 1905, 141. 1235.)

**Phosphortriamide,  $PON_3H_3$** 

See Phosphoryl triamide.

**Phosphoric acid, anhydrous,  $P_2O_5$** 

See Phosphorus pentoxide.

**Metaphosphoric acid,  $HPO_3$** 

Sol. in  $H_2O$ . Not isolated. (Fleitmann, Pogg. 78. 362.)

Deliquescent. Sol. in  $H_2O$ , but aqueous solution decomp. into  $H_3PO_4$ , slowly in the cold, but more rapidly on heating. Conc. solutions decomp. more rapidly than when dil. (Giran, A. ch. 1903, (7) 30. 203.)

Insol. in liquid  $CO_2$ . (Büchner, Z. phys. Ch. 1906, 64. 674.)

**Dimetaphosphoric acid,  $H_2P_2O_5$** 

Not isolated. (Fleitmann.)

**Trimetaphosphoric acid,  $H_3P_3O_7$** 

Sol. in  $H_2O$ ; the solution is permanent in the cold, but on evaporation it is quickly decomp. to  $H_3PO_4$ .

**Tetrametaphosphoric acid,  $H_4P_4O_{13}$** 

Not isolated.

**Hexametaphosphoric acid,  $H_6P_6O_{19}$** 

(Glacial phosphoric acid.)

Deliquescent; easily sol. in  $H_2O$  with evolution of heat and conversion into  $H_3PO_4$ . Not easily sol. in presence of slight impurities.

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

**Orthophosphoric acid,  $H_3PO_4$** 

Very sol. in  $H_2O$ .

100 pts. of the solution contain at:

26.23°	27.02°	29.42°	29.77°
95.9	95.98	96.15	96.11 pts. $H_3PO_4$

37.65° 39.35° 42.30° (mpt.)

97.8 98.48 100 pts.  $H_3PO_4$ .

(Smith and Menzies, J. Am. Chem. Soc. 1909, 31. 1186.)

See also  $10H_3PO_4 + H_2O$ , and  $2H_3PO_4 + H_2O$ .

Sp. gr. of  $H_3PO_4 + Aq$  containing:

10	20	30	40	50	% $P_2O_5$
1.1	1.23	1.39	1.6	1.85	

(Dalton.)

Sp. gr. of  $\text{H}_2\text{PO}_4 + \text{Aq.}$ 

Sp. gr.	% $\text{P}_2\text{O}_5$	Sp. gr.	% $\text{P}_2\text{O}_5$	Sp. gr.	% $\text{P}_2\text{O}_5$
1.508	49.60	1.328	36.15	1.144	17.89
1.492	48.41	1.315	34.82	1.136	16.95
1.476	47.10	1.302	33.49	1.124	15.64
1.464	45.63	1.293	32.71	1.113	14.33
1.453	45.38	1.285	31.94	1.109	13.25
1.442	44.13	1.276	31.03	1.095	12.18
1.434	43.95	1.268	30.13	1.081	10.44
1.426	43.28	1.257	29.16	1.073	9.53
1.418	42.61	1.247	28.24	1.066	8.62
1.401	41.60	1.236	27.30	1.056	7.39
1.392	40.86	1.226	26.36	1.047	6.17
1.384	40.12	1.211	24.73	1.031	4.15
1.376	39.66	1.197	23.29	1.022	3.03
1.369	39.21	1.185	22.07	1.014	1.91
1.356	38.00	1.173	20.91	1.006	0.79
1.347	37.37	1.162	19.73	..	...
1.339	36.74	1.153	18.81	..	...

(Watts, C. N. 12. 160.)

Specific gravity of  $\text{H}_2\text{PO}_4 + \text{Aq.}$  containing.

8	12	18	% $\text{H}_2\text{PO}_4$
1.0333	1.0888	1.1085	
24	36	54	% $\text{H}_2\text{PO}_4$
1.1463	1.2338	1.3840	

(Schiff, A. 113. 183.)

Sp. gr. of  $\text{H}_2\text{PO}_4 + \text{Aq.}$  at  $15^\circ$ . a = sp. gr. if % is  $\text{P}_2\text{O}_5$ , b = sp. gr. if % is  $\text{H}_2\text{PO}_4$ .

%	a	b	%	a	b
1	1.009	1.0054	31	1.288	1.1962
2	1.017	1.0109	32	1.299	1.2036
3	1.025	1.0164	33	1.310	1.2111
4	1.032	1.0220	34	1.321	1.2186
5	1.039	1.0276	35	1.333	1.2262
6	1.047	1.0333	36	1.345	1.2338
7	1.055	1.0390	37	1.357	1.2415
8	1.063	1.0449	38	1.369	1.2493
9	1.071	1.0508	39	1.381	1.2572
10	1.080	1.0567	40	1.393	1.2651
11	1.089	1.0627	41	1.407	1.2731
12	1.098	1.0688	42	1.420	1.2812
13	1.106	1.0749	43	1.432	1.2894
14	1.115	1.0811	44	1.445	1.2976
15	1.124	1.0874	45	...	1.3059
16	1.133	1.0937	46	...	1.3143
17	1.142	1.1001	47	...	1.3227
18	1.151	1.1065	48	...	1.3313
19	1.161	1.1130	49	...	1.3399
20	1.171	1.1196	50	...	1.3486
21	1.182	1.1262	51	...	1.3573
22	1.192	1.1329	52	...	1.3661
23	1.202	1.1397	53	...	1.3750
24	1.212	1.1465	54	...	1.3840
25	1.223	1.1534	55	...	1.3931
26	1.233	1.1604	56	...	1.4022
27	1.244	1.1674	57	...	1.4114
28	1.254	1.1745	58	...	1.4207
29	1.265	1.1817	59	...	1.4301
30	1.277	1.1890	60	...	1.4395

(Schiff, calculated by Gerlach, Z. anal. 8. 292.)

Sp. gr. of  $\text{H}_2\text{PO}_4 + \text{Aq.}$  at  $17.5^\circ$ .

% $\text{P}_2\text{O}_5$	Sp. gr.	% $\text{P}_2\text{O}_5$	Sp. gr.	% $\text{P}_2\text{O}_5$	Sp. gr.
1	1.007	24	1.208	47	1.476
2	1.014	25	1.219	48	1.491
3	1.021	26	1.229	49	1.505
4	1.028	27	1.240	50	1.521
5	1.036	28	1.250	51	1.536
6	1.044	29	1.261	52	1.551
7	1.053	30	1.272	53	1.566
8	1.061	31	1.282	54	1.581
9	1.070	32	1.293	55	1.597
10	1.078	33	1.304	56	1.613
11	1.086	34	1.315	57	1.629
12	1.095	35	1.326	58	1.645
13	1.103	36	1.338	59	1.661
14	1.112	37	1.350	60	1.677
15	1.120	38	1.362	61	1.693
16	1.129	39	1.374	62	1.709
17	1.139	40	1.386	63	1.725
18	1.148	41	1.398	64	1.741
19	1.158	42	1.410	65	1.758
20	1.168	43	1.423	66	1.775
21	1.178	44	1.436	67	1.792
22	1.188	45	1.448	68	1.809
23	1.198	46	1.462	..	..

(Hager, Adjumenta varia, Leipzig, 1876.)

Table for correction to be added or subtracted \*for  $1^\circ$  change in temperature.

% $\text{P}_2\text{O}_5$	Corr.	% $\text{P}_2\text{O}_5$	Corr.
10-14	0.00035	36-45	0.00068
15-25	0.0004	46-55	0.00082
26-35	0.00052	56-68	0.001

(Hager.)

Sp. gr. of  $\text{H}_2\text{PO}_4 + \text{Aq.}$ 

G-equivalents $\text{H}_2\text{PO}_4$ per litre	t°	Sp. gr. t°/w°
0.002572	17.714	1.001552
0.005143	17.706	1.0003051
0.01025	17.685	1.000595
0.02042	17.683	1.001168
0.03056	17.687	1.001708
0.04065	17.704	1.002262
0.0507	17.663	1.002790
0.10046	17.696	1.005412
0.19951	17.749	1.010560
0.29716	17.701	1.015584
0.49057	17.719	1.025469
0.5070	17.58	1.02827
5.0700	17.84	1.25162

(Kohlrausch, W. Ann. 1894, 53. 29.)

Miscible with conc  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq.}$  Sol in 30 pts warm creosote1 cc. of a sat. solution of ether in  $\text{H}_2\text{O}$  dissolves 0.0886 grams  $\text{H}_2\text{PO}_4$ .

1 cc. of a sat. solution of  $H_2O$  in ether dissolves 0.00033 grams  $H_3PO_4$ .

Solutions of  $H_3PO_4$  in  $H_2O$  containing less than 0.434 grams acid per 1 cc. lose an insignificant amount of acid to ether when agitated therewith (Berthelot, C. R. 1896, 123. 345.)

The composition of the hydrates formed by  $H_3PO_4$  at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by  $H_3PO_4$  and of the conductivity and sp. gr. of  $H_3PO_4$ +Aq. (Jones, Am. Ch. J. 1905, 34. 331.)

$10H_3PO_4 + H_2O$ . Solubility in  $H_2O$ .

100 pts. of the solution contain at.

24.11°	24.38°	24.40°
94.78	94.80	94.84 pts. $H_3PO_4$

24.81°	25.41°	25.85°
94.95	95.26	95.54 pts. $H_3PO_4$

(Smith and Menzies, J. Am. Chem. Soc. 1909, 31. 1186.)

$2H_3PO_4 + H_2O$ . Solubility in  $H_2O$ .

100 pts. of the solution contain at

-16.3°	0.5°	14.95°	24.03°	27.0°
76.7	78.7	81.7	85.7	87.7 pts. $H_3PO_4$

29.15°	29.35° (mpt.)
90.5	91.6 pts. $H_3PO_4$

28.5°	27.0°	25.41°
92.5	93.4	94.1 pts. $H_3PO_4$

Retroflex part of curve.

(Smith and Menzies, J. Am. Chem. Soc. 1909, 31. 1186.)

**Pyrophosphoric acid (Diphosphoric acid),  $H_4P_2O_7$ .**

Very sol. in  $H_2O$ . The solution may be kept without change, but on heating it is converted into  $H_3PO_4$ .

The acid in solution gradually changes to  $H_3PO_4$ ; the conversion being more rapid with more concentrated solutions. (Montemartini and Egidi, Gazz. ch. it. 1902, 32. (1) 381.)

**Phosphoric acid,  $H_3P_2O_7$  (?).**

Sol. in  $H_2O$ . (Joly, C. R. 100. 447.)

**Phosphates.**

The phosphates of  $NH_4$ ,  $K$ ,  $Na$ ,  $Li$ ,  $Cs$ , and  $Rb$  are sol. in  $H_2O$ , with the exception of certain metaphosphates; the other phosphates excepting neutral  $Tl$  salts, are nearly insol. in  $H_2O$ , excepting when an excess of  $H_3PO_4$  is present. The latter are all sol. in  $HNO_3$ +Aq.

(a) **Metaphosphates.**

**Monometaphosphates.** Only alkali monometaphosphates are known, and they are all insol. in  $H_2O$ .

**Dimetaphosphates.** Alkali dimetaphosphates and some double salts containing an alkali as one of the bases are sol. in  $H_2O$ , the rest are sl sol or insol in  $H_2O$ .

**Trimetaphosphates.** All salts are sol. in  $H_2O$ .

**Tetrametaphosphates.** The alkali salts are sol. in  $H_2O$ , the others are insol.

**Hexametaphosphates.** The alkali salts are sol., the others insol., in  $H_2O$ , but are mostly sol. in  $Na$  hexametaphosphate+Aq.

(b) **Orthophosphates.**  $K$ ,  $Na$ ,  $Li$ ,  $Cs$ , and  $Rb$  orthophosphates are sol. in  $H_2O$ . All the others are insol. in  $H_2O$ , but sol. in excess of  $H_3PO_4$  and  $HNO_3$ +Aq; less easily sol. in  $HC_2H_3O_2$ +Aq.  $Pb$ ,  $Al$ , and  $Fe_3$  phosphates are insol. in  $HC_2H_3O_2$ +Aq. Sl sol. in  $NH_4$  salts+Aq, especially  $NH_4Cl$ +Aq, from which solution they are pptd. by  $NH_4OH$ +Aq. Orthophosphates insol. in  $H_2O$  are also insol. in an excess of alkali orthophosphates+Aq.

All orthophosphates are insol., or very sl. sol. in alcohol.

(c) **Pyrophosphates.** Alkali pyrophosphates are sol. in  $H_2O$ , the others are insol. in  $H_2O$ , but are mostly sol. in an excess of  $Na$  pyrophosphate+Aq.

**Aluminum metaphosphate,  $Al_3(PO_3)_4$ .**

Insol. in  $H_2O$  and conc. acids. (Maddrell, A. 61. 59.)

**Aluminum orthophosphate, basic,  $3Al_2O_3, P_2O_5 + 18H_2O$ .**

Min. *Evanite*.

$4Al_2O_3, 3P_2O_5 + 18H_2O$ . Ppt. Insol. in  $H_2O$ . (Rammelsberg.)

$2Al_2O_3, P_2O_5$ .

+ $3H_2O$ . Min. *Angelite*.

+ $5H_2O$ . Min. *Kalaite* (*Turquoise*). Sol. in  $HCl$ +Aq.

+ $6H_2O$ . Decomp. by  $H_2O$ . (Hautefeuille, J. pr. (2) 37. 111.)

Min. *Peganite*. More or less sol. in  $HCl$ , and  $HNO_3$ +Aq.

+ $8H_2O$ . Ppt. (Munroe, A. 159. 278.)

Min. *Fischerite*. Sl attacked by  $HCl$  or  $HNO_3$ +Aq; sol. in  $H_2SO_4$ +Aq.

$3Al_2O_3, 2P_2O_5 + 8H_2O$ , or  $12H_2O$ . Sol. in acids, even after ignition (Milot, C. R. 82. 89.)

+ $10H_2O$ . Min. *Ceruleolactite*. Sol. in acids.

+ $12H_2O$ . Min. *Wavellite*.

**Aluminum orthophosphate,  $Al_3(PO_4)_2$ .**

**Crystalline.** Not attacked by conc.  $HCl$  or  $HNO_3$ +Aq, difficultly by hot conc.  $H_2SO_4$ . (de Schulten, C. R. 98. 1583.)

**Ignited  $Al_3(PO_4)_2$**  is sl. decomp. by  $H_2O$ , so that solubility determinations are variable. For an extended discussion, see original paper. (Cameron and Hurst, 1904, 26. 898.)

+4H<sub>2</sub>O Easily sol in mineral acids, insol in acetic and other organic acids Easily sol in KOH+Ag, but is reprecipitated by NH<sub>4</sub>Cl+Ag. Sol. in NH<sub>4</sub>OH+Ag. Sol. in a large amount of alum+Ag (Rose), in aluminum acetate and other aluminum salts +Ag (Fleischer, Z anal. 6, 28). More sol than ferric phosphate in ammonium oxalate or citrate+Ag. (Millot.)

Acid NH<sub>4</sub> citrate+Ag dissolves 3% of the P<sub>2</sub>O<sub>5</sub>; neutral NH<sub>4</sub> citrate+Ag dissolves 6.6% of the P<sub>2</sub>O<sub>5</sub>, ammoniacal NH<sub>4</sub> citrate+Ag dissolves completely in 25 min (Erlenmeyer, B. 14, 1869)

Sol in NH<sub>4</sub>OH+Ag, especially in presence of alkali phosphates (de Koninck, Z anal. 23, 90)

Not pptd in presence of alkali tartrates or citrates, sugar, glycerine, etc.

Insol. in ethyl acetate (Naumann, B. 1010, 43, 314)

Min *Vorlesite*. Very quickly sol in warm conc HCl+Ag.

+5H<sub>2</sub>O. Min *Zepharovitchite*

+8H<sub>2</sub>O. Min *Gibbsite*

Aluminum orthophosphate, acid, 2Al<sub>2</sub>O<sub>3</sub>, 3P<sub>2</sub>O<sub>5</sub>+16H<sub>2</sub>O

Insol. in acids after being ignited. (Millot, Bull. Soc. (2) 22, 244)

+4H<sub>2</sub>O, and 6H<sub>2</sub>O Insol in H<sub>2</sub>O or alcohol (Hautefeuille and Margottet, J. pr. (2) 37, 111.)

Al<sub>2</sub>O<sub>3</sub>, 2P<sub>2</sub>O<sub>5</sub>+8H<sub>2</sub>O. Insol in acids or aqua regia after being ignited. (Millot)

2Al<sub>2</sub>O<sub>3</sub>, 5P<sub>2</sub>O<sub>5</sub>+14H<sub>2</sub>O. Decomp by cold H<sub>2</sub>O into—

4Al<sub>2</sub>O<sub>3</sub>, 7P<sub>2</sub>O<sub>5</sub>+9H<sub>2</sub>O. Decomp by hot H<sub>2</sub>O. (Erlenmeyer, A. 194, 200.)

Al<sub>2</sub>O<sub>3</sub>, 3P<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O=Al<sub>2</sub>(H<sub>2</sub>PO<sub>4</sub>)<sub>3</sub>. Deliquescent, completely sol in a little cold H<sub>2</sub>O, and conc. solution can be boiled without decomp., but dil solution (1.20) separates Al<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub> on boiling, which redissolves on cooling, the more quickly the more dilute the original solution. (Erlenmeyer, A. 194, 198.)

Aluminum pyrophosphate, Al<sub>4</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>3</sub>+10H<sub>2</sub>O.

Precipitate. Sol in mineral acids, and Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+Ag, insol in acetic acid Sol. in KOH+Ag; sol. in NH<sub>4</sub>OH+Ag, but when dissolved in HCl+Ag is reprecipitated by NH<sub>4</sub>OH+Ag, and is not redissolved in an excess thereof. (Schwarzenberg, A. 65, 147.)

Sol. in alum+Ag (Rose, Pogg. 76, 19)

Aluminum pyrometaphosphate, Al<sub>2</sub>O<sub>3</sub>, 2P<sub>2</sub>O<sub>5</sub>.

(Hautefeuille and Margottet, C. R. 96, 849.)

Aluminum ammonium dihydrogen orthophosphate, NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub>, AlPO<sub>4</sub>.

Partially decomp. by H<sub>2</sub>O. Sol. in acids and alkalis. Nearly insol in 50% acetic acid. (Cohen, J. Am. Chem. Soc. 1907, 29, 720.)

Aluminum calcium phosphate, Al<sub>2</sub>O<sub>3</sub>, 3CaO, P<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O.

Min *Tamstackite*.

2Al<sub>2</sub>O<sub>3</sub>, 6CaO, 3P<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O Min *Kunzeite*.

Aluminum calcium phosphate sulphate, 3Al<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>+6H<sub>2</sub>O

Min *Svanbergite*. Scarcely attacked by HCl+Ag, and only sl. by H<sub>2</sub>SO<sub>4</sub>+Ag.

Aluminum ferrous magnesium phosphate, (Mg, Fe)<sub>2</sub>Al<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+4H<sub>2</sub>O.

Min. *Childrenite* Slowly sol. in HCl+Ag.

Min. *Eosphorite*. Sol. in HNO<sub>3</sub> or HCl+Ag.

(Mg, Fe)Al<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+H<sub>2</sub>O Min. *Lazulite*

Only sl attacked by acids, when not previously ignited

Aluminum lithium phosphate, Al<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub>, 4Li<sub>2</sub>PO<sub>4</sub>+30H<sub>2</sub>O

Precipitate. (Berzelius)

Insol in H<sub>2</sub>O; easily sol. in acids

Aluminum magnesium phosphate.

Min *Lazulite*.

See Phosphate, aluminum ferrous magnesium.

Aluminum potassium phosphate, Al<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, 2P<sub>2</sub>O<sub>5</sub>

Insol in acids. (Ouvrard, A. ch. (6) 16, 289.)

2Al<sub>2</sub>O<sub>3</sub>, 2K<sub>2</sub>O, 3P<sub>2</sub>O<sub>5</sub> (Ouvrard)

Aluminum silver metaphosphate, 2Al<sub>2</sub>O<sub>3</sub>, Ag<sub>2</sub>O, 4P<sub>2</sub>O<sub>5</sub>

(Hautefeuille and Margottet, C. R. 96, 849, 1142)

Aluminum sodium pyrophosphate,

Al<sub>2</sub>Na<sub>2</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>3</sub>.

Insol. in H<sub>2</sub>O and acids (Wallroth.)

Nearly insol. in acids (Ouvrard, A. ch. (6) 16, 338.)

2Al<sub>2</sub>O<sub>3</sub>, 3Na<sub>2</sub>O, 3P<sub>2</sub>O<sub>5</sub>. Sol. in HNO<sub>3</sub>+Ag. (Ouvrard)

Al<sub>2</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>3</sub>, 2Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+30H<sub>2</sub>O

Very difficultly sol. in H<sub>2</sub>O. (Pahl, Bull. Soc. (2) 22, 122)

Aluminum phosphate lithium fluoride,

2Al<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub>, 3LiF

Min. *Amblygonite*. Sl. attacked by HCl+Ag, more easily by H<sub>2</sub>SO<sub>4</sub>+Ag.

Ammonium metaphosphate, NH<sub>4</sub>PO<sub>3</sub>.

Insol. in H<sub>2</sub>O. (Flettman, Pogg. 78, 345.)

Ammonium dimetaphosphate, (NH<sub>4</sub>)<sub>2</sub>(PO<sub>3</sub>)<sub>2</sub>.

Sol. in 1.15 pts cold or hot H<sub>2</sub>O. (Flettman, Pogg. 78, 245.) More sol. in dil. alcohol than Na or K salt.

Sol in 0.9 pts  $H_2O$ ; easily sol. in acids especially by boiling with conc.  $H_2SO_4$  (Glatzel, Dissert. 1880.)

**Ammonium trimetaphosphate,  $(NH_4)_3P_3O_9$**

Very sol. in  $H_2O$ . (Lindholm, Acta Lund 1873. 15)

**Ammonium tetrametaphosphate,  $(NH_4)_4P_4O_{12}$**

Sol. in  $H_2O$ . (Warschauer, Z. anorg. 1903, 36. 177.)  
+4 $H_2O$ . Much more sol. in  $H_2O$  than the K or Na salt. 1 pt. is sol. in 8 pts.  $H_2O$ . (Glatzel, Dissert. 1880.)

**Ammonium pentametaphosphate,  $(NH_4)_5P_5O_{15}$**

Sol. in  $H_2O$ . (Tammann, J. pr. 1892, (2) 45. 455)

**Ammonium dekametaphosphate,  $(NH_4)_{10}P_{10}O_{30}$**

Very sl. sol. in  $H_2O$ ; 100 g.  $H_2O$  dissolved 1.20-1.54 g. in 2 months. Easily sol. in hot  $H_2O$  with decomp. (Tammann, J. pr. 1892, (2) 45. 448.)  
+12 $H_2O$  (Tammann, J. pr. 1892, (2) 45. 465.)

**Ammonium orthophosphate,  $(NH_4)_3PO_4 + 3H_2O$**

Difficultly sol. in  $H_2O$ .  
Less sol. in  $H_2O$  than  $(NH_4)_2HPO_4$ . (Berzelius.)  
Insol. in alkalies + Aq. (Berzelius.)  
Sl. sol. in  $H_2O$ . Decomp. in the air. (Schottländer, Z. anorg. 1894, 7. 344.)

Solubility in  $H_3PO_4 + Aq$  at 25°.

In 1000 g. of the solution, mols	
$NH_4$	$PO_4$
7.42	0.084
5.02	0.20
2.95	0.46
3.04	1.02
3.32	1.32
4.78	2.32

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 105.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)  
+5 $H_2O$  (Sestini, Gazz. ch. it. 9. 298.)

**Ammonium hydrogen orthophosphate,  $(NH_4)_2HPO_4$**

Easily sol. in  $H_2O$ . Effloresces to form  $NH_4H_2PO_4$ . (Schiff, A. 112. 88.)  
Sol. in 4 pts. cold, and less hot  $H_2O$ . Solution loses  $NH_3$  by boiling. Insol. in alcohol.

100 g.  $H_2O$  dissolve 131 g. at 15°; sp. gr. of sat. solution = 1.343. (Greenish and Smith, Pharm. J. 1901, 66. 774.)

Solubility in  $H_3PO_4 + Aq$  at 25°.

In 1000 g. of the solution, mols	
$NH_4$	$PO_4$
6.42	3.23
6.46	3.74
6.56	4.01
6.78	4.34
7.26	4.83
7.16	4.82

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 105.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Ammonium dihydrogen orthophosphate,  $NH_4H_2PO_4$**

Does not effloresce  
Less easily sol. in  $H_2O$  than  $(NH_4)_2HPO_4$ . (Mitscherlich, A. ch. 19. 385.)  
Sol. in 5 pts. cold, and less hot  $H_2O$

Solubility in  $H_3PO_4 + Aq$  at 25°.

In 1000 g. of the solution, mols	
$NH_4$	$PO_4$
6.72	4.54
5.62	3.88
4.62	3.36
2.72	2.59
2.50	2.54
2.58	4.29
2.76	6.21
3.06	7.70
3.10	7.86

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 106.)

Insol. in acetone (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329)

**Ammonium orthophosphate, acid.**

Decomp. into  $NH_4H_2PO_4$  at 77-78°. (Parravano and Miel, Gazz. ch. it. 1908, 38, II. 536.)

**Ammonium pyrophosphate,  $(NH_4)_2P_2O_7$**

Easily sol. in  $H_2O$ . Alcohol precipitates it from the aqueous solution. (Schwarzenberg, A. 65. 141.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Ammonium hydrogen pyrophosphate,  $(NH_4)H_2P_2O_7$**

Very sol. in  $H_2O$ . Insol. in alcohol. (Schwarzenberg, A. 65. 141.)

**Ammonium barium trimetaphosphate,**  
 $(\text{NH}_4)_2\text{BaP}_3\text{O}_9 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  (Lindbom)

**Ammonium cadmium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{CdO} \cdot \text{CdO} \cdot 2\text{P}_2\text{O}_5 + 3\text{H}_2\text{O} =$   
 $(\text{NH}_4)_2\text{Cd}(\text{P}_2\text{O}_5)_2$ .

Efflorescent (Fleitmann, Pogg. 78. 347.)

**Ammonium cadmium orthophosphate,**  
 $\text{NH}_4\text{CdPO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$

Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  and acids.  
 (Drewson, Gm K Handb. 6te Aufl. III 74)

**Ammonium calcium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Ca}(\text{P}_2\text{O}_5)_2 + 2\text{H}_2\text{O}$ .

Very sl sol in  $\text{H}_2\text{O}$  Not decomp. by acids. (Fleitmann, Pogg. 78. 344)

**Ammonium calcium phosphate,**  $\text{NH}_4\text{CaPO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

Ppt. (Hertzfeld and Feuerlein, Z. anal. 191.)

+  $7\text{H}_2\text{O}$  Not completely decomp by cold  $\text{H}_2\text{O}$  in  $\frac{3}{4}$  hour; rapidly by hot  $\text{H}_2\text{O}$ . (Lasne, Bull. Soc 1902, (3) 27. 131.)

**Ammonium chromium orthophosphate, basic,**  
 $5(\text{NH}_4)_2\text{H}_2\text{PO}_4 \cdot 2\text{CrPO}_4 \cdot 4\text{Cr}(\text{OH})_3$ .

(Cohen, J. Am. Chem. Soc 1907, 29. 1196.)  
 $(\text{NH}_4)_3\text{HPO}_4 \cdot 2\text{CrPO}_4 + 3\text{H}_2\text{O}$  Ppt. (Cohen.)

**Ammonium chromic pyrophosphate,**  
 $\text{NH}_4(\text{CrP}_2\text{O}_7) \cdot 6\text{H}_2\text{O}$

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 586.)

**Ammonium cobaltous metaphosphate.**

Extremely sol in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Persoz, J. pr. 3. 215)

**Ammonium cobaltous orthophosphate,**  
 $\text{NH}_4\text{CoPO}_4 + \text{H}_2\text{O}$ .

Not decomp. by boiling  $\text{H}_2\text{O}$ . (Debray, J. Pharm. (3) 46. 121)

+  $12\text{H}_2\text{O}$ . Ppt. (Chance, 1862.)  
 $\text{Co}(\text{NH}_4)_2\text{H}_2(\text{PO}_4)_2 + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Debray.)

**Ammonium copper dimetaphosphate,**  
 $(\text{NH}_4)_2\text{P}_2\text{O}_5 \cdot \text{CuP}_2\text{O}_5 + 2\text{H}_2\text{O}$

Very sl. sol. in  $\text{H}_2\text{O}$ , insol. in alcohol. (Fleitmann, Pogg. 78. 345.)

+  $4\text{H}_2\text{O}$ . Efflorescent. Very sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol (F.)

Sol. in 50 pts.  $\text{H}_2\text{O}$ . Slowly attacked by acids. Only boiling  $\text{H}_2\text{SO}_4$  attacks easily. (Glatzel, Dissert. 1880.)

**Ammonium glucinum orthophosphate,**  
 $\text{NH}_4\text{GlPO}_4$ .

Insol in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . (Rössler, Z. anal. 17. 148.)

**Ammonium glucinum sodium orthophosphate,**  
 $(\text{NH}_4)_2\text{GlNa}_2(\text{PO}_4)_2 + 7\text{H}_2\text{O}$ .

(Scheffer, A. 109. 146)

**Ammonium iron (ferrous) orthophosphate,**  
 $\text{NH}_4\text{FePO}_4 + \text{H}_2\text{O}$ .

Insol. even in boiling  $\text{H}_2\text{O}$ . When still moist, easily sol. in dil acids, but sparingly and slowly sol. after drying, even in conc. acids. Decomp by  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq}$ . Insol in alcohol. (Otto, J. pr. 2. 409.)

$(\text{NH}_4)_2\text{FeH}_2(\text{PO}_4)_2 + 4\text{H}_2\text{O}$ . (Debray.)

**Ammonium iron (ferric) hydrogen orthophosphate, basic,**  $2(\text{NH}_4)_2\text{HPO}_4 \cdot 3\text{Fe}(\text{OH})_3$ .

Ppt. Insol. in 95% alcohol. (Cohen, J. Am. Chem. Soc. 1907, 29. 719)

**Ammonium iron (ferric) hydrogen orthophosphate,**  $\text{NH}_4\text{H}_2\text{Fe}(\text{PO}_4)_2$ .

Ppt. Same properties as Na salt. (Weinland, Z. anorg 1913, 84. 356.)

Partially hydrolyzed by  $\text{H}_2\text{O}$ . Readily sol in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{H}_2\text{PO}_4$ . Partially hydrolyzed by cold  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol in excess of hot  $\text{NH}_4\text{OH} + \text{Aq}$ . Completely hydrolyzed by caustic alkalies. Practically insol. in 50% acetic acid (Cohen, J. Am. Chem. Soc 1907, 29. 718)

**Ammonium lead dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Pb}(\text{P}_2\text{O}_5)_2$

Very difficultly sol. in  $\text{H}_2\text{O}$  and acids. (Fleitmann, Pogg. 78. 343.)

**Ammonium lithium metaphosphate,**  $\text{Li}_2\text{O}$ ,  $2(\text{NH}_4)_2\text{O}$ ,  $3\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ .

Not appreciably sol in cold  $\text{H}_2\text{O}$  but rapidly and abundantly sol in  $\text{H}_2\text{O}$  at  $70^\circ$  (Tammann, J. pr. 1892, (2) 45. 442)

**Ammonium lithium phosphate,**  $(\text{NH}_4)_2\text{LiPO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Ammonium magnesium metaphosphate,**  
 $(\text{NH}_4)_2\text{O}$ ,  $2\text{MgO}$ ,  $2\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$  (?)

Sol. with difficulty in  $\text{H}_2\text{O}$  or acids when heated. Easily sol. in  $\text{H}_2\text{O}$  before heating. (Wach, Schw. J. 59. 29.)

Precipitated from aqueous solution by alcohol.

**Ammonium magnesium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Mg}(\text{P}_2\text{O}_5)_2 + 6\text{H}_2\text{O}$ .

Efflorescent. (Fleitmann, Pogg. 78. 346.)

**Ammonium magnesium phosphate,**  
 $\text{NH}_4\text{MgPO}_4$ , and  $+6\text{H}_2\text{O}$ .

1 l  $\text{H}_2\text{O}$  dissolves 66 mg. anhydrous  $\text{NH}_4\text{MgPO}_4$  at  $15^\circ$ . (Fresenius, A. 55. 109.)

1 l  $\text{H}_2\text{O}$  dissolves 74 l mg anhydrous  $\text{NH}_4\text{MgPO}_4$  at  $20.5-22.5^\circ$ . (Ebermayer.)

1 l.  $\text{H}_2\text{O}$  dissolves 106 mg anhydrous  $\text{NH}_4\text{MgPO}_4$ . (Liebig.)

Insol. in  $\text{H}_2\text{O}$ , but when boiled with  $\text{H}_2\text{O}$  it loses  $\text{NH}_3$  and  $\text{H}_2\text{O}$  (Struve, Z. anal. 1898, 37. 485.)

Solubility of  $\text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G salt in 100 g. $\text{H}_2\text{O}$
0	0.0231
20	0.0516
40	0.0359
50	0.0303
60	0.0401
70	0.0163
80	0.0195

(Wenger, Dissert. Geneva, 1911.)

Aqueous solution is precipitated by  $\text{NH}_4\text{OH}$ , but not by  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ . (Fresenius.)

Sol. in 44,600 pts.  $\text{H}_2\text{O}$  containing ammonia. More sol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$ , and is sol. in 7548 pts. of a solution containing 1 pt.  $\text{NH}_4\text{Cl}$  to 5 pts.  $\text{H}_2\text{O}$  and ammonia, and in 15,627 pts. of a solution containing 1 pt. of  $\text{NH}_4\text{Cl}$  to 7 pts.  $\text{H}_2\text{O}$  and ammonia (Fresenius.)

According to Kremers (J. pr. 55. 190), a solution of 3 pts.  $\text{H}_2\text{O}$  to 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.96 sp. gr. is best suited for washing the precipitated  $\text{NH}_4\text{MgPO}_4$ .

According to Ebermayer (J. pr. 60. 41), 1 pt. anhydrous salt is sol. in 13,497 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ , in 31,098 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (4 pts.  $\text{H}_2\text{O}$ : 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.961 sp. gr.) at  $21.25^\circ$ ; in 36,764 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (3 pts.  $\text{H}_2\text{O}$ : 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $20.6^\circ$ ; in 43,089 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt.  $\text{H}_2\text{O}$ : 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $22.5^\circ$ ; in 45,206 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt.  $\text{H}_2\text{O}$ : 2 pts.  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $22.5^\circ$ ; in 52,412 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt.  $\text{H}_2\text{O}$ : 3 pts.  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $22.5^\circ$ ; in 60,883 pts. pure  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. 0.961) at  $22.5^\circ$ .

Almost absolutely insol. in  $\text{H}_2\text{O}$  containing  $\frac{1}{2}$  vol.  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. 0.96) and  $\text{NH}_4\text{Cl}$ , i. e., much more insol. than given by Fresenius (Kubel, Z. anal. 8. 125.)

According to Kissel (Z. anal. 8. 173), 1 l.  $\text{NH}_4\text{OH} + \text{Aq}$  (3 pts.  $\text{H}_2\text{O}$ : 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.96 sp. gr.) dissolves 4.98 mg. in 24 hours, while 13.9 mg. are dissolved if 18 g.  $\text{NH}_4\text{Cl}$  to a litre of  $\text{H}_2\text{O}$  are also present.

$(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  containing 22 g. per litre dissolves 71.7 mg., 30 g., 113 mg.; 10 g., 147 mg.;  $\text{NaCl} + \text{Aq}$  containing 2 g.  $\text{NaCl}$  per l. dissolves 123.4 mg.;  $\text{NaNO}_3 + \text{Aq}$  containing 3 g.  $\text{NaNO}_3$  per l. dissolves 93.1 mg. (Liebig, A. 106. 196.)

Completely insol. in water containing ammonium phosphate or ammonium sodium phosphate. (Berzelius.)

800 ccm  $\text{H}_2\text{O}$ , sat. with  $\text{CO}_2$ , dissolve 1.425 g. (Liebig.)

Easily sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ , acetic and other

acids, also in boiling solution of ammonium citrate. (Milot, Bull. Soc. (2) 18. 20.)

When in presence of Fe or Al salts it is sol to a considerable extent in  $\text{H}_2\text{C}_2\text{H}_3\text{O}_6 + \text{Aq}$ . 6 g.  $\text{NH}_4\text{Cl}$  in 100 ccm  $\text{H}_2\text{O}$  containing 10 ccm. 6.34%  $\text{NH}_4\text{OH} + \text{Aq}$  dissolve pptd. salt = 0.0039 g.  $\text{Mg}_2\text{P}_2\text{O}_7$ . 1 g.  $(\text{NH}_4)_2\text{C}_2\text{O}_4$  in 100 ccm  $\text{H}_2\text{O}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$  dissolve = 0.0061 g.  $\text{Mg}_2\text{P}_2\text{O}_7$ . 2 g. citric acid in excess of  $\text{NH}_4\text{OH} + \text{Aq}$  dissolve = 0.0147 g.  $\text{Mg}_2\text{P}_2\text{O}_7$ . Solubility prevented by excess of magnesia mixture (Lando, C. N. 48. 217.)

Solubility of  $\text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$  in salts +  $\text{Aq}$  at  $t^\circ$ .

(G salt dissolved in 100 g. solvent.)

$t^\circ$	5% $\text{NH}_4\text{NO}_3 + \text{Aq}$	5% $\text{NH}_4\text{Cl} + \text{Aq}$	1 pt. $\text{NH}_4\text{OH}$ (D = 0.96) + 4 pts. $\text{H}_2\text{O}$
0	0.1100	0.0597	0.0087
20	0.0463	0.1055	0.0098
30	0.0546	0.1133	
40	0.0645	0.0713	0.0135
50	0.0723	0.0931	0.0153
60	0.0846	0.1728	0.0174
70	0.0834	0.1239	0.0178
80	0.1009	0.1913	0.0145

$t^\circ$	4% $\text{NH}_4\text{OH} + \text{Aq}$ and 5% $\text{NH}_4\text{Cl} + \text{Aq}$	4% $\text{NH}_4\text{OH} + \text{Aq}$ and 10% $\text{NH}_4\text{Cl} + \text{Aq}$
20	0.0165	0.0541
60	0.0274	0.0781

(Wenger, Dissert. Geneva, 1911.)

About 3 times as sol. in  $\text{Ca}(\text{C}_2\text{H}_3\text{O}_6)_2 + \text{Aq}$  as in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , but solubility is prevented by excess of  $\text{MgCl}_2$ . (Ville, Bull. Soc. (2) 18. 316.)

Sl. sol. in ammonium citrate +  $\text{Aq}$  containing 400 g. ammonium citrate in a litre. Solubility = 0.457% at ord. temp. and 0.53% at  $50^\circ$ . (Bohs, Ch. Z. 1903, 27. 1151.)

Mm Struvite  
+  $\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  or citric acid +  $\text{Aq}$ . (Milot and Maquenne, Bull. Soc. (2) 23. 238.)

Ammonium magnesium hydrogen orthophosphate,  $(\text{NH}_4)_2\text{MgH}_2(\text{PO}_4)_2 \cdot 3\text{H}_2\text{O}$  (?). (Graham.)

Ammonium magnesium phosphate,  $5\text{MgO}$ ,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{P}_2\text{O}_5 + 24\text{H}_2\text{O}$  (Gawalovsky, C. C. 1886. 721.)

Ammonium magnesium sodium pyrophosphate,  $(\text{NH}_4)_2\text{Mg}_2\text{Na}(\text{P}_2\text{O}_7)_4$ .

Insol. in  $\text{H}_2\text{O}$  and not decomp. thereby. (Berthelot and André, A. ch. 1897, (7) 11. 186.)

**Ammonium manganous dimetaphosphate**,  
 $(\text{NH}_4)_2\text{Mn}(\text{PO}_3)_4 + 4\text{H}_2\text{O}$ .  
 Relatively easily attacked by acids (Glatzel, Dissert. 1880.)  
 $+6\text{H}_2\text{O}$ .  
 Efflorescent (Fleitmann, Pogg. 78. 346.)

**Ammonium manganous orthophosphate**,  
 $\text{NH}_4\text{MnPO}_4 + \text{H}_2\text{O}$   
 Sol in 32,092 pts. cold, and 20,122 pts. boiling  $\text{H}_2\text{O}$ , and in 17,755 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (1.4%  $\text{NH}_4\text{Cl}$ ). (Fresenius.)  
 $+7\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$  below  $70^\circ$ ; at  $70^\circ$  100 g  $\text{H}_2\text{O}$  dissolve 0.0052 g salt; at  $80^\circ$ , 0.0067 (Wenger, Dissert Geneva, 1911.)  
 Easily sol. in dil acids. Decomp by  $\text{KOH} + \text{Aq}$ , but not by  $\text{NH}_4\text{OH} + \text{Aq}$  or  $\text{K}_2\text{CO}_3 + \text{Aq}$ . Insol in  $\text{NH}_4\text{OH}$  or  $\text{NH}_4$  salts  $+ \text{Aq}$ . (Gibbs)

Solubility in salts  $+ \text{Aq}$  at  $t^\circ$ .  
 (G. in 100 g. solvent.)

$t^\circ$	5% $\text{NH}_4\text{NO}_3$ $+ \text{Aq}$ .	5% $\text{NH}_4\text{Cl} + \text{Aq}$	1 pt. $\text{NH}_4\text{OH}$ D = 0.96 $+ 4$ pts $\text{H}_2\text{O}$
0	0.0206	0.0020	0.0116
20	0.0200	0.0255	0.0122
30	0.0226	0.0345	.
40	0.0209	0.0386	0.0118
50	0.0226	0.0355	0.0132
60	0.0270	0.0384	0.0193
70	0.0281	0.0414	0.0191
80	0.0326	0.0451	0.0197

(Wenger, l. c.)

Insol in alcohol  
 Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Ammonium manganic pyrophosphate**,  
 $\text{NH}_4\text{Mn}_2\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$ .  
 Decomp by cold  $\text{H}_2\text{O}$  with separation of  $\text{Mn}_2\text{O}_3$  (Rosenheim, B. 1915, 48. 584.)

**Ammonium manganous sodium pyrophosphate**,  $\text{NH}_4\text{NaMn}_2\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$   
 Insol. in  $\text{H}_2\text{O}$  or alcohol. Easily sol in very dil acids. (Otto, J. pr. 2. 418.)  
 Formula is  $\text{Na}_4(\text{NH}_4)_2\text{Mn}_2(\text{P}_2\text{O}_7)_2 + 12\text{H}_2\text{O}$ , according to Berzelius.

**Ammonium mercuric metaphosphate**.  
 Sol. in  $\text{H}_2\text{O}$ , or at least in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Persoz, J. pr. 3. 215)

**Ammonium nickel metaphosphate**.  
 Insol in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , from which it is reprecip. on evaporation of the  $\text{NH}_3$  (Persoz, J. pr. 3. 215)

**Ammonium nickel dimetaphosphate**,  
 $(\text{NH}_4)_2\text{NiP}_2\text{O}_{12} + 4\text{H}_2\text{O}$ .  
 Sol. in 12.5 pts.  $\text{H}_2\text{O}$ . (Glatzel, Dissert. 1880.)

**Ammonium nickel orthophosphate**,  
 $\text{NH}_4\text{NiPO}_4 + 2\text{H}_2\text{O}$ .  
 Ppt (Debray, C. R. 59. 40)  
 $+ 6\text{H}_2\text{O}$  Decomp. by boiling  $\text{H}_2\text{O}$ . (Debray)

**Ammonium potassium dimetaphosphate**,  
 $(\text{NH}_4)_2\text{K}_2(\text{P}_2\text{O}_6)$ .  
 More sol in  $\text{H}_2\text{O}$  than following salt. (Fleitmann, Pogg. 78. 341.)  
 $\text{NH}_4\text{K}_2\text{P}_2\text{O}_7 + 2\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ . (Fleitmann.)

**Ammonium potassium pyrophosphate**,  
 $\text{NH}_4\text{K}_2\text{HP}_2\text{O}_7 + \frac{1}{2}\text{H}_2\text{O}$ .  
 Deliquescent. Sol. in  $\text{H}_2\text{O}$ . Decomp. on boiling. (Schwarzenberg.)

**Ammonium sodium dimetaphosphate**,  
 $\text{NH}_4\text{NaP}_2\text{O}_6 + \text{H}_2\text{O}$ .  
 More sol. in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{P}_2\text{O}_6$ , but less than  $(\text{NH}_4)_2\text{P}_2\text{O}_6$ . Less sol in alcohol than in  $\text{H}_2\text{O}$ . (Fleitmann, Pogg. 78. 340.)

**Ammonium sodium orthophosphate**,  
 $(\text{NH}_4)_2\text{NaPO}_4 + 4\text{H}_2\text{O}$ .  
 Decomp by  $\text{H}_2\text{O}$ . Cryst from  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.96 sp. gr. From  $\text{H}_2\text{O}$  solution,  $\text{NaNH}_4\text{HPO}_4 + 4\text{H}_2\text{O}$  separates out (Uelsmann, Arch. Pharm. (2) 99. 138.)  
 Insol. in acetone. (Naumann, B. 1904, 37. 4329.)  
 $+ 5\text{H}_2\text{O}$   
 $\text{NH}_4\text{Na}_2\text{PO}_4 + 12\text{H}_2\text{O}$ . (Hersfeld, Z. anal. 20. 191.)  
 $(\text{NH}_4)_2\text{Na}_2(\text{PO}_3)_2 + 6\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$  with decomp. Cryst from hot conc  $\text{NH}_4\text{OH} + \text{Aq}$ . (Uelsmann, Arch. Pharm. (2) 99. 138.)

**Ammonium sodium hydrogen phosphate** (Microcosmic salt),  $\text{NH}_4\text{NaHPO}_4 + 4\text{H}_2\text{O}$ .  
 Efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . Sol in 6 pts cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . Insol in alcohol.

Aqueous solution gives off  $\text{NH}_3$ , especially if hot.  
 Insol in acetone. (Eidmann, C. C. 1899, II. 1014.)

*Mm. Sten carlie.*  
 $+ 5\text{H}_2\text{O}$ . (Uelsmann.)  
 The composition of the hydrates formed by this salt at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by the salt and of the conductivity and sp. gr. of its aqueous solutions. (Jones, Am. Ch. J. 1905, 34. 319.)  
 $(\text{NH}_4)_2\text{Na}_2\text{H}_2(\text{PO}_3)_4 + 3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Filhol and Senderens, C. R. 93. 388.)

**Ammonium sodium pyrophosphate**,  
 $(\text{NH}_4)_2\text{Na}_2\text{P}_2\text{O}_7 + 5\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$ . Aqueous solution decomp by boiling. (Schwarzenberg, A. 65. 142.)  
 $+ 6\text{H}_2\text{O}$ . (Rammelsberg.)

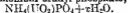
**Ammonium sodium glucinum orthophosphate,**  
 $(\text{NH}_4)_2\text{Na}_2\text{Gl}(\text{PO}_4)_2 \cdot 7\text{H}_2\text{O}$

Precipitate. (Scheffer.)

**Ammonium thalious orthophosphate,**  
 $(\text{NH}_4)_3\text{PO}_4$ ,  $(\text{NH}_4)_2\text{TiPO}_4$ , or  $\text{H}_2\text{NHL}_2\text{PO}_4$ ,  
 $\text{HTl}_2\text{PO}_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Lamy; Rammelsberg.)

**Ammonium uranyl phosphate,**



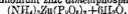
Insol. in  $\text{H}_2\text{O}$  and  $\text{HCl}$ ;  $\text{H}_2\text{O}_2$  + Aq. Sol. in mineral acids, from which it is precipitated by  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  + Aq, in which it is insol (Knop.)

+  $3\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  and acetic acid Sol. in all mineral acids, oxalic acid and  $\text{M}_2\text{CO}_3$  + Aq. (Liebau, Dissert. 1898.)

**Ammonium vanadium phosphate.**

See Phosphovanadate, ammonium.

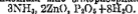
**Ammonium zinc dimetaphosphate,**



Efflorescent. (Flattmann, Pogg. 78. 347.)

+  $4\text{H}_2\text{O}$  Sol. in 70 pts.  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{SO}_4$ . (Glatzel, Dissert. 1880.)

**Ammonium zinc orthophosphate, basic,**



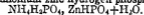
(Rother, A. 1887, 143. 356.)

$4(\text{NH}_4)_2\text{O}, 6\text{ZnO}, 3\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$ . (Schweikert, A. 1868, 145. 57.)

**Ammonium zinc orthophosphate,  $\text{NH}_4\text{ZnPO}_4$  +  $\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids, and caustic alkalis. (Bette, A. 15. 129.)

**Ammonium zinc hydrogen phosphate,**



Insol. in  $\text{H}_2\text{O}$ . (Debray.)

$4(\text{NH}_4)_2\text{O}, 6\text{ZnO}, 3\text{P}_2\text{O}_5$ . (Schweikert, A. 146. 57.)

$3(\text{NH}_4)_2\text{O}, 4\text{ZnO}, 2\text{P}_2\text{O}_5 + 13\text{H}_2\text{O}$  (Rother, A. 143. 356.)

**Ammonium phosphate selenate.**

See Selenophosphate, ammonium.

**Barium triphosphate,  $5\text{BaO}, 3\text{P}_2\text{O}_5$ .**

Insol. in  $\text{H}_2\text{O}$ ; insol. in acids after heating to a high temp. (Schwarz, Z. anorg. 1895, 9. 264.)

**Barium metaphosphate,  $\text{Ba}(\text{PO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$  or dil. acids. (Maddrell, A. 61. 61.)

Not decomp. by boiling with acids or alkali carbonates + Aq. (Fleitmann, Pogg. 78. 352.)

**Barium dimetaphosphate,  $\text{BaP}_2\text{O}_7 + 2\text{H}_2\text{O}$ .**

More difficultly sol. in  $\text{H}_2\text{O}$  than  $\text{Ba}_3(\text{P}_2\text{O}_7)_2$ . Slightly attacked by boiling conc.  $\text{HCl}$  + Aq or  $\text{HNO}_3$  + Aq. Easily decomp. by  $\text{H}_2\text{SO}_4$  (Fleitmann, Pogg. 78. 254.)

**Barium trimetaphosphate,  $\text{Ba}_3(\text{P}_3\text{O}_{10})_2 + 2\text{H}_2\text{O}$ .**

Somewhat sol. in  $\text{H}_2\text{O}$ . (Fleitmann, A. 55. 313.)

+  $6\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$  + Aq. (Lindbom.)

1 l.  $\text{H}_2\text{O}$  dissolves 2.589 g. at ord. temp. (Wiedler, Z. anorg. 1901, 28. 198.)

**Barium hexametaphosphate,  $\text{Ba}_3\text{P}_6\text{O}_{18}$  (?)**

Sol. in  $\text{H}_2\text{O}$  only after boiling several hours.

Nearly insol. in  $\text{H}_2\text{O}$  (Ludert, Z. anorg. 5. 15.)

Insol. in  $\text{NH}_4\text{Cl}$  + Aq. (Wackenroder.)

Sol. in  $\text{Na}_2\text{P}_2\text{O}_7$  + Aq. Sol. in  $\text{HNO}_3$  + Aq. After ignition it is nearly insol. in  $\text{HNO}_3$  + Aq.

**Barium orthophosphate,  $\text{Ba}_3(\text{PO}_4)_2$ .**

Precipitate. Very sl. sol. or insol. in  $\text{H}_2\text{O}$ . (Graham, Pogg. 32. 49.)

Sol. in  $\text{HCl}$  + Aq. Decomp. by  $\text{SO}_2$  + Aq.

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Barium hydrogen phosphate,  $\text{BaHPO}_4$ .**

Sol. in 10,000 pts.  $\text{H}_2\text{O}$ . (Malaguti, A. ch. (3) 51. 346.)

Sol. in 20,570 pts.  $\text{H}_2\text{O}$  at  $20^\circ$  (Bischof, 1833.)

Not completely soluble in water containing  $\text{CO}_2$ , but  $\text{BaCl}_2$  causes no ppt. in  $\text{Na}_2\text{HPO}_4$  + Aq containing 7.16 g. or less  $\text{Na}_2\text{HPO}_4$  in a litre after it has been saturated with  $\text{CO}_2$ . (Setschenow, C. C. 1875. 97.)

Easily sol. in  $\text{H}_3\text{PO}_4$  + Aq, and dil.  $\text{HCl}$  + Aq.  $\text{HNO}_3$  + Aq of 1.275 sp. gr. if not diluted has scarcely any solvent action, but more dissolves on dilution until a maximum is reached, when 10 vols. of  $\text{H}_2\text{O}$  have been added. (Bischof, Schw. J. 67. 39.)

Sol. in 367–403 pts. acetic acid (1.032 sp. gr.) at  $22.5^\circ$ . (Bischof, l. c.)

Easily sol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4$  succinate, from which solutions it is completely pptd. by  $\text{NH}_4\text{OH}$  + Aq. (Rose.)

Insol. in  $\text{Na}_2\text{HPO}_4$  or  $\text{BaCl}_2$  + Aq. (Rose, Pogg. 76. 23.)

More sol. in  $\text{BaCl}_2$  or  $\text{NaCl}$  + Aq than in  $\text{H}_2\text{O}$ , 1 pt.  $\text{BaHPO}_4$  being sol. in 4362 pts.  $\text{H}_2\text{O}$  containing 1.2%  $\text{NaCl}$  and 0.8%  $\text{BaCl}_2$ . (Ludwig, Arch. Pharm. (2) 56. 265.)

Sol. in Na citrate + Aq (Spiller.)

**Barium tetrahydrogen phosphate,**



Sol. in  $\text{H}_2\text{O}$ . (Mitscherlich, 1821.)

Decomp. by much  $\text{H}_2\text{O}$  into  $\text{BaHPO}_4$ .

Sol. in phosphoric, and certain other acids. (Berzelius, A. ch. 2. 153.)

**Barium pyrophosphate,  $\text{Ba}_2\text{P}_2\text{O}_7 + x\text{H}_2\text{O}$ .**

Somewhat sol. in  $\text{H}_2\text{O}$ , in much  $\text{H}_3\text{P}_2\text{O}_7$  + Aq, also in  $\text{HCl}$  + Aq or  $\text{HNO}_3$  + Aq. Insol. in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq or  $\text{Na}_2\text{P}_2\text{O}_7$  + Aq. (Schwarzenberg.)

Insol. in  $\text{NH}_4\text{Cl}$  + Aq. (Wackenroder.)

**Barium hydrogen pyrophosphate**,  $\text{BaH}_2\text{P}_2\text{O}_7$ ,  
 $\text{Ba}_2\text{P}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$ .

Ppt. (Knorre and Oppelt, B. 21. 773.)

**Barium tetraphosphate**,  $\text{Ba}_3\text{P}_4\text{O}_{13}$

Insol. in  $\text{H}_2\text{O}$  or acids when strongly heated.  
(Fleitmann and Henneberg, A. 65. 331)

**Barium manganic pyrophosphate**,  
 $\text{Ba}(\text{MnP}_2\text{O}_7)_2 \cdot 5\text{H}_2\text{O}$

Almost insol. in  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 585.)

**Barium potassium trimetaphosphate**,  
 $\text{BaKP}_3\text{O}_9 \cdot \text{H}_2\text{O}$ .

Much less sol. in  $\text{H}_2\text{O}$  than  $\text{NH}_4\text{BaP}_3\text{O}_9$  or  
 $\text{Na}_2\text{BaP}_3\text{O}_9$ . (Lindbom)

Sol. in  $\text{HCl} + \text{Aq}$  after ignition

**Barium potassium orthophosphate**,  $\text{BaKPO}_4$ .

Insol. in  $\text{H}_2\text{O}$  (Ouvryard, A. ch. (6) 16. 297)

+  $10\text{H}_2\text{O}$  (de Schulten, C. R. 96. 706.)

**Barium sodium dimetaphosphate**,

$\text{BaNa}_2(\text{P}_2\text{O}_5)_2 \cdot 4\text{H}_2\text{O}$

(Glatzel, Dissert. 1880.)

**Barium sodium trimetaphosphate**,  $\text{BaNaP}_3\text{O}_9$ ,  
+  $4\text{H}_2\text{O}$

More easily sol. in  $\text{H}_2\text{O}$  than  $\text{Ba}_2(\text{P}_2\text{O}_5)_2$ .  
Sol. in acids, unless ignited (Fleitmann and  
Henneberg, A. 65. 314)

Efflorescent. Sol. in  $\text{HCl} + \text{Aq}$  after igni-  
tion only by long boiling. When fused it is  
easily sol. in  $\text{HCl} + \text{Aq}$ . (Lundbom, Acta  
Lund 1873. 21.)

**Barium sodium orthophosphate**,  $\text{BaNaPO}_4$  +  
 $10\text{H}_2\text{O}$ .

(de Schulten, C. R. 96. 706)

Not attacked by cold, but decomp. by hot  
 $\text{H}_2\text{O}$  (Vilhers, C. R. 104. 1103.)

Sl. sol. in  $\text{H}_2\text{O}$ . (Quartaroli, C. A. 1911.  
2375.)

**Barium sodium pyrophosphate**,

$\text{Ba}_2\text{Na}_4(\text{P}_2\text{O}_7)_2$ .

Sol. in hot  $\text{HCl}$  and  $\text{HNO}_3$  (Tamman,  
J. pr. 1892, (2) 45. 469)

$8\text{Ba}_2\text{P}_2\text{O}_7$ ,  $\text{Na}_4\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$ . Completely  
insol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ , but not insol. in  $\text{H}_2\text{O}$   
or  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in  $\text{HNO}_3$  or  $\text{HCl}$   
+  $\text{Aq}$ . Insol. in alcohol (Baer, Pogg. 76.  
164.)

**Barium uranous metaphosphate**,  $\text{UO}_2$ ,  $\text{BaO}$ ,  
 $\text{P}_2\text{O}_5$ .

(Colani, A. ch. 1907, (8) 12. 142)

**Barium uranyl orthophosphate**,  
 $\text{Ba}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$

Mm *Uranocircite*.

**Barium phosphate chloride**,  $3\text{Ba}_2(\text{PO}_4)_2$ ,  
 $\text{BaCl}_2$ .

Mm *Barylapatite* (Deville and Caron, A.  
ch. (3) 67. 451.)

$4\text{BaH}_2(\text{PO}_4)_2$ ,  $\text{BaCl}_2$  (Erlenmeyer, J. B.  
1857. 145)

$15\text{BaO}$ ,  $6\text{P}_2\text{O}_5$ ,  $\text{BaCl}_2 + 6\text{H}_2\text{O}$  (?). Sol. in  
18,000 pts. cold  $\text{H}_2\text{O}$ . Much more sol. in  $\text{H}_2\text{O}$   
containing  $\text{BaCl}_2$ ,  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{OH}$ .  
(Ludwig, Arch. Pharm. (2) 56. 271)

**Bismuth orthophosphate**, basic,  $2\text{BiPO}_4$ ,  
 $3\text{Bi}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . (Cavazzi,  
Gazz. ch. it. 14. 289)

**Bismuth orthophosphate**,  $\text{BiPO}_4$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . Sl. sol. in  
 $\text{NH}_4$  salts +  $\text{Aq}$  (Chance, C. R. 50. 418)

Not decomp. by  $\text{H}_2\text{O}$ . Other phosphates  
of Bi are decomp. by  $\text{H}_2\text{O}$ . (Montmartin,  
C. C. 1900, II. 1256)

Not hydrolyzed by hot  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{BiCl}_3$   
+  $\text{Aq}$ , decomp. by boiling alkali. (Caven,  
J. Soc. Chem. Ind. 1897, 16. 30)

More sol. in  $\text{HCl} + \text{Aq}$  than in  $\text{HNO}_3 + \text{Aq}$ .  
(Rose)

Sol. in  $\text{UO}_2(\text{NO}_3)_2 + \text{Aq}$ . (M'Curdy, Am. J.  
Sci. (2) 31. 282.)

Insol. in  $\text{MNO}_3 + \text{Aq}$ .

Insol. in Bi salts +  $\text{Aq}$ . (Rose, Pogg. 76.  
26)

Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ , but insol. in  $\text{NH}_4\text{NO}_3 +$   
 $\text{Aq}$ . (Brett, 1837.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . (Kühn.)

+  $3\text{H}_2\text{O}$ . Ppt. Decomp. by  $\text{H}_2\text{S}$  or  $\text{KOH}$   
+  $\text{Aq}$ . (Vanino, J. pr. 1906, (2) 74. 151.)

**Bismuth pyrophosphate**, basic,  $2\text{Bi}_2\text{O}_3$ ,  $\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$  and  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ ; sol. in  
hot  $\text{HCl}$  and  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{Na}_2\text{P}_2\text{O}_7$   
+  $\text{Aq}$ , and  $\text{NH}_4$  citrate +  $\text{Aq}$ . (Passerini,  
Chim. 9. 84)

**Bismuth pyrophosphate**,  $\text{Bi}_2(\text{P}_2\text{O}_7)_2$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$  (Chance,  
C. R. 50. 416)

Decomp. by  $\text{H}_2\text{O}$  (Wallroth, Bull. Soc. (2)  
39. 316.)

Sol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$  (Stromeyer)

**Bismuth sodium pyrophosphate**,  $\text{NaBiP}_2\text{O}_7$ ,  
+  $3\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$  (Rosenheim, B. 1915, 48.  
588.)

**Boron phosphate**,  $\text{BPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Not attacked by boiling  
alkalies. (Meyer, B. 22. 2919.)

**Bromomolybdenum phosphate.**

See under Bromomolybdenum comps.

**Cadmium triphosphate,  $\text{Cd}_3(\text{P}_3\text{O}_{10})_2$ .**

Insol. in  $\text{H}_2\text{O}$  and acids (Güthmann, Dissert. 1899.)

**Cadmium tetraphosphate,  $6\text{CdO}, 4\text{P}_2\text{O}_5 + 18\text{H}_2\text{O}$** 

Insol. in acids. (Güthmann)

**Cadmium metaphosphate.**

Very sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Persoz, A. ch. 56. 334)

**Cadmium dimetaphosphate,  $\text{Cd}_2(\text{PO}_3)_2 + 2\text{H}_2\text{O}$** 

Sol. in 32 pts.  $\text{H}_2\text{O}$ . Scarcely attacked by acids, especially conc.  $\text{H}_2\text{SO}_4$ . (Glatzel, Dissert. 1880.)

**Cadmium tetrametaphosphate.**

Insol. in  $\text{H}_2\text{O}$ . Easily decomp. by  $\text{Na}_2\text{S} + \text{Aq}$ . (Fleischmann, Pogg. 78. 358.)

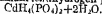
$\text{Cd}_2(\text{PO}_3)_4 + 10\text{H}_2\text{O}$ . Not so very difficultly attacked by acids but insol. after ignition. (Glatzel, Dissert. 1880.)

**Cadmium orthophosphate,  $\text{Cd}_3(\text{PO}_4)_2$ .**

Ppt. Insol. in  $\text{H}_2\text{O}$ . Sol. in Cd salts + Aq (Stromeyer)

Easily sol. in  $\text{NH}_4$  sulphate, chloride, nitrate, or succinate + Aq (Wittstein, Repert 57. 32)

$\text{H}_2\text{Cd}_3(\text{PO}_4)_4 + 4\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_3\text{PO}_4 + \text{Aq}$ . (de Schulten, Bull. Soc. (3) 1. 473.)

**Cadmium tetrahydrogen phosphate,**

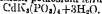
Decomp. by great excess of  $\text{H}_2\text{O}$ . (de Schulten)

**Cadmium pyrophosphate,  $\text{Cd}_2\text{P}_2\text{O}_7 + 2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$ ,  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ , or acids. Insol. in  $\text{KOH} + \text{Aq}$ . Sol. in  $\text{SO}_2 + \text{Aq}$ . (Schwarzenberg, A. 65. 183.)

**Cadmium hydrogen orthophosphate hydrate,  $\text{CdHPO}_4 \cdot 2\text{N}_2\text{H}_4$** 

Decomp. by light (Franzen, Z. anorg. 1908, 60. 283.)

**Cadmium potassium tetrametaphosphate,**

Sol. in 135 pts.  $\text{H}_2\text{O}$ . Difficultly decomp. by acids (Glatzel, Dissert. 1880.)

**Cadmium potassium orthophosphate,**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HCl} + \text{Aq}$ . (Ouvrard, A. ch. (6) 16. 321.)

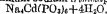
**Cadmium potassium pyrophosphate,**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HCl} + \text{Aq}$ . (Ouvrard)

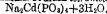
$5\text{Cd}_2\text{P}_2\text{O}_7, 4\text{K}_2\text{P}_2\text{O}_7 + 30\text{H}_2\text{O}$ . Much more easily sol. in  $\text{H}_2\text{O}$  than the  $\text{CdNa}$  salt (Pahl, Sv. V. A. F. 30, 7. 39.)

**Cadmium sodium triphosphate,  $\text{Na}_3\text{CdP}_3\text{O}_{10} + 12\text{H}_2\text{O}$ .**

Sol. in acids even after ignition. (Güthmann, Dissert. 1899.)

**Cadmium sodium trimetaphosphate,**

Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Wiesler, Z. anorg. 1901, 28. 204)

**Cadmium sodium tetrametaphosphate,**

Completely insol. in  $\text{H}_2\text{O}$ . (Glatzel, Dissert. 1880.)

**Cadmium sodium orthophosphate,**

Insol. in  $\text{H}_2\text{O}$ , very sol. in dil. acids.  $\text{CdNaPO}_4$ . As above (Ouvrard.)

**Cadmium sodium pyrophosphate,**

Sol. in dil. acids, even acetic acid. (Wallroth.)

$+4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Pahl, Sv. V. A. F. 30, 7. 39)

**Cadmium phosphate bromide,  $3\text{Cd}_3(\text{PO}_4)_2, \text{CdBr}_2$ .**

Sol. in cold very dil.  $\text{HNO}_3 + \text{Aq}$  (de Schulten, Bull. Soc. (3) 1. 472.)

**Cadmium phosphate chloride,  $3\text{Cd}_3(\text{PO}_4)_2, \text{CdCl}_2$ .**

Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (de Schulten.)

**Cesium metaphosphate,  $\text{Cs}_3\text{PO}_3$ .**

Sol. in  $\text{H}_2\text{O}$  (von Berg, B. 1901, 34. 4185)

**Cesium orthophosphate,  $\text{Cs}_3\text{PO}_4 + 5\text{H}_2\text{O}$ .**

Deliquescent, very sol. in  $\text{H}_2\text{O}$ . (von Berg.)

**Cesium hydrogen orthophosphate,  $\text{Cs}_2\text{HPO}_4 + \text{H}_2\text{O}$** 

Very sol. in  $\text{H}_2\text{O}$ . (von Berg.)

**Cesium dihydrogen orthophosphate,**

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (von Berg.)

**Cesium pyrophosphate,  $\text{Cs}_2\text{P}_2\text{O}_7$ .**

Very sol. in  $\text{H}_2\text{O}$ ; very hygroscopic (von Berg.)

Calcium triphosphate,  $5\text{CaO}, 3\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$  (Schwarz, Z. anorg. 1896, 9. 264.)

Calcium monometaphosphate,  $\text{Ca}_3(\text{PO}_3)_2$ .

Insol. in  $\text{H}_2\text{O}$  and dil acids. (Maddrell, A. 61. 61.)

Not decomp by digestion with alkali carbonates + Aq (Fleitmann)

Calcium dimetaphosphate,  $\text{Ca}_2(\text{P}_2\text{O}_5)_2 + 4\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$ . Decomp. by warm  $\text{H}_2\text{SO}_4$ , but not appreciably by conc.  $\text{HCl}$  or  $\text{HNO}_3$  + Aq (Fleitmann, Pogg. 78. 255)

Calcium hexametaphosphate (?)

Insol. in  $\text{H}_2\text{O}$ . Sol in  $\text{Na}_2\text{P}_2\text{O}_5$  + Aq and in  $\text{HCl}$  + Aq. (Rose, Pogg. 76. 3)

$\text{Ca}_6\text{P}_6\text{O}_{18}$ . Nearly insol in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Lüder, Z. anorg. 6. 15.)

Calcium orthophosphate, basic,  $3\text{Ca}_3(\text{PO}_4)_2 + \text{Ca}_2\text{O}_2\text{H}_2$

(Warington, J. B. 1873. 253)

$4\text{CaO}, \text{P}_2\text{O}_5$  (Hilgenstock)

Calcium orthophosphates,

Equilibrium in system  $\text{CaO} + \text{P}_2\text{O}_5 + \text{H}_2\text{O}$

Solubility of  $\text{CaO}$  in  $\text{P}_2\text{O}_5$  + Aq at  $25^\circ$

g. CaO per l. of solution	g. $\text{P}_2\text{O}_5$ per l. of solution	Solid phase
1.71	4.69	} $\text{CaHPO}_4, 2\text{H}_2\text{O}$
7.45	22.39	
8.10	23.87	
11.57	36.14	
12.88	41.24	
18.77	59.35	
19.25	63.03	
23.31	75.95	
23.69	79.10	
32.41	109.8	
35.90	129.8	
39.81	139.6	
40.89	142.7	
43.82	154.6	
49.76	191.0	
55.52	216.5	
59.40	234.6	
70.31	279.7	
72.30	351.9	} $\text{Ca}_2\text{H}_4(\text{PO}_4)_2, \text{H}_2\text{O}$
69.33	361.1	
65.46	380.3	
63.53	395.1	
59.98	419.7	
59.25	424.6	
57.74	428.0	
53.59	451.7	
48.78	475.3	
44.52	505.8	
41.86	528.9	
39.89	538.3	

(Cameron and Seidell, J. Am. Chem. Soc. 1905, 27. 1508)

Solubility of  $\text{CaO}$  in  $\text{P}_2\text{O}_5$  + Aq at  $25^\circ$

g. CaO per l. of solution	g. $\text{P}_2\text{O}_5$ per l. of solution	Solid phase
7.61	19.96	} $\text{CaHPO}_4$
6.51	16.52	
5.01	12.82	
3.42	8.16	
2.42	5.75	
1.58	3.66	} Solid phases are evidently solid solutions
0.544	1.516	
0.400	1.108	
0.291	0.773	
0.232	0.662	
0.145	0.381	} $\text{Ca}_2(\text{PO}_4)_2$
0.062	0.109	
0.049	0.088	
0.034	0.015	
0.587	0.013	
0.789	0.012	} Solid phase is probably a solid solution

(Cameron and Seidell, J. Am. Chem. Soc. 1905, 27. 1513.)

Solubility of  $\text{CaO}$  in  $\text{P}_2\text{O}_5$  + Aq at  $50.7^\circ$ .

100 g. of the solution contain		Solid phase
g. $\text{P}_2\text{O}_5$	g. CaO	
62.01	0.336	$\text{CaH}_4\text{P}_2\text{O}_6 + \text{CaH}_4\text{P}_2\text{O}_6, \text{H}_2\text{O}$
58.08	0.635	$\text{CaH}_4\text{P}_2\text{O}_6, \text{H}_2\text{O}$
54.67	0.939	"
50.25	1.428	"
46.15	2.100	"
41.92	2.974	"
37.33	3.898	"
33.18	4.880	"
29.61	5.725	$\text{CaH}_4\text{P}_2\text{O}_6, \text{H}_2\text{O} + \text{CaHPO}_4$
15.48	3.507	$\text{CaHPO}_4$
9.465	2.328	"
6.157	1.583	"
2.946	0.852	"
2.281	0.692	"
0.1521	0.0588	"
0.1527	0.0596	$\text{CaHPO}_4, 2\text{H}_2\text{O}$
0.1331	0.0514	$\text{Ca}_2\text{P}_2\text{O}_6, \text{H}_2\text{O}$
0.0942	0.0351	"
0.0309	0.0106	"
0.00068	0.00071	"

(Bassett, Z. anorg. 1908, 69. 15.)

Solubility of CaO in  $P_2O_5 + Aq$  at 40°

100 g. of the solution contain		Solid phase
g. $P_2O_5$	g. CaO	
45.42	1.768	$CaH_4P_2O_8, H_2O$
41.33	2.588	
36.79	3.581	
32.46	4.505	
28.27	5.501	
21.67	4.813	$CaHPO_4$
17.78	4.100	
16.35	3.810	
9.905	2.536	
6.979	1.847	
4.397	1.267	$Ca_3P_2O_8, H_2O$
1.819	0.576	
0.423	0.156	
0.294	0.110	
0.158	0.0502	
0.146	0.0519	$Ca_4P_2O_7, 4H_2O$
0.128	0.0508	
0.0202	0.0098	
trace	0.0709	
"	0.0814	
"	0.0829	"
"	0.0840	

(Bassett, Z. anorg. 1908, 59. 18.)

Solubility of CaO in  $P_2O_5 + Aq$  at 25°.

100 g. of the solution contain		Solid phase
g. $P_2O_5$	g. CaO	
36.11	3.088	$CaH_4P_2O_8, H_2O$
31.97	4.128	
28.34	4.908	
27.99	4.930	
25.45	5.489	
22.90	5.523	$CaHPO_4$
17.55	4.499	
15.34	4.027	
9.10	2.638	
6.049	1.878	
3.613	1.181	$CaHPO_4 + CaHPO_4, 2H_2O$
2.387	0.826	
0.417	0.165	
0.178	0.0696	
0.0332	0.0126	
0.0048	0.0352	Probably $Ca_3P_2O_8, H_2O$
0.0571	0.0211	
0.0525	0.0175	
0.0468	0.0180	
trace	0.1131	
	0.118	$Ca_4P_2O_7, 4H_2O + Ca(OH)_2$

(Bassett, Z. anorg. 1908, 59. 20.)

Calcium orthophosphate,  $Ca_3(PO_4)_2$ .

Decomp. by long boiling with  $H_2O$  into basic salt,  $3Ca_3(PO_4)_2 \cdot CaO \cdot H_2O$ . This decomp. begins with cold  $H_2O$ , so that the solubility at 6-8° varies from 0.9 to 28.6 mg. in a litre. (Warington, Chem. Soc. (2) 11. 983.)

1 l. cold  $H_2O$  dissolves in 7 days 31 mg. ignited, and 79 mg. freshly precipitated  $Ca_3(PO_4)_2$ . (Volcker, J. B. 1862. 131.)

100,000 pts.  $H_2O$  dissolve 2.36 pts. gelatinous Ca phosphate; 2.56 pts. ignited Ca phosphate; 3.00 pts. Ca phosphate from bone dust. (Maly and Donath, J. pr. (2) 7. 416.)

Solubility of bones in various solvents is given by Maly and Donath, l. c.

0.009 g.  $Ca_3(PO_4)_2$  is sol. in 1 l.  $H_2O$ .  
0.153 " " " " " "

sat. with  $CO_2$ . (Joffre, Bull. Soc. 1898, (3) 19. 372.)

Determinations of solubility in  $H_2O$  as stated in the literature vary because  $Ca_3(PO_4)_2$  is apparently a solid solution of  $CaHPO_4$  and  $CaO$ . When placed in contact with  $H_2O$  more  $PO_4$  ions dissolve than Ca ions, the resulting solution is acid and solid phase richer in Ca than before addition of  $H_2O$ . For material of the approximate composition,  $Ca_3(PO_4)_2$ , the amt. dissolved by  $CO_2$  free  $H_2O$  at ord. temp. is 0.01-0.10 g. per l. depending on conditions of experiment.  $H_2O$  sat. with  $CO_2$  dissolves 0.15-0.30 g. per l. (Cameron and Hurst, J. Am. Chem. Soc. 1904, 26. 903.)

The decomposition of  $Ca_3(PO_4)_2$  in  $H_2O$  is increased by presence of  $CaSO_4$ , decreased by presence of  $CaCO_3$  or of  $CaSO_4$  and  $CO_2$ .  $CO_2$  increases the amount of  $PO_4$  dissolved in the solution of water alone and the sat.  $CaSO_4$  solutions, but has no other effect than to increase the amount of Ca in the solutions in contact with  $CaCO_3$ . (Cameron and Seidell, J. Am. Chem. Soc. 1904, 26. 1458.)

Sol. in  $CO_2 + Aq$

1 l.  $H_2O$  containing 1 vol.  $CO_2$  dissolves in 12 hours at 10° 0.75 g. precipitated  $Ca_3(PO_4)_2$ ; 0.166 g.  $Ca_3(PO_4)_2$  from bone ash; 0.300 g.  $Ca_3(PO_4)_2$  from bones which had been buried 20 years. (Lassaigne, J. ch. méd. (3) 3. 11.)

1 l.  $H_2O$  containing 0.8 vol.  $CO_2$  dissolves 0.61 g.  $Ca_3(PO_4)_2$ . (Liebig, A. 108. 198.)

$H_2O$  sat. with  $CO_2$  at 5-10° and 760 mm. pressure dissolves 0.527-0.60 g.  $Ca_3(PO_4)_2$ , or, if containing 1%  $NH_4Cl$ , 0.739 g.  $Ca_3(PO_4)_2$  (Warington, Chem. Soc. (2) 9. 80.)

Solubility varies according to form of  $Ca_3(PO_4)_2$ .

In apatite, 1 pt.  $Ca_3(PO_4)_2$  dissolves in 222,222 pts.  $H_2O$  sat. with  $CO_2$ ; in raw bones, in 5698 pts.; in bone ash, in 8029 pts.; in So. Carolina phosphate, in 6983 pts.; in phosphatic guano from Orchilla Id., in 8009 pts (Williams, C. N. 24. 306.)

$Al_2O_3 \cdot H_2O$  and  $Fe_2O_3 \cdot H_2O$  prevent the solubility of  $Ca_3(PO_4)_2$  in  $H_2O$  containing  $CO_2$ . (Warington, l. c.)

1 l.  $H_2O$  dissolves 0.22848 g.  $Ca_3(PO_4)_2$  under a  $CO_2$ -pressure of 2 atmos. at 14° (Ehlert, Z. Elektrochem. 1912, 18. 728.)

Sol. in  $SO_2 + Aq$ , forming a liquid of 1.3 sp. gr. at 9° from freshly precipitated  $Ca_3(PO_4)_2$ , and of 1.188 sp. gr. from bone ash.

Sol. in  $H_2S + Aq$ . 1 l.  $H_2O$  sat. with  $H_2S$

dissolves 190-240 mg  $\text{Ca}_3(\text{PO}_4)_2$ . (Béchamp, A. ch. (4) 16, 241.)

Easily sol. in  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ .

100 pts very dil  $\text{HCl} + \text{Aq}$  dissolve 198-225 pts  $\text{Ca}_3(\text{PO}_4)_2$ . (Crum, A. 63, 294)

100 pts  $\text{HCl}$  of 1.153 sp. gr. (containing 31%  $\text{HCl}$ ) dissolve at  $17^\circ$  when diluted with:

0	1	4	7	pts. $\text{H}_2\text{O}$
25.3	45.0	52.3	64.7	pts $\text{Ca}_3(\text{PO}_4)_2$
10	13	16	19	pts $\text{H}_2\text{O}$
68.0	71.9	69.5	69.7	pts $\text{Ca}_3(\text{PO}_4)_2$

(Busch, Schw. J. 67, 39.)

Decomp. by  $\text{H}_2\text{SO}_4$ .

Completely decomp. to  $\text{CaSO}_4$  and  $\text{H}_3\text{PO}_4$  by a mixture of  $\text{H}_2\text{SO}_4$  and alcohol.

Solubility in  $\text{HNO}_3 + \text{Aq}$ .

1 pt. of  $\text{Ca}_3(\text{PO}_4)_2$  dissolves at 16.25-17.5° in pts.  $\text{HNO}_3 + \text{Aq}$  which contain pts.  $\text{H}_2\text{O}$  to 1 pt.  $\text{HNO}_3$  (sp. gr. = 1.23)

Pts $\text{HNO}_3 + \text{Aq}$	Pts $\text{H}_2\text{O}$	Pts $\text{HNO}_3 + \text{Aq}$	Pts $\text{H}_2\text{O}$
2.72	0	30.64	10.754
4.23	0.827	26.48	13
10.25	3.309	32.14	13.236
15.45	5.791	36.06	15.718
20.34	8.273	127.81	40
20.82	10	...	...

(Busch, 1833)

More sol. in acetic, lactic, malic, and tartaric acids than in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  (Cum.)

Solubility in  $\text{H}_2\text{PO}_4 + \text{Aq}$ .

G $\text{H}_2\text{PO}_4$ in 100 cc. of $\text{H}_2\text{PO}_4 + \text{Aq}$	G $\text{Ca}_3(\text{PO}_4)_2$ dissolved by 100 cc of solvent
5	3.85
10	7.28
15	9.45
20	12.50
25	13.79
30	15.10

(Causse, C. R. 1892, 114, 414)

Very small quantities of the salts of the alkali metals increase the solubility in  $\text{H}_2\text{O}$ . (Lassagne, J. chim. méd. (3) 3, 11)

1 litre cold  $\text{H}_2\text{O}$  with 2 g.  $\text{NaCl}$  dissolves 45.7 mg  $\text{Ca}_3(\text{PO}_4)_2$ ; with 3 g.  $\text{NaNO}_3$ , 33 mg.  $\text{Ca}_3(\text{PO}_4)_2$ . (Liebig.)

1 litre  $\text{H}_2\text{O}$  containing 8.75%  $\text{NaCl}$  dissolves 317.5 mg.  $\text{Ca}_3(\text{PO}_4)_2$ . (Lassagne.)

$\text{NH}_4$  salts have even more effect, especially  $\text{NH}_4\text{Cl} + \text{Aq}$ , which dissolves  $\text{Ca}_3(\text{PO}_4)_2$  in the cold; also ammonium nitrate and succinate (Wittstein.)

$(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  dissolves  $\text{Ca}_3(\text{PO}_4)_2$  as easily as  $\text{CaSO}_4$ . (Liebig, A. 61, 128.)

1 litre  $\text{H}_2\text{O}$  containing 2 g.  $\text{NaCl}$  dissolves at  $7-12.3^\circ$  45.7 mg  $\text{Ca}_3(\text{PO}_4)_2$ ; 3 g.  $\text{NaNO}_3$  at  $17.3^\circ$ , 33 mg.  $\text{Ca}_3(\text{PO}_4)_2$ ; 2.2 g.  $(\text{NH}_4)_2\text{SO}_4$ , 76.7 mg.  $\text{Ca}_3(\text{PO}_4)_2$ . (Liebig, A. 106, 185)

Dry  $\text{Ca}_3(\text{PO}_4)_2$  also dissolves by long boiling with solutions of ammonium chloride, nitrate, succinate (Wittstein), or sulphate (Delkeskamp).

Sol. in 89,448 pts.  $\text{H}_2\text{O}$  (boiled) at  $7^\circ$ ; 19,628 pts  $\text{H}_2\text{O}$  (boiled) containing 1%  $\text{NH}_4\text{Cl}$  at  $10^\circ$ , 4324 pts  $\text{H}_2\text{O}$  (boiled) containing 10%  $\text{NH}_4\text{Cl}$  at  $17^\circ$ , 1788 pts  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  and containing 10%  $\text{NH}_4\text{Cl}$  at  $10^\circ$  and 751 mm pressure, 1351 pts  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  and containing 1%  $\text{NH}_4\text{Cl}$  at  $12^\circ$  and 745 mm pressure; 42,313 pts  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  and containing  $\text{CaCO}_3$  at  $21^\circ$  and 756.3 mm pressure, 18,551 pts  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  and containing  $\text{CaCO}_3$  and 1%  $\text{NH}_4\text{Cl}$  at  $16^\circ$  and 746.1 mm pressure (Warrington, Chem. Soc. (2) 4, 296.)

Aqueous solutions of the following  $\text{NH}_4$  salts dissolve the given amts of  $\text{Ca}_3(\text{PO}_4)_2$ , calculated for 100 pts. of the corresponding acid:  $\text{NH}_4\text{Cl}$ , 0.655 pt.,  $\text{NH}_4\text{NO}_3$ , 0.306 pt.;  $(\text{NH}_4)_2\text{SO}_4$ , 1.050 pts.;  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , 0.255 pt.;  $\text{NH}_4$  tartrate, 4.56 pts.;  $\text{NH}_4$  citrate, 7.015 pts.;  $\text{NH}_4$  malate, 1.125 pts.  $\text{Ca}_3(\text{PO}_4)_2$  (Terrell, Bull. Soc. (2) 35, 578)

Solubility in various salts +  $\text{Aq}$  under a  $\text{CO}_2$  pressure of 2 atmospheres, at  $14^\circ$ .

Salt	G salt per 100 g $\text{H}_2\text{O}$	G $\text{Ca}_3(\text{PO}_4)_2$ sol in 1 l. of the solvent
$\text{H}_2\text{O}$		0.22848
$\text{NaCl}$	50 conc.	1.3208 0.64089
$\text{MgCl}_2 + 6\text{H}_2\text{O}$	86.9 conc.	1.2878 2.8923
$\text{KMgCl}_2 + 6\text{H}_2\text{O}$	79.2 conc.	1.5771 1.1536
$\text{K}_2\text{SO}_4$ , $\text{MgSO}_4$ , $\text{MgCl}_2 + 6\text{H}_2\text{O}$	70.95 conc.	1.7777 2.4911
$\text{NaN}_3$	72.7 conc.	1.5827 0.8638
$\text{K}_2\text{SO}_4$	74.5 conc.	4.9041 4.7649
$(\text{NH}_4)_2\text{SO}_4$	56.5 conc.	2.4131 5.8849
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	137.7 conc.	2.4911 3.2267
$\text{MgSO}_4 + 7\text{H}_2\text{O}$	105.3 conc.	1.9728 3.6001
$\text{NH}_4\text{Cl}$	45.74 conc.	1.3710 1.2929

(Ehlert and Hempel, Z. Elektrochem. 1912, 18, 728)

$\text{Ca}_3(\text{PO}_4)_2$  is sol. in  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq}$  100 cem.  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq}$  (1½%  $\text{K}_2\text{C}_2\text{O}_4$ ) dissolves 57 1% of the  $\text{P}_2\text{O}_5$  from phosphorite, 71% from guano by boiling 25 min. At ord. temp. bone meal gives up 50–80% of its  $\text{P}_2\text{O}_5$  to  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq}$  in 36 hours. (Liebig, Landw. J. B. 1881. 603.)

Sol. in  $\text{Ca}$  succate +  $\text{Aq}$ . (Bobbier, C. R. 32. 859)

More sol. in  $\text{H}_2\text{O}$  containing starch, glue, or other animal substances than in pure  $\text{H}_2\text{O}$ . (Vauquelin, Pogg. 85. 126.)

Sol. in  $\text{H}_2\text{O}$  containing organic matter, therefore when bones decay under  $\text{H}_2\text{O}$ ,  $\text{Ca}_3(\text{PO}_4)_2$  is dissolved in considerable quantity. (Hayes, Edin. Phil. J. 5. 378.)

Sol. in sodium citrate +  $\text{Aq}$  (Spiller.)

Solubility in  $\text{NH}_4$  citrates +  $\text{Aq}$ .

Ammonium citrate solution of 1.09 sp. gr. at 30–35° dissolves precipitated  $\text{Ca}_3(\text{PO}_4)_2$  completely, but not phosphorite. (Fresenius.)

Dried on the air, with 2½  $\text{H}_2\text{O}$ . Sol. in 40 min. in diammonium citrate +  $\text{Aq}$  (sp. gr. = 1.09); triammonium citrate +  $\text{Aq}$  (sp. gr. =

1.09) dissolves 55 3% of the  $\text{P}_2\text{O}_5$ ; citric acid +  $\text{Aq}$  (¼%) dissolves 83 8% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer, B. 14. 1253.)

Dried at 50°, with 1½  $\text{H}_2\text{O}$ . Sol. in 45 min. in diammonium citrate +  $\text{Aq}$  (sp. gr. = 1.09); triammonium citrate +  $\text{Aq}$  dissolves 52.3% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer.)

Ignited. Diammonium citrate +  $\text{Aq}$  (sp. gr. 1.09) dissolves 93% of the  $\text{P}_2\text{O}_5$ , triammonium citrate +  $\text{Aq}$  (sp. gr. 1.09) dissolves 32% of the  $\text{P}_2\text{O}_5$ ; citric acid (¼%) dissolves 53 4% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in alcohol and ether.

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Fadmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

Min. *Apatite*.

0.002 g. is sol. in 1 l.  $\text{H}_2\text{O}$ .

0.014 " " " 1 l.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$ . (Joffre, Bull. Soc. 1898, (3) 19. 374.)

+  $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ , in  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$ , and in  $\text{H}_2\text{O}$  containing  $\text{CO}_2 + \text{CaH}_2(\text{CO}_3)_2$ . Temp. 16°–20°.

Solvent	In 1 l. of the filtrate	
	$\text{P}_2\text{O}_5$ mg	$\text{CaO}$ mg
(1) Boiled distilled $\text{H}_2\text{O}$ .	0.74	
(2) 1200 cc. distilled $\text{H}_2\text{O} + 50$ cc. $\text{H}_2\text{O}$ sat. with $\text{CO}_2$ .	6.9	
(3) 1000 cc. " " + 250 cc. " " " "	48.5	
(4) 1250 cc. $\text{H}_2\text{O}$ sat. with $\text{CO}_2$ .	91.9	
Solutions of $\text{CO}_2 + \text{CaH}_2(\text{CO}_3)_2$ . 1 l. (filtered) contains:		
(5) Calcium carbonate	13 mg	
Bicarbonate	166 "	
Free carbonic acid	73 "	0.38
	9 "	100.0
(6) Calcium carbonate	13 "	
Bicarbonate	277 "	
Free carbonic acid	122 "	1.1
	49 "	162.3
(7) Calcium carbonate	13 "	
Bicarbonate	376 "	
Free carbonic acid	165 "	0.80
	105 "	218.8
(8) Calcium carbonate	13 "	
Bicarbonate	475 "	
Free carbonic acid	209 "	1.77
	206 "	273.3
(9) Calcium carbonate	13 "	
Bicarbonate	545 "	
Free carbonic acid	240 "	1.30
	301 "	312.7

(Schloesing, C. R. 1900, 131. 151.)

Calcium hydrogen phosphate,  $\text{CaHPO}_4$ , and  $+2\text{H}_2\text{O}$

Insol. or nearly so in  $\text{H}_2\text{O}$ . Gradually decomp. by cold, more quickly by hot  $\text{H}_2\text{O}$

1000 pts  $\text{H}_2\text{O}$  dissolve 0.135–0.152 pt  $\text{CaHPO}_4+2\text{H}_2\text{O}$ . Solution clouds up on boiling. (Birnbäum.)

1000 pts  $\text{H}_2\text{O}$  dissolve 0.28 pt., and if sat with  $\text{CO}_2$ , 0.66 pt.  $\text{CaHPO}_4+2\text{H}_2\text{O}$ . (Dusart and Pelouze.)

When this salt dissolves in  $\text{H}_2\text{O}$ , decomp. takes place and a very considerable time is necessary to establish equilibrium (Rindell, C. R. 1902, 134, 112.)

Much less decomp. by  $\text{H}_2\text{O}$  than  $\text{Ca}_3(\text{PO}_4)_2$  or  $\text{CaH}_2(\text{PO}_4)_2$ , and the decomposition of this salt in water depends only slightly upon the relative amounts of solid and solvent which are present. The decomposition is increased by the addition of  $\text{CO}_2$ . The presence of  $\text{CaSO}_4$  or of  $\text{CaCO}_3$  decreased the amount of phosphoric acid which dissolved. See original paper. (Cameron and Seidell, J. Am. Chem. Soc. 1904, 26, 1460.)

When the ratio of  $\text{P}_2\text{O}_5 : \text{CaO}$  is above 1.0 or below 1.27,  $\text{H}_2\text{O}$  dissolves 0.40–0.54 g.  $\text{CaO}$  and 1.11–1.52 g.  $\text{P}_2\text{O}_5$  (see original paper). (Cameron and Bell, J. Am. Chem. Soc. 1905, 27, 1512.)

#### Solubility in $\text{H}_3\text{PO}_4+\text{Aq.}$

G. $\text{H}_3\text{PO}_4$ in 100 cc. $\text{H}_3\text{PO}_4+\text{Aq.}$	G. $\text{CaHPO}_4$ dissolved by 100 cc. of solvent
5	4.30
10	7.15
15	9.30
20	11.86
25	13.40
30	15.10

(Causse, C. R. 1892, 114, 415.)

1 l.  $\text{H}_2\text{O}$  containing 2.2 g.  $(\text{NH}_4)_2\text{SO}_4$ , 2 g.  $\text{NaCl}$ , or 3 g.  $\text{NaNO}_3$  dissolves 79.2, 66.3, or 78.9 mg.  $\text{CaP}_2\text{O}_7$ , which is present in form of  $\text{CaHPO}_4$ . (Liebig, A. 106, 185.) Slowly but completely sol. in boiling  $\text{NH}_4\text{Cl}+\text{Aq.}$  (Kraut, Arch. Pharm. (2) 111, 102.) Easily sol. in  $\text{H}_2\text{SO}_4+\text{Aq.}$  (Gerland, J. pr. (2) 4, 123.) Very sol. in  $\text{HCl}$  or  $\text{HNO}_3+\text{Aq.}$  Less sol. in  $\text{HC}_2\text{H}_3\text{O}_2$ . (Berzelius.) More sol. in dil. than conc.  $\text{HC}_2\text{H}_3\text{O}_2+\text{Aq.}$  but 60 pts  $\text{HC}_2\text{H}_3\text{O}_2$  (1 mol.) dissolve at most 23.1 pts.  $\text{P}_2\text{O}_5$  (1 mol.=142 pts.) from this compound. Aqueous solution of sodium acetate dissolves more easily than  $\text{H}_2\text{O}$ , and becomes turbid on boiling. (Birnbäum.)

Completely sol. in  $\text{K}_2\text{C}_2\text{O}_4+\text{Aq.}$  (Liebig, Landw. J. B. 1881, 603.)

1 l. of sat. solution in N/200 acid K tartrate +  $\text{Aq.}$  at 25° contains 0.235 g.  $\text{CaHPO}_4$ .

Insol. in alcohol. Sol. in many organic substances, as starch or gelatine +  $\text{Aq.}$

Insol. in acetone. (Eidmann, C. C. 1899, II 1014.)

$+1/2\text{H}_2\text{O}$  (Vorbringer, Z. anal. 9, 457.)

$+ \text{H}_2\text{O}$  (Gerlach, J. pr. (2) 4, 104.)

$+2\text{H}_2\text{O}$  Min. *Brushite*

$+3\text{H}_2\text{O}$  Min. *Metabrushite*.

$+5\text{H}_2\text{O}$ . (Dusart, C. R. 66, 327.)

Calcium tetrahydrogen orthophosphate,  $\text{CaH}_4(\text{PO}_4)_2+\text{H}_2\text{O}$ .

Very deliquescent. Crystals take up 97.7 pts  $\text{H}_2\text{O}$  in 16 days, and 220 pts  $\text{H}_2\text{O}$  in 28 days from air saturated with moisture. (Birnbäum, Zeit. Ch. (2) 7, 131.)

Not hygroscopic when pure. (Stocklass, B. 23, 626 R.)

Completely sol. in 100 pts.  $\text{H}_2\text{O}$ , but decomp. by 10–40 pts.  $\text{H}_2\text{O}$  with separation of  $\text{CaHPO}_4$ , which slowly dissolves (Erlenmeyer, J. B. 1873, 254.)

Later (B. 9, 1839) Erlenmeyer says  $\text{CaH}_4(\text{PO}_4)_2+\text{H}_2\text{O}$  is sol. in 700 pts.  $\text{H}_2\text{O}$  and decomp. into  $\text{CaHPO}_4$  by a less amount of  $\text{H}_2\text{O}$ . Wattenberg (Z. anal. 19, 243) says that the decomposition by small ams of  $\text{H}_2\text{O}$  down to 1–4 pts.  $\text{H}_2\text{O}$  to 1 pt salt is inappreciable.

Completely sol. in 200 pts  $\text{H}_2\text{O}$  if pure, and in less  $\text{H}_2\text{O}$  in presence of  $\text{H}_3\text{PO}_4$ . (Stocklass.)

Sol. in 25 pts.  $\text{H}_2\text{O}$  at 15°. Solution begins to decompose when warmed to 50°. (Otto, C. C. 1887, 1563.)

Gently decomp. by  $\text{H}_2\text{O}$  and the resulting solution is to be regarded as a solution of the decomposition products rather than of the substance itself. The presence of an excess of  $\text{CaSO}_4$  does not materially affect the amount of phosphoric acid entering the solution. (Cameron, J. Am. Chem. Soc. 1904, 26, 1462.)

Violently decomp. by  $\text{H}_2\text{O}$  in conc. solution, only sl. decomp. when dissolved in 200 pts.  $\text{H}_2\text{O}$ . (Stocklass, Z. anorg. 1892, 1, 310.)

Solubility of  $\text{CaH}_4\text{P}_2\text{O}_7$  in  $\text{H}_3\text{PO}_4+\text{Aq.}$  at pressure of 745 mm. at high temp.

T °C	100 g of the solution contain		Solid phase
	G $\text{P}_2\text{O}_5$	G $\text{CaO}$	
115°	43.60	5.623	$\text{CaH}_4\text{P}_2\text{O}_7$ , $\text{H}_2\text{O}+\text{CaHPO}_4$
132°	53.43	4.327	$\text{CaH}_4\text{P}_2\text{O}_7+\text{CaH}_2\text{P}_2\text{O}_7$ , $\text{H}_2\text{O}$
169°	63.95	4.489	$\text{CaH}_4\text{P}_2\text{O}_7$

(Bassett, Z. anorg. 1908, 59, 26.)

Glacial  $\text{HC}_2\text{H}_3\text{O}_2$  ppts. it completely from aqueous solution even in presence of  $\text{HNO}_3$ . (Persoz.)

Decomp. by 50 pts. absolute alcohol at b. pt. in 1 hour, by 30 pts. in 2 hours. Sol. in absolute ether. (Erlenmeyer, l. c.)

**Calcium pyrophosphate,  $\text{Ca}_2\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$** 

Somewhat sol. in  $\text{H}_2\text{O}$ ; completely sol. in mineral acids; less sol. in acetic acid, and insol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq.}$  (Schwauzenberg, A. 65. 145.) Less sol. in warm than in cold acetic acid. (Baer, Pogg. 75. 155.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Wackenroder, A. 41. 316.)

Insol. in  $\text{CaCl}_2 + \text{Aq.}$   
Min. *Pyrophosphorite*.

**Calcium hydrogen pyrophosphate,  $\text{CaH}_2\text{P}_2\text{O}_7 + 2\text{H}_2\text{O}$** 

Sol. in  $\text{H}_2\text{O}$ . (Pahl, B. 7. 478.)

$2\text{CaH}_2\text{P}_2\text{O}_7, \text{Ca}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$  Decomp. by boiling with  $\text{H}_2\text{O}$  into—

$\text{CaH}_2\text{P}_2\text{O}_7, \text{Ca}_2\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$ . Insol. in hot  $\text{H}_2\text{O}$  (Knorre and Oppelt, B. 21. 771.)

**Tetracalcium hydrogen phosphate,**

$\text{Ca}_4\text{H}(\text{PO}_4)_3 + \text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling therewith. Sol. in acids. (Warrington, Chem. Soc. (2) 4. 296.)

$+ 2\text{H}_2\text{O}$ .

**Calcium tetrathosphate,  $\text{Ca}_3\text{P}_4\text{O}_{13}$** 

Insol. in acids when ignited. (Fleitmann and Henneberg, A. 65. 331.)

**Calcium lithium phosphate,  $\text{CaLiPO}_4$** 

Insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 77. 298.)

**Calcium potassium dimetaphosphate,**

$\text{CaK}_2(\text{P}_2\text{O}_7)_2 + 4\text{H}_2\text{O}$ .

As  $\text{BaK}$  comp. (Glatzel, Dissert. 1880.)

**Calcium potassium orthophosphate,  $\text{CaKPO}_4$** 

Insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 77. 291.)

Easily sol. in acids. (Ouvrard, A. ch. (6) 16. 308.)

**Calcium potassium pyrophosphate,  $\text{CaK}_2\text{P}_2\text{O}_7$** 

Insol. in  $\text{H}_2\text{O}$ , easily sol. in dil. acids. (Ouvrard, C. R. 106. 1599.)

**Calcium sodium dimetaphosphate,**

$\text{CaNa}_2(\text{P}_2\text{O}_7)_2 + 4\text{H}_2\text{O}$ .

As  $\text{BaNa}$  comp. (Glatzel.)

**Calcium sodium trimetaphosphate,**

$\text{CaNa}_3\text{P}_3\text{O}_{10} + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Fleitmann, A. 65. 315.)

Easily sol. in  $\text{H}_2\text{O}$ . Difficultly sol. in  $\text{HCl} + \text{Aq}$  when heated to redness. Easily sol. in boiling  $\text{HCl} + \text{Aq}$  after being fused. (Lindbom.)

**Calcium sodium orthophosphate,  $\text{CaNaPO}_4$** 

Insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 77. 292.)

Easily sol. in dil. acids. (Ouvrard, A. ch. (6) 16. 308.)

$3\text{CaO}, 3\text{Na}_2\text{O}, 2\text{P}_2\text{O}_5$ . Sol. in dil. acids. (Ouvrard, C. R. 1888, 106. 1599.)

**Calcium sodium pyrophosphate,  $\text{CaNa}_2\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$** 

Insol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ ,  $\text{HNO}_3 + \text{Aq}$ , and also in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Baer, Pogg. 75. 159.)

$\text{CaNaNa}_6(\text{P}_2\text{O}_7)_6$ . Sol. in acids. (Wallroth, Bull. Soc. (2) 39. 316.)

$3\text{CaO}, 3\text{Na}_2\text{O}, 2\text{P}_2\text{O}_5$ . Easily sol. in acids. (Ouvrard, A. ch. (6) 16. 307.)

**Calcium thorium metaphosphate,  $\text{ThO}_2, \text{CaO}, \text{P}_2\text{O}_5$** 

(Colani, C. R. 1909, 149. 209.)

**Calcium uranous metaphosphate,  $\text{UO}_2, \text{CaO}, \text{P}_2\text{O}_5$** 

Insol. in acids. (Colani, A. ch. 1907, (8) 12. 140.)

**Calcium uranyl phosphate,  $\text{Ca}(\text{UO}_2)_2(\text{PO}_4)_2 + 2, 3, \text{or } 4\text{H}_2\text{O}$** 

Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Debray.)

$\text{Ca}(\text{UO}_2)_2(\text{PO}_4)_2 + 8\text{H}_2\text{O}$ . Min. *Uranite*. Sol. in  $\text{HNO}_3 + \text{Aq}$ .

$3\text{CaO}, 5\text{UO}_3, 2\text{P}_2\text{O}_5 + 16\text{H}_2\text{O}$ . (Blinkoff, Dissert. 1900.)

**Calcium phosphate chloride,  $\text{Ca}_3(\text{PO}_4)_2, \text{CaCl}_2$** 

(Deville and Caron, A. ch. (3) 67. 458.)

$3\text{Ca}_3(\text{PO}_4)_2, \text{CaCl}_2$ . *Chlorapatite*. Insol. in  $\text{H}_2\text{O}$ . (Daubrée, Ann. Min. (4) 19. 684.)

$7\text{CaH}_2(\text{PO}_4)_2, \text{CaCl}_2 + 14\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ .

$4\text{CaH}_2(\text{PO}_4)_2, \text{CaCl}_2 + 8\text{H}_2\text{O}$ .

$\text{CaH}_2(\text{PO}_4)_2, \text{CaCl}_2 + 2\text{H}_2\text{O}$ . Partly sol. in  $\text{H}_2\text{O}$  with decomp. Also with  $8\text{H}_2\text{O}$ . (Erlenmeyer, J. B. 1857. 145.)

**Calcium phosphate chloride fluoride,**

$3\text{Ca}_3(\text{PO}_4)_2, \text{CaClF}$ .

Min. *Apatite*. Boiling  $\text{H}_2\text{O}$  dissolves out  $\text{CaCl}_2$ ; dil. mineral acids dissolve easily, acetic acid with more difficulty. Easily soluble in molten  $\text{NaCl}$ , crystallizing on cooling. (Forchhammer.)

**Calcium phosphate silicate,  $\text{Ca}_2(\text{PO}_4)_2$** 

$\text{Ca}_2\text{SiO}_4$ .

Insol. in  $\text{H}_2\text{O}$ ; decomp. by  $\text{HCl} + \text{Aq}$ . (Carnot and Richard, C. R. 97. 316.)

$4\text{Ca}_3(\text{PO}_4)_2, \text{Ca}_2\text{SiO}_4$ . (Bücking and Linck, C. C. 1887. 562.)

$4\text{Ca}_2(\text{PO}_4)_2, 3\text{Ca}_2\text{SiO}_4$ . (B. and L.)

$\text{Ca}(\text{PO}_4)_2, \text{CaSiO}_3$ . (Stend and Ridsdote, Chem. Soc. 51. 601.)

**Calcium dihydrogen phosphate sulphite,  $\text{CaH}_2(\text{PO}_4)_2, \text{CaSO}_3 + \text{H}_2\text{O}$** 

Not decomp. by cold, slowly by boiling  $\text{H}_2\text{O}$ . Slightly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in mineral acids. Insol. in cold, slowly sol. in boiling acetic acid. More sol. in a solution of oxalic acid. (Gerland, C. N. 20. 268.)

**Cerous metaphosphate,  $\text{Ce}(\text{PO}_3)_3$** 

(Rammelsberg)  
 $\text{Ce}_2\text{O}_3, 5\text{P}_2\text{O}_5$  Insol. in  $\text{H}_2\text{O}$  or acids.  
 (Johnsson, B. 22. 976)

**Cerous orthophosphate,  $\text{CePO}_4$** 

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids  
 (Grandeau, A. ch. (8) 8. 193.)  
 Insol. in acids (Hartley, Proc. Roy. Soc. 41. 202)  
 $+2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids.  
 (Jolin.)  
 Insol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ ; sl. sol. in  $\text{HCl}$  or  
 $\text{HNO}_3 + \text{Aq}$  (Hisinger.)  
 Insol. in  $\text{HNO}_3 + \text{Aq}$  (Boussingault, A. ch. (5) 6. 178)  
 Min. *Cryptolite*. Completely decomp. by  
 $\text{H}_2\text{SO}_4$  when finely powdered. Insol. in dil.  
 $\text{HNO}_3 + \text{Aq}$ .

**Ceric orthophosphate,  $4\text{CeO}_2, 6\text{P}_2\text{O}_5 + 26\text{H}_2\text{O}$ .**  
Ppt. (Hartley, Proc. Roy. Soc. 41. 202.)**Cerous pyrophosphate,  $\text{Ce}_2\text{H}_2(\text{P}_2\text{O}_7)_3 + 6\text{H}_2\text{O}$ .**  
Sol. in cerous nitrate +  $\text{Aq}$ .  
 $\text{Ce}_2(\text{P}_2\text{O}_7)_3 + 12\text{H}_2\text{O}$ . Sol. in excess of  
sodium pyrophosphate +  $\text{Aq}$ . Easily sol. in  
 $\text{HCl}$ . (Rosenheim, B. 1915, 48. 592.)**Cerous lanthanum thorium phosphate,**  
 $(\text{Ce}, \text{La}, \text{Th})_2(\text{PO}_4)_2$ .

Min. *Monazite* Sol. in  $\text{HCl} + \text{Aq}$  with  
 white residue.

**Cerous potassium orthophosphate,  $2\text{Ce}_2\text{O}_3,$   
 $3\text{K}_2\text{O}, 3\text{P}_2\text{O}_5 = 2\text{CePO}_4, \text{K}_4\text{PO}_4$ .**  
 Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Ouvrard, C. R. 107. 37.)**Cerous sodium orthophosphate,  $\text{Ce}_2\text{O}_3, 3\text{Na}_2\text{O},$   
 $2\text{P}_2\text{O}_5 = \text{CePO}_4, \text{Na}_4\text{PO}_4$ .**  
 Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 107. 37.)**Cerous sodium pyrophosphate,  $\text{CeNa}_2\text{P}_2\text{O}_7$ .**  
 Insol. in acetic, and cold dil. mineral acids  
 Sol. in warm acids. (Wallroth)**Chromous phosphate,  $\text{Cr}_2(\text{PO}_4)_3$** 

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in citric, tartaric  
 and acetic acids. Sl. sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ .  
 (Moissan, A. ch. 1882, (5) 25. 415.)  
 $+ \text{H}_2\text{O}$ . Precipitate Easily sol. in acids.  
 (Moberg, Moissan, A. ch. (5) 21. 199)

**Chromic metaphosphate,  $\text{Cr}_2(\text{PO}_3)_4$** 

Insol. in  $\text{H}_2\text{O}$  or conc. acids. (Maddrell, A. 61. 53.)

**Chromic orthophosphate,  $\text{CrPO}_4$** 

Hydrolyzed by hot  $\text{H}_2\text{O}$ . Somewhat sol  
 in  $\text{NH}_4\text{OH} + \text{Aq}$  and in  $\text{Cr}_2(\text{SO}_4)_3 + \text{Aq}$ .  
 (Caven, J. Soc. Chem. Ind. 1897, 16. 20)  
 Insol. in methyl acetate. (Naumann, B.

1909, 42. 3790), ethyl acetate (Naumann,  
 B. 1910, 43. 314.)

**Chromic phosphate,  $\text{Cr}_2(\text{PO}_4)_3 + 12\text{H}_2\text{O}$ .**

*Violet modification.* Precipitate. (Ram-  
 melsberg, Pogg. 68. 383.)

$+ 6\text{H}_2\text{O}$ . *Green modification.* Very sl.  
 sol. in  $\text{H}_2\text{O}$  and still less in  $\text{NH}_4\text{NO}_3$  or  
 $\text{NH}_4\text{C}_2\text{H}_3\text{O}_5 + \text{Aq}$ . (Carnot, C. R. 94. 1313.)  
 Insol. in acetic, but easily sol. in mineral  
 acids Easily sol. in cold  $\text{KOH}$  or  $\text{NaOH} +$   
 $\text{Aq}$ , from which it is separated on boiling.  
 (Dowling and Plunkett, Chem. Gaz. 1858.  
 220.)

**Chromic hydrogen phosphate,  $\text{Cr}_2\text{H}_2(\text{PO}_4)_4 +$   
 $16\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  (Haushofer)

**Chromic pyrophosphate,  $\text{Cr}_4(\text{P}_2\text{O}_7)_3$ .**

*Anhydrous* Insol. in  $\text{H}_2\text{O}$  or acids (Ouv-  
 rard, A. ch. (6) 16. 344)  
 $+ 7\text{H}_2\text{O}$  Precipitate. Sol. in strong  
 mineral acids,  $\text{SO}_2 + \text{Aq}$ ,  $\text{KOH} + \text{Aq}$ , and  
 $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . (Schwarzenberg, A. 65. 149.)  
 Insol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . (Stromeyer.)

**Chromic potassium phosphate,  $\text{Cr}_2\text{O}_3, \text{K}_2\text{O},$   
 $2\text{P}_2\text{O}_5$ .**

Insol. in  $\text{H}_2\text{O}$  and in acids. (Ouvrard, A. ch. (6) 16. 289.)

**Chromic potassium pyrophosphate,**  
 $\text{K}(\text{CrP}_2\text{O}_7) + 5\text{H}_2\text{O}$ 

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling  
 $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 588.)  
 $\text{Cr}_2\text{K}_2\text{H}_2(\text{P}_2\text{O}_7)_3$ . Insol. in  $\text{H}_2\text{O}$ , acids, or  
 alkalis. Sl. decomp. by boiling conc.  $\text{H}_2\text{SO}_4$ .  
 (Schjerming, J. pr. (2) 46. 616)

**Chromic silver phosphate,  $2\text{Cr}_2\text{O}_3, 2\text{Ag}_2\text{O},$   
 $5\text{P}_2\text{O}_5$ .**

(Hautefeuille and Margottet, C. R. 96.  
 1142.)

**Chromic sodium orthophosphate,  $\text{Na}_2\text{HPO}_4,$   
 $2\text{CrPO}_4 + 5\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  (Cohen, J. Am. Chem.  
 Soc. 1907, 29. 1197.)

**Chromic sodium pyrophosphate,**  
 $\text{Cr}_2\text{Na}_2(\text{P}_2\text{O}_7)_2$ .

Insol. in acids. (Wallroth, Bull. Soc. (2)  
 39. 316.)  
 $+ 10\text{H}_2\text{O}$ , and  $16\text{H}_2\text{O}$  Sl. sol. in cold  $\text{H}_2\text{O}$ .  
 Decomp. by boiling  $\text{H}_2\text{O}$ . (Rosenheim, B.  
 1915, 48. 586.)

**Cobaltous monometaphosphate,  $\text{Co}(\text{PO}_3)_2(?)$ .**

Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sol. in conc.  
 $\text{HCl} + \text{Aq}$ . (Maddrell, A. 58. 61.)

**Cobaltous dimetaphosphate,  $\text{Co}_2(\text{P}_2\text{O}_5)_2$ .**

Insol. in cold conc.  $\text{H}_2\text{SO}_4$ ; sl. sol. on warming, but sol. in  $\text{H}_2\text{O}$  after treating with  $\text{H}_2\text{SO}_4$ . Sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq.}$  Scarcely attacked by boiling  $\text{Na}_2\text{S} + \text{Aq.}$  (Fleissmann)

**Cobaltous hexametaphosphate (?)**

Ppt. Sol. in sodium hexametaphosphate +  $\text{Aq.}$  (Rose, Pogg. 76. 4.)

**Cobaltous orthophosphate,  $\text{Co}_3(\text{PO}_4)_2 + x\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_3\text{PO}_4 + \text{Aq.}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$ ; sl. sol. in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Salvetat, C. R. 48. 295.) Sol. in Co salts +  $\text{Aq.}$  +  $2\text{H}_2\text{O}$ . (Debray, A. ch. (3) 61. 438.) +  $8\text{H}_2\text{O}$ . (Reynoso, C. R. 34. 795.)

**Cobaltous hydrogen orthophosphate,  $\text{CoHPO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Ppt. (Debray.) +  $2\frac{1}{2}\text{H}_2\text{O}$ . Ppt. Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_3\text{PO}_4 + \text{Aq.}$  (Bödeker, A. 94. 357.)

**Cobaltous tetrahydrogen orthophosphate,  $\text{CoH}_4(\text{PO}_4)_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Reynoso)

**Cobaltous pyrophosphate.**

Ppt. Sol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq.}$  (Stromeyer) Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Schwarzenberg)

**Cobaltous pyrometaphosphate,  $3\text{CoO}, 2\text{P}_2\text{O}_5$ .**

(Braun.)  $6\text{CoO}, 5\text{P}_2\text{O}_5$ . (Braun.)

**Cobaltous potassium phosphate,  $\text{CoKPO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil acids (Ouvrard, C. R. 106. 1729.)  $3\text{CoO}, 3\text{K}_2\text{O}, 2\text{P}_2\text{O}_5$ . As above

**Cobaltous sodium triphosphate,  $\text{NaCo}_2\text{P}_3\text{O}_{10}$ .**

(Schwarz, Z. anorg. 1895, 9. 260.)  $\text{Na}_2\text{CoP}_3\text{O}_{10} + 12\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ ; decomp. in aq. solution. Sol. in acids. (Schwarz, Z. anorg. 1895, 9. 258.)

**Cobaltous sodium metaposphate,  $\text{Co}_2\text{Na}_2(\text{PO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$  or acids, even conc.  $\text{H}_2\text{SO}_4$ . (Watts' Dict.)

**Cobaltous sodium monometaphosphate,  $6\text{Co}(\text{PO}_3)_2, 2\text{NaPO}_3$ .**

Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Maddrell, A. 61. 57.)

**Cobaltous sodium trimetaphosphate,  $\text{CoNa}_4(\text{PO}_3)_3 + 8\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Fleissmann and Henneberg, A. 66. 315.)

**Cobaltous sodium orthophosphate,  $\text{CoNaPO}_4$ .**

Insol. in  $\text{H}_2\text{O}$  (Ouvrard, C. R. 106. 1729.)  $\text{Co}_3(\text{PO}_4)_2, 2\text{Na}_2\text{HPO}_4 + 8\text{H}_2\text{O}$ . (Debray, J. Pharm. (3) 46. 119)

**Cobaltous sodium pyrophosphate,  $\text{Co}_2\text{Na}_2(\text{P}_2\text{O}_7)_2$ .**

Insol. in  $\text{H}_2\text{O}$  Sol. in acids (Wallroth.) +  $2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Stromeyer.)

**Cobaltous zinc phosphate,  $\text{Co}_3(\text{PO}_4)_2, 3\text{Zn}_3(\text{PO}_4)_2 + 12\text{H}_2\text{O}$ .**

Ppt. Sol. in acids. (Gentile)  $\text{CoZn}_3(\text{PO}_4)_2 + 6\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$

**Columbium phosphate (?)**

Insol. in  $\text{H}_2\text{O}$ . (Blomstrand.)

**Cupric dimetaphosphate,  $\text{Cu}_2(\text{P}_2\text{O}_5)_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Maddrell, A. 61. 62.) Insol. in most conc acids and in alkalis, except hot  $\text{NH}_4\text{OH} + \text{Aq.}$  or conc.  $\text{H}_2\text{SO}_4$ , in which it is moderately sol. Not decomp. by  $\text{H}_2\text{S}$ , but by  $(\text{NH}_4)_2\text{S} + \text{Aq.}$ , less easily by  $\text{Na}_2\text{S}$  and  $\text{K}_2\text{S} + \text{Aq.}$  (Fleissmann, Pogg. 78. 242.) +  $8\text{H}_2\text{O}$ . Completely insol. in  $\text{H}_2\text{O}$  (Fleissmann.)

**Cupric hexametaphosphate (?)**

Sol. in  $\text{Na}_2\text{P}_6\text{O}_{18} + \text{Aq.}$  or  $\text{CuCl}_2 + \text{Aq.}$  (Rose, Pogg. 76. 5.)  $\text{Cu}_2\text{P}_6\text{O}_{18}$ . Easily sol. in  $\text{H}_2\text{O}$  or acids, especially when freshly pptd. (Lüder, Z. anorg. 5. 15)

**Cupric orthophosphate, basic,  $6\text{CuO}, \text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ .**

Min. *Phosphocalcite*.  $5\text{CuO}, \text{P}_2\text{O}_5 + 2\text{H}_2\text{O}$ . Min. *Dihydrite* +  $3\text{H}_2\text{O}$ . Min. *Ehrlite*. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  and  $\text{HNO}_3 + \text{Aq.}$   $4\text{CuO}, \text{P}_2\text{O}_5 + \text{H}_2\text{O}$ . Slowly sol. in  $\text{NH}_4\text{OH}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$ ; insol. in cold  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  (Steinschneider, C. C. 1891, II 51.) Sl. sol. in  $\text{CuCl}_2 + \text{Aq.}$  and  $\text{CaSO}_4 + \text{Aq.}$  Decomp. by boiling  $\text{H}_2\text{O}$  and boiling  $\text{Aq.}$  potash. (Caven, J. Soc. Chem. Ind. 1897, 16. 29.)

Min. *Libethenite*. Sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq.}$  +  $2\text{H}_2\text{O}$ . Min. *Pseudolibethenite*. Sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq.}$  +  $3\text{H}_2\text{O}$ . Min. *Taghite*. Sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq.}$

**Cupric triphosphate,  $5\text{CuO}, 3\text{P}_2\text{O}_5 + 13\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ . (Schwarz, Z. anorg. 1895, 9. 262.)

**Cupric dimetaphosphate,  $\text{CuP}_2\text{O}_5 + 4\text{H}_2\text{O}$ .**

Sol. in 78 pts.  $\text{H}_2\text{O}$  Easily decomp. by hot conc.  $\text{H}_2\text{SO}_4$  (Glatzel, Dissert. 1880.)

Cupric trimetaphosphate,  $\text{Cu}_3(\text{P}_3\text{O}_9)_2 + 9\text{H}_2\text{O}$ .  
Very sl. sol. in  $\text{H}_2\text{O}$  (0.04 g. in 1 l. at  $20^\circ$ ).  
(Tammann, J. pr. 1892, (2) 45, 425)

Cupric tetrametaphosphate,  $\text{Cu}_4\text{P}_4\text{O}_{16}$ .  
Insol. in  $\text{H}_2\text{O}$  and in  $\text{HCl}$ . Sl. sol. in boiling  $\text{HNO}_3$ . Very sol. in boiling conc.  $\text{H}_2\text{SO}_4$ . (Glatzel.)  
+  $8\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . Slowly attacked by acids except conc.  $\text{H}_2\text{SO}_4$ . (Glatzel.)

Cupric orthophosphate,  $\text{Cu}_3(\text{PO}_4)_2 + 3\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids, even  $\text{H}_3\text{PO}_4$ ,  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sl. sol. in  $\text{NH}_4$  salts +  $\text{Aq}$ .  
Sl. sol. in  $\text{Cu}$  salts +  $\text{Aq}$ . (Rose, Pogg. 76, 28)  
Sol. in cold  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Stenschneder, C. C. 1891, II, 51.)  
Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 827.)  
Insol. in methyl acetate. (Naumann, B. 1900, 42, 3790)

Cupric hydrogen phosphate,  $\text{CuHPO}_4 + \frac{1}{2}\text{H}_2\text{O}$  (?).  
Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ , and  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett, Phil. Mag. (3) 10, 98.)

Cupric pyrophosphate, basic,  $\text{Cu}_2\text{P}_2\text{O}_7$ ,  $2\text{CuO}$ ,  $\text{H}_2\text{O} + 3\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ . (Pahl, J. B. 1873, 229.)

Cupric pyrophosphate,  $\text{Cu}_2\text{P}_2\text{O}_7$ .  
*Anhydrous*. Insol. in  $\text{H}_2\text{O}$ , and very sl. sol. in conc. acids. (Fleissmann, Pogg. 78, 244.)  
As insol. as  $\text{Cu}$  metaphosphate, but decomp. by  $\text{H}_2\text{S}$ . (Rose, Pogg. 76, 14.)  
+  $2\text{H}_2\text{O}$ . Sol. in mineral acids, and  $\text{NH}_4\text{OH} + \text{Aq}$ , also in  $\text{Na}_2\text{F}_2\text{O}_7 + \text{Aq}$  (Schwarzenberg, A. 65, 156.)  
Sol. in cold  $\text{H}_2\text{SO}_4 + \text{Aq}$  without decomp., crystallizing out on boiling.  
Decomp. by boiling  $\text{KOH} + \text{Aq}$ .  
Sol. in large excess of  $\text{CuSO}_4 + \text{Aq}$ .  
+  $2\frac{1}{2}\text{H}_2\text{O}$ . (Pahl, Sv. V. A. F. 30, 7, 40.)  
+  $5\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ .  
Sol. in dil. acids. (Wiesler, Z. anorg. 1901, 28, 202)

Cupric iron (ferric) pyrophosphate,  
 $\text{Cu}_2\text{Fe}_2(\text{P}_2\text{O}_7)_2 + 12\text{H}_2\text{O}$ .  
Ppt. (Pascal, C. R. 1908, 146, 233.)

Cupric potassium phosphate,  $4\text{CuO}$ ,  $\frac{1}{2}\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ .  
Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 111, 177.)  
 $\text{CuKPO}_4$ . As above.

Cupric potassium tetrametaphosphate,  
 $\text{K}_2\text{CuP}_4\text{O}_{16} + 4\text{H}_2\text{O}$ .  
Sol. in 58 pts.  $\text{H}_2\text{O}$ . Easily attacked by acids. (Glatzel, Dissert. 1880.)

Cupric potassium pyrophosphate,  $\text{CuK}_2\text{P}_2\text{O}_7$ .  
Extremely easily sol. in  $\text{H}_2\text{O}$ . (Persoz, A. ch. (3) 20, 315.)  
 $\text{Cu}_2\text{P}_2\text{O}_7$ ,  $3\text{K}_2\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Pahl, Sv. V. A. F. 30, 7, 44.)

Cupric sodium phosphate,  $\text{Cu}_2\text{Na}_6(\text{PO}_4)_4$ .  
Insol. in  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq}$ . Sol. in conc. acids. (Wallroth, Bull. Soc. (2) 39, 316.)

Cupric sodium triphosphate,  
 $\text{CuNa}_3\text{P}_3\text{O}_{10} + 12\text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ ; very unstable.  
Easily sol. in acids. (Stange, Z. anorg. 1896, 12, 458.)

Cupric sodium tetrametaphosphate,  
 $\text{CuNa}_4\text{P}_4\text{O}_{16}$ .  
As insol. in  $\text{H}_2\text{O}$  as  $\text{Cu}$  dimetaphosphate. Difficultly decomp. by digestion with  $\text{Na}_2\text{S} + \text{Aq}$ . (Fleissmann, Pogg. 78, 355.)  
+  $4\text{H}_2\text{O}$ . Sol. in 45 pts.  $\text{H}_2\text{O}$ . (Glatzel, Dissert. 1880.)

Cupric sodium orthophosphate,  $3\text{Cu}_3(\text{PO}_4)_2$ ,  $\text{NaH}_2\text{PO}_4$ .  
Decomp. by  $\text{H}_2\text{O}$  to  $4\text{CuO}$ ,  $\text{P}_2\text{O}_5$ . (Stenschneder, C. C. 1891, II, 52.)  
 $2\text{Cu}_3(\text{PO}_4)_2$ ,  $\text{Na}_2\text{HPO}_4$ . Decomp. by  $\text{H}_2\text{O}$  into—  
 $3\text{Cu}_3(\text{PO}_4)_2$ ,  $\text{Na}_2\text{HPO}_4$ . Decomp. by  $\text{H}_2\text{O}$ . (S.)  
 $\text{Cu}_2(\text{PO}_4)_2$ ,  $\text{NaH}_2\text{PO}_4$ . Decomp. by  $\text{H}_2\text{O}$ . (S.)  
 $6\text{Cu}_3(\text{PO}_4)_2$ ,  $2\text{Na}_2\text{PO}_4$ . Decomp. by  $\text{H}_2\text{O}$ . (S.)

Cupric sodium pyrophosphate,  $\text{CuNa}_2\text{P}_2\text{O}_7$ .  
Insol. in  $\text{H}_2\text{O}$ . (Fleissmann and Henneberg, A. 65, 387.)  
+  $\frac{1}{2}\text{H}_2\text{O}$ . (F. and H.) Much more sol. than the next salt. (Pahl.)  
+  $6\text{H}_2\text{O}$ . (Persoz, A. ch. (3) 20, 315.)  
 $\text{Cu}_2\text{P}_2\text{O}_7$ ,  $\text{CuNa}_2\text{P}_2\text{O}_7 + 3\frac{1}{2}\text{H}_2\text{O}$ . (Very efflorescent, insol. in  $\text{H}_2\text{O}$  (F. and H.)  
+  $10\frac{1}{2}\text{H}_2\text{O}$ . (Pahl, Sv. V. A. F. 30, 7, 42.)  
 $\text{CuNa}_2\text{P}_2\text{O}_7$ ,  $\text{Na}_2\text{P}_2\text{O}_7$ . Sol. in  $\text{H}_2\text{O}$ . (F. and H.)  
+  $2\text{H}_2\text{O}$ . (F. and H.)  
+ 12, and  $16\text{H}_2\text{O}$ . Very efflorescent, and sol. in  $\text{H}_2\text{O}$ . (Pahl.)  
 $\text{Cu}_2\text{Na}_2\text{P}_2\text{O}_{10} + 10\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$  and  $\text{HNO}_3$  even after heating. (Stange, Z. anorg. 1896, 12, 456.)

Cupric uranyl phosphate,  $(\text{UO}_2)_2\text{Cu}(\text{PO}_4)_2 + 8\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Debray.)  
Min. *Chalcocite*. Sol. in  $\text{HNO}_3 + \text{Aq}$ .

Cupric *orthophosphate ammonia*,  $\text{Cu}_3(\text{PO}_4)_2 \cdot 4\text{NH}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$ . (Schiff, A. 123. 41.)  
 $2\text{CuO}$ ,  $3\text{P}_2\text{O}_5$ ,  $20\text{NH}_3 + 21\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ , with subsequent decomp. (Metzner, A. 149. 66.)

$2\text{CuO}$ ,  $\text{P}_2\text{O}_5$ ,  $6\text{NH}_3$ . (Mauerné.)

Cupric *pyrophosphate ammonia*,  $8\text{CuO}$ ,  $3\text{P}_2\text{O}_5$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$

Sl. sol. in  $\text{H}_2\text{O}$ . (Schwarzenberg, A. 65. 133.)

$\text{Cu}_2\text{P}_2\text{O}_7$ ,  $4\text{NH}_3 + \text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Schiff, A. 123. 1.)

Didymium *metaphosphate*,  $\text{D}_2(\text{PO}_3)_2$ .

Precipitate. (Smith.)

$\text{D}_2\text{O}_3$ ,  $5\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . (Cleve.)

Didymium *phosphate*,  $2\text{D}_2\text{O}_3$ ,  $3\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 107. 37.)

Didymium *orthophosphate*,  $\text{DiPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in dil. easily sol. in conc. acids. (Marignac.) Insol. in  $\text{H}_2\text{O}$ . (Wallroth, Bull. Soc. (2) 39. 316.)  
 $+ \text{H}_2\text{O}$ . (Frerichs and Smith, A. 191. 355.)

Didymium *trihydrogen phosphate*,

$\text{D}_2\text{H}_3(\text{PO}_4)_3$ .

Precipitate. (Frerichs and Smith.)

Existence is doubtful (Cleve, B. 12. 910.)

Didymium *hexahydrogen phosphate*,

$\text{DiH}_6(\text{PO}_4)_3 + \text{H}_2\text{O}$ .

Precipitate. (Hermann.)

Didymium *pyrophosphate*,  $\text{Di}_2(\text{P}_2\text{O}_7)_2 + 6\text{H}_2\text{O}$ .

Precipitate. (Cleve.)

Didymium *hydrogen pyrophosphate*,

$\text{DiH}_2(\text{P}_2\text{O}_7)_2$ .

Precipitate. Sol. in disodium pyrophosphate + Aq. (Frerichs and Smith, A. 191. 355.)

Does not exist. (Cleve.)

Didymium *potassium phosphate*,  $2\text{D}_2\text{O}_3$ ,

$3\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5 = 2\text{DiPO}_4$ ,  $\text{K}_3\text{PO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 107. 37.)

Didymium *sodium orthophosphate*,  $\text{D}_2\text{O}_3$ ,

$3\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5 = \text{DiPO}_4$ ,  $\text{Na}_3\text{PO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard.)

Didymium *sodium pyrophosphate*,  $\text{Di}_2\text{O}_3$ ,

$\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5 = \text{DiNaP}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 107. 37.)

Dysprosium *orthophosphate*,  $\text{DyPO}_4 + 5\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ .

Easily sol. in dil. acids or acetic acid. (Jantsch, B. 1911, 44. 1276.)

Erbium *phosphate*,  $\text{ErPO}_4 + \text{H}_2\text{O}$ .

Precipitate

Erbium *pyrophosphate*,  $\text{ErHP}_2\text{O}_7 + 3\frac{1}{2}\text{H}_2\text{O}$ .

Scarcely sol. in boiling  $\text{H}_2\text{O}$ . Slowly sol. in acids.

Erbium *sodium pyrophosphate*,  $\text{ErNaP}_2\text{O}_7$ .

Precipitate. (Wallroth.)

Glucinum *metaphosphate*,  $\text{Gl}(\text{PO}_3)_2$ .

Insol. in  $\text{H}_2\text{O}$  and acids. (Bleyer, Z. anorg. 1912, 79. 274)

Glucinum *orthophosphate*, basic.

$2\text{Gl}_2\text{P}_2\text{O}_7$ ,  $\text{GlO} + 13\text{H}_2\text{O}$ .

Ppt. (Bleyer, Z. anorg. 1912, 79. 268.)

Glucinum *orthophosphate*,  $\text{Gl}_2(\text{PO}_4)_3 + 6\text{H}_2\text{O}$ .

Precipitate. Insol. in  $\text{H}_2\text{O}$ . Sol. in acids (Atterberg, Sv. V. A. Handl. 12, 5. 33.)

1 l. 2%  $\text{HCl}$  + Aq. dissolves 0.55 g. of the anhydrous salt, 1 l. 10%  $\text{HCl}$  + Aq. dissolves 1.725 g. (Sestini, Gazz. ch. it. 20. 313.)

$+ 7\text{H}_2\text{O}$ . (Atterberg.)

Glucinum *hydrogen orthophosphate*,  $\text{GlHPO}_4 + 3\text{H}_2\text{O}$ .

$\text{GlH}_4(\text{PO}_4)_2$ , hygroscopic. (Bleyer, Z. anorg. 1912, 79. 268.)

Precipitated by alcohol. (Atterberg.)

Glucinum *phosphate*,  $5\text{GlO}$ ,  $2\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ .

Ppt. Sol. in  $\text{H}_2\text{O}$  with decomp. (Scheffer.)  
 $3\text{GlO}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{H}_2\text{O} + \text{H}_2\text{O}$ . (Sestini, Gazz. ch. it. 20. 313.)

Glucinum *pyrophosphate*,  $\text{Gl}_2\text{P}_2\text{O}_7 + 5\text{H}_2\text{O}$ .

Precipitate (Scheffer.)

Sol. in  $\text{Na}_4\text{P}_2\text{O}_7$  + Aq. (Stromeyer.)

Glucinum *potassium phosphate*,  $\text{GlKPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 110. 1333.)

Glucinum *sodium phosphate*,  $\text{GlNaPO}_4$ .

Sl. sol. in cold, easily sol. in hot acids. (Wallroth.) Insol. in acetic acid.

Min. *Beryllonite*.

$\text{GlO}$ ,  $2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 110. 1333.)

Gold (Auric) *sodium pyrophosphate* (?),

$\text{Au}_4(\text{P}_2\text{O}_7)_3$ ,  $2\text{Na}_4\text{P}_2\text{O}_7 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Persoz.)

Gold sodium *pyrophosphate*, ammonia,  $14\text{Au}_2\text{O}_3, 6\text{P}_2\text{O}_5, 3\text{Na}_2\text{O}, 14\text{NH}_3 + 24\text{H}_2\text{O}$   
Insol. in  $\text{H}_2\text{O}$ . (Gibbs, Am Ch J. 1895, 17. 172)

Iron (ferrous) *trimetaphosphate*,  $\text{Fe}(\text{P}_3\text{O}_{10})_2 + 12\text{H}_2\text{O}$ .

Rather sl sol in cold, more easily in hot  $\text{H}_2\text{O}$ . After ignition sol in  $\text{HCl} + \text{Aq}$  only after long boiling (Lundbom, Acta Lund. 1873. 17)

Ferrous *hexametaphosphate*,  $\text{Fe}_2\text{P}_6\text{O}_{18}$ .

When freshly pptd. is sol. in  $\text{H}_2\text{O}$ , and very sol. in least traces of acids, or  $\text{Na}_2\text{P}_6\text{O}_{18} + \text{Aq}$  (Lüdt, Z. anorg. 6. 15)

Ferrous phosphate, basic,  $7\text{FeO}, 2\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$ .

Min. *Ludlamis*. Sol. in dil.  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$ . Decomp by boiling  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ .

Ferrous orthophosphate,  $\text{Fe}_2(\text{PO}_4)_3$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids.  
Sol. in 1000 pts  $\text{H}_2\text{O}$  containing more than 1 vol.  $\text{CO}_2$  (Pierre)

Sol. in an excess of ferrous salts +  $\text{Aq}$   
Sol. in 560 pts.  $\text{H}_2\text{O}$  containing  $\frac{1}{1000}$  pt.  $\text{HCl} \cdot \text{H}_2\text{O}$ . Sol. in 1666 pts.  $\text{H}_2\text{O}$  containing 160 pts  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ . (Pierre, A. ch. (3) 36. 78.)

Sol in  $\text{NH}_4$  salts +  $\text{Aq}$ .  
Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  Not pptd. in presence of  $\text{Na}$  citrate.

Insol in acetone. (Naumann, B. 1904, 37. 4329.)

+  $\text{H}_2\text{O}$ . (Debray, A. ch. (3) 61. 437)  
+  $8\text{H}_2\text{O}$ . Min. *Vivandis*. Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . Boiling  $\text{KOH} + \text{Aq}$  dissolves out phosphoric acid. Sol. in cold citric acid +  $\text{Aq}$ . (Bolton, C. N. 37. 14)

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Evans, C. C. 1897, I. 580.)

Ferrous hydrogen orthophosphate,  $\text{FeHPO}_4 + \text{H}_2\text{O}$ .

Ppt (Debray, A. ch. (3) 61. 437.)  
Is impure  $\text{Fe}_2(\text{PO}_4)_3$ . (Erlenmeyer and Heinrichs, A. 194. 176.)

Ferrous *tetrahydrogen orthophosphate*,  $\text{FeH}_4(\text{PO}_4)_3 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Not changed by alcohol. (Erlenmeyer and Heinrichs, A. 194. 176.)

Ferrous *pyrophosphate*.

Ppt. Sol in an excess of  $\text{Na}_2\text{P}_2\text{O}_7$  or  $\text{FeSO}_4 + \text{Aq}$ . (Schwarzenberg, A. 65. 153.)

Ferric metaphosphate,  $\text{Fe}_2(\text{PO}_3)_2$  or  $\text{Fe}(\text{PO}_3)_3$ .

Insol. in  $\text{H}_2\text{O}$  or dil. acids Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Maddrell, Phil. Mag. (3) 30. 322.)

Iron (ferrio) *orthophosphate*, basic,  $2\text{Fe}_2\text{O}_3, \text{P}_2\text{O}_5 + x\text{H}_2\text{O}$

Insol. in  $\text{NH}_4$  citrate, sol in  $\text{NH}_4$  tartrate +  $\text{Aq}$ . (Wittstein.)

+  $3\text{H}_2\text{O}$ . Min *Krausite* Easily sol in  $\text{HCl} + \text{Aq}$

+  $4\text{H}_2\text{O}$  Ppt (Millet, C. R. 82. 89)

+  $6\text{H}_2\text{O}$  Min *Dufrenoyte*.  
+  $12\text{H}_2\text{O}$ . Min. *Cacoxene* Sol in  $\text{HCl} + \text{Aq}$ .

+ 18, or  $24\text{H}_2\text{O}$  Min *Delvausite*.

$5\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + 14\text{H}_2\text{O}$  Min. *Beraunite*

Sol. in  $\text{HCl} + \text{Aq}$

$3\text{Fe}_2\text{O}_3, 2\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Min *Eleonorite*.

Sol in  $\text{HCl} + \text{Aq}$

Ferric orthophosphate,  $\text{Fe}_3(\text{PO}_4)_2 + x\text{H}_2\text{O}$ , or  $2\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + x\text{H}_2\text{O}$ .

+ 4, or  $8\text{H}_2\text{O}$ . (Pptd. ferric phosphate.)

Insol. in  $\text{H}_2\text{O}$ . Sol in 1500 pts. boiling  $\text{H}_2\text{O}$ . (Bergmann, 1816.) Sol in pure  $\text{H}_2\text{O}$  when all traces of soluble salts are absent (Fresenius.) Very sl. sol. in, but decomp by  $\text{H}_2\text{O}$ . (Lachowicz, W. A. B. 101, 2b. 374.) For an extended discussion of solubility in and decomposition by  $\text{H}_2\text{O}$  and effect of salts see Cameron and Hurst, (J. Am. Chem. Soc. 1904, 26. 888.)

Easily sol in dil. mineral acids, excepting  $\text{H}_3\text{PO}_4 + \text{Aq}$  Insol. in cold  $\text{H}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Wittstein.) 100 cem. cold  $\text{H}_2\text{O}$  containing 10%  $\text{HCl} \cdot \text{H}_2\text{O}$  dissolve 0.007 g salt (Sestini, Gazz. ch. it 5. 252.) When freshly pptd. easily sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$ , or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Berthier.) Easily sol. in tartaric or citric acid +  $\text{Aq}$ , also in  $\text{NH}_4$  salts of those acids, and  $\text{Na}$  citrate +  $\text{Aq}$ . (Heydenreich, C. N. 4. 158.) See below.

Sol. in 12,500 pts  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$ . (Pierre, A. ch. (3) 36. 78.)

Insol. in  $\text{NH}_4$  salts +  $\text{Aq}$  (Wittstein.) Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  in presence of  $\text{Na}_2\text{HPO}_4$ ; insol. in hot  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ ; sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Berzelius).  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  dissolve out  $\text{H}_3\text{PO}_4$ .

Sol. in ferric salts +  $\text{Aq}$ , even ferric acetate, but insol. in ferrous acetate +  $\text{Aq}$ .

Partially sol. in large amt. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Not pptd. in presence of  $\text{Na}$  citrate. (Spiller.) Arth (Bull. Soc. (3) 2. 324) obtained a modification of  $\text{Fe}_2(\text{PO}_4)_3$  insol in  $\text{HNO}_3 + \text{Aq}$ , but sol. in hot conc  $\text{HCl} + \text{Aq}$ .

+  $4\text{H}_2\text{O}$ . Min. *Strengite*. Easily sol in  $\text{HCl} + \text{Aq}$ ; insol. in  $\text{HNO}_3 + \text{Aq}$

+  $5\text{H}_2\text{O}$ . Only sl. sol. in  $\text{H}_2\text{O}$  Slowly sol. in  $\text{HNO}_3$ , easily sol. in  $\text{HCl}$ . (Weinland, Z. anorg. 1913, 84. 361.)

Diammonium citrate +  $\text{Aq}$  dissolves 4.8% of the  $\text{P}_2\text{O}_5$ ; triammonium citrate, 5.8%  $\text{P}_2\text{O}_5$ ; and with an excess of  $\text{NH}_4\text{OH}$ , 21.2%  $\text{P}_2\text{O}_5$  is dissolved. (Erlenmeyer, B. 14. 1253.)

+  $9\text{H}_2\text{O}$ . Dissolves in 35 min in diammonium citrate +  $\text{Aq}$  (sp. gr. 1.09); in 55 min. in triammonium citrate +  $\text{Aq}$  (sp. gr. 1.09); citric acid +  $\text{Aq}$  (¼% citric acid) dissolves 17.5% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer, l. c.)

**Iron (ferric) phosphate, acid,  $8\text{Fe}_2\text{O}_3, 9\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Rumpler, Z anal. 12. 151.)  
 $6\text{Fe}_2\text{O}_3, 7\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ .  
 $4\text{Fe}_2\text{O}_3, 5\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

$2\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Ppt. Decomp. by  $\text{H}_2\text{O}$  finally into  $\text{Fe}_2(\text{PO}_4)_2$  (Erlenmeyer and Heinrich, A. 194. 176.)

$8\text{Fe}_2\text{O}_3, 11\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$ . As above (E. and H.)

$4\text{Fe}_2\text{O}_3, 7\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$ . As above. (E. and H.)

$\text{Fe}_2\text{O}_3, 2\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl}, \text{H}_2\text{SO}_4 + \text{Aq}$ ; sol. in  $\text{NH}_4$  citrate, alkali hydrates, or carbonates + Aq. (Winkler.) Slowly decomp. by  $\text{H}_2\text{O}$ . (E. and H.)

+  $10\text{H}_2\text{O}$ . (Warne, C. N. 36. 132)

$2\text{Fe}_2\text{O}_3, 5\text{P}_2\text{O}_5 + 17\text{H}_2\text{O}$ .

$\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + 6\text{H}_2\text{O} = \text{FeH}_2(\text{PO}_4)_2$ . Dehydroquiescent. Insol. in  $\text{H}_2\text{O}$ , but decomp. into  $\text{Fe}_2(\text{PO}_4)_2$ . (E. and H.)

+  $4\text{H}_2\text{O}$ . (Hautefeuille and Margottet, C. R. 108. 135.)

**Ferric pyrophosphate,  $\text{Fe}_4(\text{P}_2\text{O}_7)_2$ .**

*Two modifications*—(a) Sol. in acids,  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ ,  $\text{FeCl}_3 + \text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , and in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$

Insol. in acetic, sulphurous acid, or  $\text{NH}_4\text{Cl} + \text{Aq}$  Sol. in  $\text{NH}_4$  citrate + Aq. (Schwarzenberg, A. 65. 153)

(b) Insol. in dil acids,  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ ,  $\text{FeCl}_3 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Gladstone, Chem. Soc. (2) 5. 435)

**Solubility of  $\text{Fe}_4(\text{P}_2\text{O}_7)_2$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $0^\circ$**

100 g. sat. solution contain		100 g. sat. solution contain	
G $\text{NH}_3$	G $\text{Fe}_4(\text{P}_2\text{O}_7)_2$	G $\text{NH}_3$	G $\text{Fe}_4(\text{P}_2\text{O}_7)_2$
0.884	5.606	5.92	14.71
1.59	9.75	8.26	13.89
3.71	14.85	10.55	7.40
4.72	15.94	15.96	2.52
5.93	13.92	18.83	0.445
7.91	14.61		

(Pascal, A ch 1909, (8) 18. 374.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Appl. Ch. 6. 184.)

Insol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 828.)

**Ferroferric orthophosphate,  $2\text{Fe}_2(\text{PO}_4)_3, 3\text{Fe}_2\text{O}_3, 2\text{P}_2\text{O}_5 + 16\text{H}_2\text{O}$**

Ppt. Sol. in  $\text{HCl} + \text{Aq}$ . (Rammelsberg.)

$4\text{Fe}_2\text{O}_3, 6\text{FeO}, 5\text{P}_2\text{O}_5 + 40\text{H}_2\text{O}$ . Sol. in 40 min. in diammonium citrate + Aq (sp. gr. = 1.09); diammonium citrate + Aq (sp. gr. = 1.09) dissolves 55.7% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer, B. 14. 1253)

**Ferrous lithium phosphate,  $\text{Li}_2\text{PO}_4, \text{Fe}_2(\text{PO}_4)_2$ .**

Min. *Triphylite*. Easily sol. in acids; not wholly decomp. by  $\text{KOH} + \text{Aq}$ .

**Iron (ferrous) manganous phosphate,  $\text{Fe}_2(\text{PO}_4)_2, \text{Mn}_2(\text{PO}_4)_2$ .**

Min. *Triphite*. Easily sol. in  $\text{HCl} + \text{Aq}$   
 $5(\text{Mn}, \text{Fe})_2\text{O}_3, 2\text{P}_2\text{O}_5 + 5\text{H}_2\text{O}$ . Min. *Huraultite*. Sol. in acids

**Ferric manganous sodium phosphate,  $\text{FePO}_4, (\text{Na}, \text{Mn})_2\text{PO}_4 + \frac{1}{2}\text{H}_2\text{O}$**

Min.—(?)

**Ferrous manganous phosphate chloride,  $3(\text{Mn}, \text{Fe})_2(\text{PO}_4)_2, \text{MnCl}_2$ .**

(Deville and Caron)

**Ferrous manganous phosphate fluoride,  $(\text{Mn}, \text{Fe})_2(\text{PO}_4)_2, (\text{Mn}, \text{Fe})\text{F}_2$ .**

Min. *Triphite*, *Zwieselite*. Sol. in  $\text{HCl} + \text{Aq}$   
 $3(\text{Mn}, \text{Fe})_2(\text{PO}_4)_2, \text{MnF}_2$ . [(Deville and Caron, C. R. 47. 985)]

**Ferric potassium phosphate,  $2\text{Fe}_2\text{O}_3, 3\text{K}_2\text{O}, 3\text{P}_2\text{O}_5$ .**

Not attacked by boiling  $\text{H}_2\text{O}$ . (Ouvrard, A. ch. (6) 16. 289)

$\text{Fe}_2\text{O}_3, \text{K}_2\text{O}, 2\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ ; very sl. attacked by acids (Ouvrard.)

**Ferric silver metaphosphate,  $2\text{Fe}_2\text{O}_3, 2\text{Ag}_2\text{O}, 5\text{P}_2\text{O}_5$ .**

(Hautefeuille and Margottet, C. R. 96. 1142)

**Ferric silver pyrophosphate,  $\text{Fe}_3\text{Ag}_2(\text{P}_2\text{O}_7)_2 + 4\text{H}_2\text{O}$ .**

Ppt. (Pascal, C. R. 1908, 146. 232)

**Ferric sodium phosphate,  $2\text{Fe}_2\text{O}_3, 3\text{Na}_2\text{O}, 3\text{P}_2\text{O}_5$ .**

Decomp by  $\text{H}_2\text{O}$ . (Ouvrard.)

**Ferrous sodium triphosphate,  $\text{FeNa}_2\text{P}_3\text{O}_{10} + 11\frac{1}{2}\text{H}_2\text{O}$**

Stable dry; sol. in  $\text{HNO}_3$ ; decomp. in contact with  $\text{H}_2\text{O}$  (Stange, Z anorg. 1896, 12. 451)

**Ferric sodium hydrogen orthophosphate,  $\text{Fe}(\text{PO}_4)_2\text{H}_2\text{Na} + \text{H}_2\text{O}$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ . Slowly decomp by boiling with  $\text{H}_2\text{O}$  Sol. in dil.  $\text{HCl}$  and dil.  $\text{HNO}_3$ . Decomp by alkalis and alkali carbonates. (Weinland, Z. anorg. 1913, 84. 354)

$\text{Fe}(\text{PO}_4)_2\text{H}_2\text{Na} + \text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ . Decomp by boiling with  $\text{H}_2\text{O}$  Sol. in dil.  $\text{HCl}$  and in dil.  $\text{HNO}_3$ . Decomp. by alkalis and alkali carbonates (Weinland, Z. anorg. 1913, 84. 358)

**Ferric sodium pyrophosphate,  $\text{Fe}_4(\text{P}_2\text{O}_7)_2, 2\text{Na}_2\text{P}_2\text{O}_7 + 7\text{H}_2\text{O}$ .**

Slowly but completely sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol. (Milek, J. B. 1865, 263.)

Very sol in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg.)

+5, and  $6\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ , especially if warm (Pahl, J. B. 1873. 229.)

$\text{FeNaP}_2\text{O}_7$ . Insol. in  $\text{H}_2\text{O}$ , dil.  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ ; sl. sol. in conc.  $\text{HCl} + \text{Aq}$ ; decomp. by cone hot  $\text{H}_2\text{SO}_4$  without solution. (Jørgensen, J. pr (2) 16. 342.)

Insol. in acetone. (Naumann, B. 1904. 37. 4329.)

$\text{Na}_4\text{Fe}_2(\text{P}_2\text{O}_7)_3 + 9\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915. 48. 586.)

$\text{Fe}_2(\text{P}_2\text{O}_7)_3$ ,  $5\text{Na}_2\text{P}_2\text{O}_7 + 7\text{H}_2\text{O}$ . (Pahl, J. B. 1873. 229.)

**Iron (ferric) phosphate sulphate**,  $3\text{Fe}_2(\text{PO}_4)_3 \cdot 2\text{Fe}_2(\text{SO}_4)_3$ ,  $2\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .

Min. *Disacchite*.

**Lanthanum metaphosphate**,  $\text{La}_2(\text{PO}_3)_4$ .

Precipitate. (Frerichs and Smith.)

$\text{La}_2\text{O}_3$ ,  $5\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ , dil. or conc. acids. (Johnson, B. 22. 976.)

**Lanthanum orthophosphate**,  $\text{LaPO}_4$ .

Precipitate. (Hermann.)

Insol. in  $\text{H}_2\text{O}$  and acids (Ouvrard, C. R. 107. 37.)

**Lanthanum hydrogen phosphate**,

$\text{La}_2\text{H}_2(\text{PO}_4)_3$ .

Precipitate. (Frerichs, B. 7. 709.)

Existence is doubtful. (Cleve, B. 11. 910.)

**Lanthanum phosphate, acid**,  $\text{La}_2\text{O}_3$ ,  $2\text{P}_2\text{O}_5$ .

Precipitate (Hermann.)

**Lanthanum pyrophosphate**,  $\text{LaHP}_2\text{O}_7 + 3\text{H}_2\text{O}$ . (Cleve.)

$\text{La}_2\text{H}_2(\text{P}_2\text{O}_7)_2$ . Precipitate. (Frerichs and Smith.)

Does not exist. (Cleve.)

**Lanthanum potassium orthophosphate**,

$2\text{La}_2\text{O}_3$ ,  $3\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5 = 2\text{LaPO}_4$ ,  $\text{K}_2\text{PO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 107. 37.)

**Lanthanum sodium orthophosphate**,  $\text{La}_2\text{O}_3$ ,

$3\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard.)

**Lanthanum sodium pyrophosphate**,

$\text{LaNaP}_2\text{O}_7$ .

Insol. in acetic, and dil. cold mineral acids. Sol. in warm dil. acids. (Walroth.)

**Lead dimetaphosphate**,  $\text{Pb}_2\text{P}_2\text{O}_7$ .

Ppt. Almost insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Fleitmann, Pogg. 78. 253.)

**Lead trimetaphosphate**,  $\text{Pb}_3(\text{P}_3\text{O}_{10})_2 + 3\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than the corresponding Ag salt. (Fleitmann and Henneberg, A. 65. 304.)

Most insol. of the trimetaphosphates (Landbom, Acta Lund. 1873. 12.)

Anhydrous salt is insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (Landbom.)

**Lead tetametaphosphate**,  $\text{Pb}_4\text{P}_4\text{O}_{13}$ .

Insol. in  $\text{H}_2\text{O}$ .

More easily decomp. by acids than the other insol. metaphosphates. Easily decomp. by alkali hydrosulphides +  $\text{Aq}$  in the cold. (Fleitmann, Pogg. 78. 353.)

**Lead hexametaphosphate**,  $\text{Pb}_6\text{P}_6\text{O}_{19}$ .

Nearly insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Lüder, Z. anorg. 5. 15.)

**Lead orthophosphate, basic**,  $4\text{PbO}$ ,  $\text{P}_2\text{O}_5$ .

(Gerhardt, A. 72. 85.)

**Lead orthophosphate**,  $\text{Pb}_3(\text{PO}_4)_2$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq}$ .

Sl. sol. in  $\text{H}_2\text{O}$ .  $1.35 \times 10^{-4}$  g. is contained in 1 litre of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903. 48. 604.)

Not hydrolyzed by boiling  $\text{H}_2\text{O}$ . Sol. in boiling  $\text{KOH} + \text{Aq}$ , insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ . (Caven, J. Soc. Chem. Ind. 1897. 16. 30.)

Sol. in  $782.0$  pts.  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq}$  containing  $38.94$  pts. pure  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$ . (Bertrand, Monit. Scient. (3) 10. 477.)

Insol. in methyl acetate. (Naumann, B. 1909. 42. 3790); ethyl acetate. (Naumann, B. 1910. 43. 314.)

**Lead hydrogen phosphate**,  $\text{PbHPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{HNO}_3$ , or in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ . Insol. in  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq}$ . Sol. in cold  $\text{NH}_4\text{Cl} + \text{Aq}$  (Brett), from which it can be completely precipitated by a great excess of  $\text{NH}_4\text{OH} + \text{Aq}$ .

More sol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  at  $18.8-25^\circ$  than in pure  $\text{H}_2\text{O}$ . (Wappen.)

Sol. in sat.  $\text{NaCl} + \text{Aq}$ , but less than  $\text{PbSO}_4$ . (Bequerel, C. R. 20. 1524.)

Insol. in  $\text{Pb}$  salts +  $\text{Aq}$ .

Not pptd. in presence of  $\text{Na}$  citrate (Spillier.)

**Lead pyrophosphate**,  $\text{Pb}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ , or  $\text{KOH} + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$ , or  $\text{SO}_2 + \text{Aq}$ . (Schwaizenberg, A. 65. 133.) Sol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$  (Stromeyer.)

Insol. in acetone. (Naumann, B. 1904. 37. 4329.)

**Lead potassium phosphate**,  $\text{PbKPO}_4$ .

Decomp. by hot  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 110. 1333.)

**Lead sodium phosphate**,  $\text{PbNaPO}_4$ .

Very sol. in dil. acids. (Ouvrard, C. R. 110. 1333.)

$10\text{PbO}$ ,  $8\text{Na}_2\text{O}$ ,  $9\text{P}_2\text{O}_5$ . (Ouvrard.)

Lead sodium pyrophosphate,  $\text{PbNa}_2\text{P}_2\text{O}_7$ .

Insol. in hot  $\text{H}_2\text{O}$ . (Gerhardt, A. ch. (3) 22. 506.)

Lead triphosphate sodium pyrophosphate,  $\text{Pb}_2\text{Na}_4\text{P}_3\text{O}_{11} + 10\text{H}_2\text{O}$ .

Sol. in  $\text{HNO}_3$  after melting. (Stange, Z. anorg. 1806, 12. 459.)

Lead phosphate chloride,  $2\text{PbHPO}_4$ ,  $\text{PbCl}_2$ .

Insol. in boiling  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3$  + Aq. (Gerhardt, A. ch. (3) 22. 505.)

$2\text{Pb}_3(\text{PO}_4)_2$ ,  $\text{PbCl}_2$ . Ppt. (Heintz, Pogg. 73. 119.)

$3\text{Pb}_3(\text{PO}_4)_2$ ,  $\text{PbCl}_2$ . Min *Pyromorphite*. Sol. in  $\text{HNO}_3$  and  $\text{KOH}$  + Aq.

Sl. sol. in cold citric acid + Aq. (Bolton, C. N. 37. 14.)  
+  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HNO}_3$  + Aq. (Heintz.)

Lithium metaphosphate,  $\text{LiPO}_3$ .

Insol. in boiling  $\text{H}_2\text{O}$ . Scarcely sol. in acetic acid. Easily sol. in mineral acids. (Merling, Z. anal. 1879, 18. 565.)

Lithium tetrametaphosphate,  $\text{Li}_4\text{P}_4\text{O}_{12} + 4\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ . (Warschauer, Z. anorg. 1903, 36. 180.)

Lithium orthophosphate,  $\text{Li}_3\text{PO}_4$ .

Very slightly sol. in  $\text{H}_2\text{O}$ .

Sol. in 2530 pts. pure  $\text{H}_2\text{O}$  and 3920 pts. ammoniacal  $\text{H}_2\text{O}$ ; much more readily in  $\text{H}_2\text{O}$  containing  $\text{NH}_4$  salts. Easily sol. in  $\text{HCl}$  + Aq. or  $\text{HNO}_3$  + Aq. (Mayer, A. 98. 193.) Easily sol. in carbonic acid water. (Troost.) Sol. in dil. acids or acetic acid. (de Schulten, Bull. Soc. (3) 1. 479.)

Insol. in methyl acetate. (Naumann, B. 1903, 42. 3790.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II 1014.)

+  $\frac{1}{2}\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$ .

Lithium hydrogen phosphate,  $\text{Li}_2\text{HPO}_4$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Gmelin.) Sol. in 833 pts.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Rammelsberg.)

$\text{Li}_2\text{H}(\text{PO}_4)_2 + \text{H}_2\text{O}$ . Sol. in 200 pts.  $\text{H}_2\text{O}$ . (Rammelsberg.)

Lithium dihydrogen phosphate,  $\text{LiH}_2\text{PO}_4$ .

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

Heptalithium dihydrogen phosphate,

$\text{Li}_7\text{H}_2(\text{PO}_4)_4$ .  
+  $1\text{H}_2\text{O}$ , or  $2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

Lithium pentahydrogen phosphate,

$\text{LiH}_4(\text{PO}_4)_3 + \text{H}_2\text{O}$ .  
Deliquescent, and sol. in  $\text{H}_2\text{O}$ .

Lithium pyrophosphate,  $\text{Li}_4\text{P}_2\text{O}_7 + 2\text{H}_2\text{O}$   
(Rammelsberg, B. A. B. 1883. 21.)

Lithium manganous phosphate,  $\text{Li}_2\text{PO}_4$ ,  
 $\text{Mn}_2(\text{PO}_4)_2$ .

Min *Lithophilite*.

Lithium potassium metaphosphate,  $\text{Li}_2\text{O}$ ,  
 $2\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$ .

As  $\text{NH}_4$  comp. (Tammann, J. pr. 1892, (2) 45. 443.)

Lithium potassium pyrophosphate,  $\text{Li}_2\text{KP}_2\text{O}_7$ .  
(Kraut, A. 1878, 182. 170.)

Lithium sodium phosphate,  $3\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  
 $\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Ouvrard, C. R. 110. 1333.)

$2\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ . As above (Ouvrard.)

Lithium sodium pyrophosphate,  $\text{Li}_4\text{O}$ ,  $\text{Na}_2\text{O}$ ,  
 $\text{P}_2\text{O}_5$ .

$5\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ .  
 $4\text{Li}_2\text{O}$ ,  $6\text{Na}_2\text{O}$ ,  $5\text{P}_2\text{O}_5$ . (Kraut, A. 1876, 182. 168.)

Magnesium metaphosphate,  $\text{Mg}(\text{PO}_3)_2$ .

Insol. in  $\text{H}_2\text{O}$  or dil. acids, but sol. in  $\text{H}_2\text{SO}_4$  + Aq. (Maddrell, A. 61. 82.)

Not decomp. by very long digestion with alkali carbonates, or orthophosphates + Aq. (Fleitmann.)

Magnesium dimetaphosphate,  $\text{Mg}_2(\text{P}_2\text{O}_5)_2 + 9\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , decomp. by acids. (Fleitmann, Pogg. 78. 259.)

Magnesium trimetaphosphate,  $\text{Mg}_3(\text{P}_3\text{O}_9)_2$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ , more easily in hot  $\text{H}_2\text{O}$ . When ignited, insol. in boiling  $\text{HCl}$  + Aq. (Landborn.)

Cryst. with 12, or  $15\text{H}_2\text{O}$ .

Magnesium tetrametaphosphate,  $\text{Mg}_4\text{P}_4\text{O}_{12}$ .

Insol. in  $\text{H}_2\text{O}$ , somewhat sol. in  $\text{HCl}$  + Aq. More easily sol. in  $\text{HNO}_3$  + Aq, especially easily sol. in conc.  $\text{H}_2\text{SO}_4$ . (Glatzel, Dissert. 1880.)

+  $10\text{H}_2\text{O}$ . Sol. in 70 pts.  $\text{H}_2\text{O}$ . (Glatzel.)

Magnesium orthophosphate,  $\text{Mg}_3(\text{PO}_4)_2$ , and  
+ 5, or  $7\text{H}_2\text{O}$ .

1 litre  $\text{H}_2\text{O}$  dissolves 0.1 g. ignited  $\text{Mg}_3(\text{PO}_4)_2$  in 7 days, but 0.205 g. if freshly precipitated. (Voleker, J. B. 1862. 131.)

1 l.  $\text{H}_2\text{O}$  with 2 g.  $\text{NaCl}$  dissolves 75.8 mg.; 1 l.  $\text{H}_2\text{O}$  with 3 g.  $\text{NaNO}_3$  dissolves 61.9 mg.  $\text{Mg}_3(\text{PO}_4)_2$ . (Liebig, A. 106. 185.)

Easily sol. in acids, except in acetic acid. (Schaffner, A. 50. 145.)

Easily sol. in  $\text{H}_2\text{O}$  in presence of alkali salts.

+6½H<sub>2</sub>O. Sol in 30 min. in diammonium citrate+4q (sp. gr.=1.09); triammonium citrate+4q (sp. gr.=1.09) dissolves 37.5% of the P<sub>2</sub>O<sub>5</sub> (Erlenmeyer, B. 14. 1253.)  
 +20H<sub>2</sub>O. Sol. in 10 min. in diammonium citrate+4q (sp. gr.=1.09), triammonium citrate+4q (sp. gr.=1.09) dissolves 23.2% of the P<sub>2</sub>O<sub>5</sub>, sol. in 15 min. in ¼% citric acid +4q. (Erlenmeyer, l. c.)  
 Insol in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 838.)

**Magnesium hydrogen phosphate, MgHPO<sub>4</sub>+7H<sub>2</sub>O.**

Sol. in 322 pts. cold H<sub>2</sub>O in several days. If heated to 40° becomes milky, and separates a precipitate out at 100° of same salt, so that solution at 100° contains only 1 pt. salt in 498 pts. H<sub>2</sub>O. Much more sol. in H<sub>2</sub>O containing traces of acids, even dil. oxalic or acetic acids. (Graham, Phil. Mag. Ann. 2. 20.) Easily sol. in H<sub>2</sub>SO<sub>4</sub>+4q (Gerland, J. pt. (2) 4. 127.)

Sol in aqueous solution of Mg salts, but insol in Na<sub>2</sub>HPO<sub>4</sub>+4q. (Rose.) Sol. in sodium citrate+4q (Spiller.) When freshly precipitated it is sol. in hot NH<sub>4</sub>Cl+4q, and NH<sub>4</sub>OH+4q does not completely reprecipitate it, less sol. in NH<sub>4</sub>NO<sub>3</sub>+4q (Brett, Phil. Mag. (3) 10. 96.) Insol in alcohol (Berzelius.)

For solubility in H<sub>3</sub>PO<sub>4</sub>, see under MgO.

+½H<sub>2</sub>O. (Debray.)  
 +H<sub>2</sub>O. Easily sol. in dil. acids. (de Schulten, C. R. 100. 263.)  
 +3H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O, easily in acids (Stoklassa, Z. anorg. 3. 67.)  
 +4½H<sub>2</sub>O. (Bergmann)  
 +6H<sub>2</sub>O. (Debray.)

**Magnesium tetrahydrogen phosphate, MgH<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>.**

Not hygroscopic. Sol. in 5 pts. H<sub>2</sub>O without decomp. (Stoklassa, Z. anorg. 3. 67.)  
 +2H<sub>2</sub>O. Not hygroscopic. Sol. in H<sub>2</sub>O without decomp. (Stoklassa, Z. anorg. 1. 307.)  
 Decomp. by alcohol into MgHPO<sub>4</sub>+3H<sub>2</sub>O.

**Magnesium pyrophosphate, Mg<sub>2</sub>P<sub>2</sub>O<sub>7</sub>.**

Nearly insol. in H<sub>2</sub>O; readily sol. in HCl or HNO<sub>3</sub>+4q. (Fresenius.)  
 +3H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O, easily in HCl or HNO<sub>3</sub>+4q; sol. in H<sub>2</sub>SO<sub>4</sub>+4q, and Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+4q. (Schwarzenberg.)  
 Sol. in MgSO<sub>4</sub>+4q, and (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+4q.

**Magnesium tetraphosphate, Mg<sub>3</sub>P<sub>4</sub>O<sub>13</sub>.**

Insol. in H<sub>2</sub>O (Fleitmann and Henneberg, A. 65. 331.)

**Magnesium potassium dimetaphosphate, K<sub>2</sub>Mg<sub>2</sub>(P<sub>2</sub>O<sub>5</sub>)<sub>2</sub>.**

Very sol. in dil. acids. (Ouvrard, C. R. 1888, 106. 1729.)  
 +4H<sub>2</sub>O. Sol. in 10.2 pts. H<sub>2</sub>O. (Glatzel.)

**Magnesium potassium orthophosphate, MgKPO<sub>4</sub>.**

Sl. sol. in H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. Easily sol. in acids  
 +6H<sub>2</sub>O  
 2MgO, K<sub>2</sub>O, 3P<sub>2</sub>O<sub>5</sub>. Insol. in H<sub>2</sub>O; sol. in dil. HCl+4q. (Ouvrard, C. R. 106. 1729.)  
 Mg<sub>2</sub>HK(PO<sub>4</sub>)<sub>2</sub>+15H<sub>2</sub>O. (Haushofer.)

**Magnesium rubidium orthophosphate, RbMgPO<sub>4</sub>+6H<sub>2</sub>O.**

Easily sol. in warm dil. HCl+4q.  
 Not decomp. by boiling H<sub>2</sub>O (Erdmann, A. 1897, 294. 73.)

**Magnesium sodium triphosphate, MgNa<sub>2</sub>P<sub>3</sub>O<sub>10</sub>+13H<sub>2</sub>O.**

Decomp. in the air (Stange, Z. anorg. 1896, 12. 454.)

**Magnesium sodium metaphosphate, 3MgO, Na<sub>2</sub>O, 4P<sub>2</sub>O<sub>5</sub>.**

Insol. in H<sub>2</sub>O or H<sub>3</sub>PO<sub>4</sub>+4q. Scarcely sol. in HCl+4q, or aqua regia. Not decomp. by (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+4q. Sol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Maddrell, A. 61. 53.)

**Magnesium sodium dimetaphosphate, MgNa<sub>2</sub>(P<sub>2</sub>O<sub>5</sub>)<sub>2</sub>+4H<sub>2</sub>O.**

Sol. in 25 pts. H<sub>2</sub>O. (Glatzel, Dissert 1880.)

**Magnesium sodium trimetaphosphate, MgNa<sub>3</sub>(P<sub>3</sub>O<sub>9</sub>)<sub>2</sub>+5H<sub>2</sub>O.**

Sl. sol. in H<sub>2</sub>O. After ignition is insol. in H<sub>2</sub>O. (Lindborn.)

**Magnesium sodium phosphate, 10MgO, 8Na<sub>2</sub>O, 9P<sub>2</sub>O<sub>5</sub>.**

Insol. in H<sub>2</sub>O; easily sol. in dil. acids. (Ouvrard, C. R. 106. 1729.)

**Magnesium sodium orthophosphate, MgNaPO<sub>4</sub>.**

Insol. in H<sub>2</sub>O. (Rose.)  
 +9H<sub>2</sub>O. (Schoecker and Violet, A. 140. 232.)  
 MgO, 2Na<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>. Insol. in H<sub>2</sub>O. (Ouvrard.)  
 3MgO, 3Na<sub>2</sub>O, 2P<sub>2</sub>O<sub>5</sub>. Insol. in H<sub>2</sub>O. (Ouvrard.)

**Magnesium sodium pyrophosphate, basic (?).**

Precipitate; sl. sol. in H<sub>2</sub>O. Easily in HCl+4q, HNO<sub>3</sub>+4q, and Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+4q (Baer, Pogg. 75. 188.)  
 Sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+4q, and in MgSO<sub>4</sub>+4q.  
 Insol. in alcohol.

**Magnesium phosphate chloride, Mg<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>, MgCl<sub>2</sub>.**

(Deville and Caron, A. ch. (3) 67. 455.)

**Magnesium pyrophosphate nitrogen dioxide,**  
 $\text{Mg}_2\text{P}_2\text{O}_7, \text{H}_2\text{O}, \text{NO}_2$ .

Scarcely sol in water. (Lueck, Z. anal. 13. 255)

**Magnesium phosphate fluoride,  $\text{Mg}_3(\text{PO}_4)_2$ ,  $\text{MgF}_2$ .**

Min. *Wagnerite*. Slowly sol in hot  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4$ .

**Magnesium phosphate calcium fluoride,**  
 $2\text{Mg}_3(\text{PO}_4)_2, \text{CaF}_2$

Min. *Kjerulfite*.

**Manganous dimetaphosphate,  $\text{Mn}_2(\text{P}_2\text{O}_6)_2$ .**

Anhydrous Insol in  $\text{H}_2\text{O}$  and dil. acids (Fleitmann.) Sol. in conc  $\text{H}_2\text{SO}_4$ . (Madrell.) Scarcely attacked by warm  $\text{Na}_2\text{S} + \text{Aq}$ , and not much more by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Decomp. by  $\text{Na}_2\text{CO}_3 + \text{Aq}$   $+ 8\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$  and dil. acids. (Fleitmann, Pogg 78. 257.)

**Manganous trimetaphosphate,  $\text{Mn}_3(\text{P}_3\text{O}_{10})_2 + 11\text{H}_2\text{O}$ .**

Difficultly sol. in cold or warm  $\text{H}_2\text{O}$ . More easily sol in cold, very easily in warm  $\text{HCl} + \text{Aq}$ . When ignited, is insol. in acids, even aqua regia. (Landborn.)

**Manganous hexametaphosphate.**

Sol in sodium hexametaphosphate  $+ \text{Aq}$ . (Rose, Pogg. 76. 4.)

$\text{Mn}_6\text{P}_{10}\text{O}_{46}$ . Nearly insol. in  $\text{H}_2\text{O}$ ; easily sol in acids. (Lüder, Z. anorg. 6. 15)

**Manganic metaphosphate,  $\text{Mn}(\text{PO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$  or acids, decomp. by alkalis. (Sehjerning, J pr. (2) 45. 515)

Insol. in  $\text{H}_2\text{O}$ , sol. in  $\text{HCl}$ ; decomp. by alkalis  $+ \text{Aq}$  (Barbier, C. R. 1902, 136. 1035)

$+ \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or acids, except  $\text{HCl} + \text{Aq}$ . Sl decomp. by boiling with  $\text{H}_2\text{SO}_4$ . (Hermann, Pogg. 74. 303.)

**Manganous tetrametaphosphate,  $\text{Mn}_2(\text{PO}_2)_4$ .**

Not attacked by acids. (Glatzel, Dissert. 1880.)

$+ 10\text{H}_2\text{O}$ . Sol. only in boiling conc.  $\text{H}_2\text{SO}_4$ . (Glatzel.)

**Manganous dekametaphosphate,**

$5\text{MnO}, 5\text{P}_2\text{O}_5 + 12\text{H}_2\text{O}$ .

Ppt. (Tammann, J pr. 1892, (2) 45. 450.)

**Manganous orthophosphate,  $\text{Mn}_2(\text{PO}_4)_2$ .**

$+ \text{H}_2\text{O}$ . (Debray)

$+ 3\text{H}_2\text{O}$ . Sol. in 20 min. in diammonium citrate  $+ \text{Aq}$  (sp. gr. = 1.09); triammonium citrate  $+ \text{Aq}$  (sp. gr. = 1.09) dissolves 30.2% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer, B. 14. 1253.)

$+ 4\frac{1}{2} - 5\frac{1}{2}\text{H}_2\text{O}$ . Efflorescent (Erlenmeyer and Heinrich, A. 190. 208.)

$+ 7\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.) Easily sol. in mineral acids; sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ .

Easily sol. in  $\text{SO}_2 + \text{Aq}$  (Gerland, J. pr. (2) 4. 97)

Somewhat sol. in boiling  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , but deposited on cooling (Berzelius.)

Partly sol in cold  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Jrett.)

Sol. in cold or hot solutions of ammonium sulphate or succinate. (Wittstein)

Sl. sol. in Mn salts  $+ \text{Aq}$ . (Rose, Pogg. 76. 25)

Insol. in alcohol

Sol. in 10 min. in diammonium citrate  $+ \text{Aq}$  (sp. gr. = 1.09); triammonium citrate  $+ \text{Aq}$  (sp. gr. = 1.09) dissolves 53% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer, B. 14. 1253.)

**Manganous dihydrogen orthophosphate,**  
 $\text{MnHPO}_4 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Solution decomp at  $100^\circ$ . (Debray) Slowly decomp. by cold  $\text{H}_2\text{O}$  into  $\text{Mn}_2(\text{PO}_4)_2$ . (Erlenmeyer and Heinrich, A. 190. 208)

Easily sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Gerland.)

Sl. sol in  $\text{HC}_2\text{H}_3\text{O}_2$ , easily in conc mineral acids. (Heintz.) Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , from which it is reprecipitated on boiling. Decomp. by boiling  $\text{KOH} + \text{Aq}$ .

Insol in alcohol.

$\text{Mn}_2(\text{PO}_4)_3, 2\text{MnHPO}_4 + 4\text{H}_2\text{O}$ . (de Schulten, C. C. 1905, I 188.)

**Manganous tetrahydrogen phosphate,**  
 $\text{MnH}_2(\text{PO}_3)_2 + 2\text{H}_2\text{O}$ .

Deliquescent Easily sol. in  $\text{H}_2\text{O}$ , with decomp. to  $\text{MnHPO}_4$ . (Erlenmeyer and Heinrich, A. 190. 208)

Not decomp by  $\text{H}_2\text{O}$ . (Otto, C. C. 1887. 1563.)

$\text{H}_2\text{O}$  decomp. it into  $\text{MnHPO}_4$  and  $\text{H}_2\text{PO}_4$ , containing some dissolved salt. The less  $\text{H}_2\text{O}$  used, the more  $\text{MnHPO}_4$  separates. The acid filtrate separates  $\text{MnHPO}_4$  on boiling. At  $0^\circ$  the decomp. increases in proportion to the amt. of salt, but 1 g. of the salt is unchanged in 100 g.  $\text{H}_2\text{O}$ . With less than 20 g. of salt to 100 g.  $\text{H}_2\text{O}$  the decomp. is analogous to that of  $\text{CaH}_2(\text{PO}_3)_2$ , but with larger amts. of salt it is the opposite, becoming less with increasing amts. of the salt. (Viard, C. R. 1899, 129. 412)

Alcohol dissolves out  $\text{H}_2\text{PO}_4$ . (Heintz.)

**Pentamanganous dihydrogen phosphate,**

$\text{Mn}_5\text{H}_2(\text{PO}_4)_4 + 4\text{H}_2\text{O}$ .

Not decomp. by boiling  $\text{H}_2\text{O}$  (Erlenmeyer and Heinrich, A. 190. 208.)

**Manganic orthophosphate, basic,  $\text{Mn}_3\text{P}_2\text{O}_8 + \text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ .

Manganic orthophosphate,  $\text{MnPO}_4 \cdot \text{H}_2\text{O}$ .

Sol. in acids. (Christensen, J. pr. (2) 28. 1.)

Manganous pyrophosphate,  $\text{Mn}_2\text{P}_2\text{O}_7$ .

Anhydrous (Lewis, Sill. Am J. (3) 14. 281.)

+  $\text{H}_2\text{O}$ .  
+  $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{MnSO}_4$  + Aq. but sol in  $\text{Na}_2\text{P}_2\text{O}_7$  + Aq. (Rose.)

Difficultly sol. in  $\text{Na}_2\text{P}_2\text{O}_7$  + Aq. but easily sol in  $\text{K}_4\text{P}_2\text{O}_7$  + Aq. (Pahl.) Decomp. by  $\text{KOH}$  + Aq. Sol. in  $\text{H}_2\text{SO}_4$  + Aq. (Schwarzenberg.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Manganous hydrogen pyrophosphate,

$\text{MnH}_2\text{P}_2\text{O}_7 \cdot 4\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Pahl.)

Manganic pyrophosphate,

$\text{Mn}_2\text{P}_2\text{O}_7 \cdot 14\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$  (Auger, C. R. 1901, 133. 95.)

$\text{MnH}_2\text{P}_2\text{O}_7$ . Insol. in  $\text{H}_2\text{O}$ ; very sl. attacked by dil  $\text{HCl}$  + Aq. easily by conc. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Schjerning, J. pr. (2) 45. 515.)

Manganous potassium dimetaphosphate,  $\text{K}_2\text{Mn}(\text{PO}_3)_2 \cdot 6\text{H}_2\text{O}$ .

Sol. in 95 pts  $\text{H}_2\text{O}$ . When ignited is not attacked by acids. (Glatzel, Dissert. 1880.)

Manganous potassium orthophosphate,

$\text{MnKPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ , easily sol. in dil. acids (Ouvrard.)

Manganic potassium pyrophosphate,

$\text{MnKP}_2\text{O}_7$ .

+  $5\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ .  
+  $3\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 584.)

Manganous potassium phosphate,  $\text{MnK}_2\text{P}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids (Ouvrard, C. R. 1906, 1729.)

+  $8\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Pahl.)  
 $\text{Mn}_2\text{P}_2\text{O}_7$ ,  $2\text{K}_2\text{P}_2\text{O}_7$  +  $10\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$  (Pahl.)

Manganic potassium pyrophosphate,

$\text{MnKP}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids and bases. (Schjerning.)

Manganic silver pyrophosphate,

$\text{AgMn}_2\text{P}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$ .

Almost insol. in  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 585.)

Manganous sodium triphosphate,

$\text{MnNa}_3\text{P}_3\text{O}_{10} \cdot 12\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ , the melt obtained by heating the salt is readily sol. in  $\text{H}_2\text{SO}_4$ . (Stange, Z. anorg. 1896, 12. 455.)

Manganous sodium dimetaphosphate,

$\text{MnNa}_2(\text{PO}_3)_2 \cdot 6\text{H}_2\text{O}$ .

Easily sol. in boiling  $\text{H}_2\text{SO}_4$ , but not attacked by acids after boiling. (Glatzel, Dissert. 1880.)

Manganous sodium trimetaphosphate,

Sol. in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg.)  
 $\text{MnNa}(\text{PO}_3)_3$ . Insol. in  $\text{H}_2\text{O}$ , dil. acids, or alkalis. (Schjerning, J. pr. (2) 45. 515.)

Manganous sodium octometaphosphate,

$\text{Mn}_2\text{Na}_2(\text{PO}_3)_8$ .

Insol. in acids except conc.  $\text{H}_2\text{SO}_4$  (Tammann, J. pr. 1892, (2) 45. 469.)

+  $5\text{H}_2\text{O}$ . Almost insol. in cold  $\text{H}_2\text{O}$ .  
Decomp. by boiling  $\text{H}_2\text{O}$  with separation of  $\text{Mn}_2\text{O}_3$ . (Rosenheim, B. 1915, 48. 584.)

Manganous sodium orthophosphate,

$\text{MnNaPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 1906, 1729.)  
 $\text{MnO}$ ,  $2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ . As above.

Manganous sodium pyrophosphate,

$\text{MnNa}_2\text{P}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Wallroth.)

+  $4\frac{1}{2}\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Pahl.)  
 $3\text{Mn}_2\text{P}_2\text{O}_7$ ,  $2\text{Na}_4\text{P}_2\text{O}_7$  +  $24\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$  (Pahl.)

Manganic sodium pyrophosphate,  $\text{MnNa}_2\text{P}_2\text{O}_7$ .

+  $\text{H}_2\text{O}$ .

(Christensen, J. pr. (2) 28. 1.)

Manganic dypyrophosphate ammonia,

$\text{Mn}_2\text{F}_2\text{O}_{14}$ ,  $2\text{NH}_3$ .

Insol. in  $\text{H}_2\text{O}$ .  
Decomp. by  $\text{HCl}$  and by alkalis (Barbier, C. R. 1902, 135. 1109.)

Manganous phosphate chloride,  $\text{Mn}_2(\text{PO}_4)_2$ .

$\text{MnCl}_2$ .

Insol. in  $\text{H}_2\text{O}$ . (Deville and Caron, A. ch. (3) 67. 459.)

$3\text{Mn}_2(\text{PO}_4)_2$ ,  $\text{MnCl}_2$ . Insol. in  $\text{H}_2\text{O}$ . (Deville and Caron.)

Mercurous hexametaphosphate (?).

Ppt. Sol. in sodium hexametaphosphate + Aq. (Rose.)

$\text{Hg}_2\text{P}_6\text{O}_{18}$ . Insol. in  $\text{H}_2\text{O}$ , very sl. sol. in acids. (Lüdtke, Z. anorg. 5. 15.)

Moderately sol. in  $\text{H}_2\text{O}$  when freshly pptd. More sol. in acids than the mercurous salt. (Lüdtke.)

**Mercurous orthophosphate,  $(\text{Hg}_2)_2(\text{PO}_4)_2$** 

Ppt. Decomp. by boiling with  $\text{H}_2\text{O}$ . (Geihardt.)

Sol. in  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$ . Insol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ .

**Mercuric orthophosphate,  $\text{Hg}_3(\text{PO}_4)_2$** 

Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in hot  $\text{H}_2\text{O}$ , crystallizing out on cooling. (Haack, A. 262. 185. Slowly sol. in cold dil., quickly in hot dil. or cold conc.  $\text{HCl} + \text{Aq}$ . Less easily sol. in  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$  (Berzelius.) Insol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ . (Haack.) Decomp. by  $\text{NaCl} + \text{Aq}$  into insol.  $\text{HgCl}_2$ ,  $3\text{H}_2\text{O}$ , but sol. in  $\text{NaCl} + \text{Aq}$ , containing  $\text{HNO}_3$ . (Haack.)

Sol. in 6 pts.  $\text{NH}_4\text{Cl}$  in aqueous solution by heating (Trommsdorff.)

Sol. in  $(\text{NH}_4)_2\text{CO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Wittstein.)

Insol. in alcohol

**Mercuriomercuric orthophosphate,  $7\text{Hg}_2\text{O}$ ,  $11\text{HgO}$ ,  $2\text{P}_2\text{O}_5 + 20\text{H}_2\text{O}$** 

(Brooks, Pogg. 66. 63.)

**Mercurous pyrophosphate,  $\text{Hg}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}$** 

Sol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , when recently pptd. Insol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , when heated to  $100^\circ$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . Decomp. by  $\text{HCl} + \text{Aq}$  (Schwarzenberg, A. 65. 133.)

**Mercuric pyrophosphate,  $\text{Hg}_2\text{P}_2\text{O}_7$** 

Sol. in acids; insol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , after being heated to  $100^\circ$ . Sol. in  $\text{NaCl} + \text{Aq}$ ; quickly decomp. by  $\text{NaOH} + \text{Aq}$ , and  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ .

Sol. in 6 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Trommsdorff.) Sol. in  $\text{NH}_4\text{NO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ ; also in  $\text{KI} + \text{Aq}$ .

**Mercurous silver orthophosphate,  $\text{AgHg}_2\text{PO}_4$** 

Sol. in  $\text{HNO}_3$ . (Jacobsen, Bull. Soc. 1909, (4) 5. 949.)

**Molybdenum phosphate,  $\text{Mo}_2(\text{PO}_4)_2$  (?)**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{MoCl}_5 + \text{Aq}$ .

**Molybdenum sodium pyrophosphate,**

$\text{Na}(\text{MoP}_2\text{O}_7) + 12\text{H}_2\text{O}$

Ppt. (Rosenheim, B. 1915, 48. 589.)

**Nickel dimetaphosphate,  $\text{NiP}_2\text{O}_6$** 

Insol. in  $\text{H}_2\text{O}$  or dil. acids. Sol. in conc.  $\text{H}_2\text{SO}_4$ . Not decomp. by boiling alkali carbonates or sulphides +  $\text{Aq}$ . (Maddrell, A. 61. 58.)

+  $4\text{H}_2\text{O}$ . Sol. in cold acids. (Glatzel, Dissert. 1880.)

**Nickel tetrametaphosphate,  $\text{Ni}_2\text{P}_4\text{O}_{12}$** 

Insol. in  $\text{HCl}$ . Sol. in conc.  $\text{HNO}_3$  and especially sol. in  $\text{H}_2\text{SO}_4$  on boiling. (Glatzel.)

**Nickel tetrametaphosphate,  $\text{Ni}_2\text{P}_4\text{O}_{12} + 12\text{H}_2\text{O}$** 

Easily sol. in acids. (Glatzel.)

**Nickel orthophosphate,  $\text{Ni}_3(\text{PO}_4)_2 + 7\text{H}_2\text{O}$** 

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Rammelsberg, Pogg. 68. 383.)

Sol. in  $\text{Ni}$  salts +  $\text{Aq}$ . (Rose, Pogg. 76. 25.)

Insol. in  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ . (Tupputi, 1811.)

Very sl. sol. in hot  $(\text{NH}_4)_2\text{HPO}_4 + \text{Aq}$

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethylacetate (Naumann, B. 1910, 43. 314.)

**Nickel pyrophosphate,  $\text{Ni}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$** 

Insol. in  $\text{H}_2\text{O}$ ; sol. in mineral acids,  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ . Not pptd. from  $\text{Ni}_2\text{P}_2\text{O}_7 + \text{Aq}$  by alcohol (Schwarzenberg, A. 66. 158.)

**Nickel potassium dimetaphosphate,**

$\text{NiK}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$

Sol. in 130 pts.  $\text{H}_2\text{O}$  (Glatzel.)

**Nickel potassium orthophosphate,  $\text{Ni}_3\text{KPO}_4$** 

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Ouvrad, R. 106. 1729.)

$3\text{NiO}$ ,  $3\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ . As above.

**Nickel sodium triphosphate,  $\text{Na}_2\text{NiP}_3\text{O}_{11} + 12\text{H}_2\text{O}$** 

Very sol. in  $\text{H}_2\text{O}$ ; decomp. in  $\text{Aq}$  solution. (Schwarz, Z. anorg. 1895, 9. 261.)

**Nickel sodium metaphosphate,  $3\text{Ni}(\text{PO}_3)_2$ ,  $\text{NaPO}_3$** 

Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Maddrell, A. 61. 56.)

$\text{NiNa}_2(\text{PO}_3)_2 + 8\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Lindbom.)

**Nickel sodium dimetaphosphate,  $\text{NiNa}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$** 

Sl. sol. in  $\text{H}_2\text{O}$ . Moderately sol. in acids. (Glatzel, Dissert. 1880.)

**Nickel sodium trimetaphosphate,**

$\text{Ni}_3\text{Na}_3(\text{P}_3\text{O}_{10})_2 + 9\text{H}_2\text{O}$

1 l.  $\text{H}_2\text{O}$  dissolves 60 g. at  $20^\circ$ . (Tammann, J. pr. 1892, (2) 45. 426.)

$\text{Na}_3\text{NiP}_3\text{O}_{10} + 12\text{H}_2\text{O}$ . Insol. and not decomp. by  $\text{H}_2\text{O}$ . Sol. in acids. (Schwarz, Z. anorg. 1895, 9. 261.)

**Nickel sodium octometaphosphate,**

$\text{Na}_2\text{Ni}_3(\text{PO}_3)_8$

(Tammann, J. pr. 1892, (2) 45. 469.)

**Nickel sodium orthophosphate,  $\text{NiNaPO}_4 + 7\text{H}_2\text{O}$** 

Ppt. (Debray, C. R. 59. 40.)

$\text{NiO}$ ,  $2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Ouvrad.)

**Nickel sodium pyrophosphate,**

Insol. in  $\text{H}_2\text{O}$  Moderately sol. in acids (Wallroth)

**Osmium phosphate (?)**

Sl sol in  $\text{H}_2\text{O}$ ; sol in  $\text{HNO}_3 + \text{Aq}$  (Berzelius.)

**Palladium orthophosphate (?)**

Ppt.

**Phosphorus phosphate,  $4\text{P}_2\text{O}_5, 3\text{P}_2\text{O}_6$  (?)**

Decomp. spontaneously Sol in  $\text{H}_2\text{O}$  and alcohol when fresh; insol. in ether. (le Verner, A. 27. 167; Reinitzer, B. 14. 1884)

**Platinum phosphate,  $\text{PtP}_2\text{O}_7$ .**

Insol. in  $\text{H}_2\text{O}$ , acids and alkalies. Decomp. by fusing with potassium carbonate (Barnett, C N 1895, 71. 256.)

**Potassium monometaphosphate,  $\text{KPO}_3$** 

Nearly insol. in  $\text{H}_2\text{O}$ ; sol in weak acids, even in acetic acid (Maddrell, A. 61. 62)

Insol. in  $\text{H}_2\text{O}$  and weak acids (Fleitmann, Pogg. 78. 250)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829)

**Potassium dimetaphosphate,  $\text{K}_2\text{P}_2\text{O}_5 + \text{H}_2\text{O}$ .**

Sol. in 1.2 pts. cold  $\text{H}_2\text{O}$ , but not more in hot  $\text{H}_2\text{O}$ . (Fleitmann, Pogg. 78. 250)

**Potassium trimetaphosphate,  $\text{K}_3\text{P}_3\text{O}_9$ .**

Very sol. in cold  $\text{H}_2\text{O}$  before it is fused. (Lundborn, Acta Lund. 1873. 14)

**Potassium orthophosphate,  $\text{K}_3\text{PO}_4$ .**

Not deliquescent. Very sol in  $\text{H}_2\text{O}$  (Graham, Pogg. 32. 47)

Very sl. sol. in cold; easily in hot  $\text{H}_2\text{O}$  (Darracq)

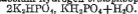
**Solubility in  $\text{H}_2\text{PO}_4 + \text{Aq}$  at  $25^\circ$ .**

In 1000 g. of the solution, mols

K	$\text{PO}_4$
9.14	3.13
8.84	3.22
8.42	3.44
7.52	3.78
6.90	4.15
6.88	4.12

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 103.)

Insol. in alcohol

**Potassium hydrogen orthophosphate,**

Very unstable; very sol in  $\text{H}_2\text{O}$  with decomp. Identical with the substance de-

scribed as dipotassium phosphate by Berzelius. (Staudenmaier, Z. anorg. 1894, 5. 389.)

$3\text{K}_2\text{HPO}_4, \text{KH}_2\text{PO}_4 + 2\text{H}_2\text{O}$ . Very unstable, very sol in  $\text{H}_2\text{O}$  with decomp (Staudenmaier.)

**Potassium hydrogen orthophosphate,**

Deliquescent Very sol. in  $\text{H}_2\text{O}$  and alcohol

**Solubility in  $\text{H}_2\text{PO}_4 + \text{Aq}$  at  $25^\circ$ .**

In 1000 g. of the solution, mols

K	$\text{PO}_4$
6.80	4.08
6.80	4.05
6.76	3.96
6.50	3.81
6.16	3.61
5.24	3.25
4.42	2.94

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 103.)

**Potassium dihydrogen phosphate,  $\text{KH}_2\text{PO}_4$** 

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Vauquelin, A. ch. 74. 98.)

11 sat. aq solution at  $7^\circ$  contains 249.9 g.  $\text{KH}_2\text{PO}_4$ . (Muthmann and Kuntze, Z. Kryst. Min. 1894, 23. 308.)

**Solubility in  $\text{H}_2\text{PO}_4 + \text{Aq}$  at  $25^\circ$ .**

In 1000 g. of the solution, mols.

K	$\text{PO}_4$
2.90	2.36
1.70	1.71
1.60	1.67
1.48	1.46
1.78	3.15
2.18	4.65
2.54	6.32
2.66	6.76
2.98	8.03
3.32	8.80

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 103.)

Sp. gr. of  $\text{KH}_2\text{PO}_4 + \text{Aq}$  at  $18^\circ$  containing:

5 10 15%  $\text{KH}_2\text{PO}_4$ .  
1.0341 1.0691 1.1092

(Kohrausch, W. Ann 1879. 1.)

Sol. in 20%  $\text{KC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Stromeyer.)

For solubility in  $\text{H}_2\text{O}$ , see  $\text{K}_2\text{HPO}_4, \text{H}_2\text{PO}_4$ .

Insol. in alcohol

Potassium *orthophosphate*, acid,  $\text{KH}_2\text{PO}_4$ ,  $\text{H}_3\text{PO}_4$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{KH}_2\text{PO}_4$ in $\text{H}_2\text{O}$	Solst phase
- 0.6	3 337	Ice
- 2.5	12 13	
- 6 7	29 43	
- 9.2	36.98	
-13	44	Ice + $\text{KH}_2\text{PO}_4$
0 (?)	45 8	
+10.9	50 3	"
65 2	68 44	
78	72 43	"
87 5	77 6	
105 5	85 9	" + $\text{KH}_2\text{PO}_4$ , $\text{H}_3\text{PO}_4$
120	92 1	
135	96 1	
139	100	

(Parravano and Mieli, Gazz. ch. it. 38. II, 536.)

Solubility in anhydrous  $\text{H}_3\text{PO}_4$  at  $t^\circ$ .

$t^\circ$	% $\text{KH}_2\text{PO}_4$ in $\text{H}_3\text{PO}_4$
38.5	18 17
84	58.42
110	77 53
126.5	92 26

(Parravano and Mieli.)

Potassium *pyrophosphate*,  $\text{K}_2\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$

Very deliquescent, and sol in  $\text{H}_2\text{O}$ .

Precipitated from aqueous solution by alcohol (Schwarzenberg, A 65. 136)

Insol. in methyl acetate. (Naumann, B. 1903, 42. 3790.)

Potassium hydrogen *pyrophosphate*,  $\text{K}_2\text{H}_2\text{P}_2\text{O}_7$ .

Very deliquescent, and sol in  $\text{H}_2\text{O}$ . Insol. in alcohol (Schwarzenberg.)

Potassium silver *metaphosphate*,  $\text{K}_2\text{Ag}_2(\text{PO}_3)_4 + \text{H}_2\text{O}$ .

(Tammann, J pr 1892, (2) 45. 417.)

Potassium sodium *dimetaphosphate*,  $\text{KNaP}_2\text{O}_6 + \text{H}_2\text{O}$ .

Sol. in 24 pts.  $\text{H}_2\text{O}$ . (Fleitmann, Pogg 78. 339.)

Potassium sodium phosphate,  $\text{KNaHPO}_4 + 7\text{H}_2\text{O}$ .

Not efflorescent Sol. in  $\text{H}_2\text{O}$ .

Tripotassium *trisodium hexahydrogen phosphate*,  $\text{H}_4\text{Na}_3\text{K}_3(\text{PO}_4)_4 + 22\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Filhol and Senderens, C. R. 93. 358.)

Potassium sodium *pyrophosphate*,  $\text{K}_2\text{Na}_2\text{P}_2\text{O}_7 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Schwarzenberg, A. 65. 140)

Potassium strontium *dimetaphosphate*,  $\text{K}_2\text{Sr}(\text{P}_2\text{O}_6)_2 + 4\text{H}_2\text{O}$

As the KBA comp. (Glatzel, Dissert. 1880.)

Potassium strontium *hexametaphosphate*,  $\text{K}_4\text{Sr}_2\text{P}_6\text{O}_{18}$ .

(Tammann, J pr. 1892, (2) 45. 435.)

Potassium strontium *orthophosphate*,  $\text{K}_2\text{SrP}_2\text{O}_6$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Grandeau, A. ch. (6) 8. 103.)

Potassium strontium *pyrophosphate*,  $\text{K}_2\text{SrP}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Ouvrard, C. R. 106. 1599.)

Potassium thorium phosphate,  $\text{K}_2\text{O}$ ,  $4\text{ThO}_2$ ,  $3\text{P}_2\text{O}_5$ .

Insol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia. (Troost and Ouvrard, C. R. 102. 1422.)

$\text{K}_2\text{O}$ ,  $\text{ThO}_2$ ,  $\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3$  + Aq. (Troost and Ouvrard)  $6\text{K}_2\text{O}$ ,  $3\text{ThO}_2$ ,  $4\text{P}_2\text{O}_5$ . Sol. in acids. (Troost and Ouvrard.)

Potassium tin (stannic) phosphate,  $\text{K}_2\text{O}$ ,  $4\text{SnO}_2$ ,  $3\text{P}_2\text{O}_5$ .

(Ouvrard, C. R. 111. 177.)

$\text{K}_2\text{O}$ ,  $2\text{SnO}_2$ ,  $\text{P}_2\text{O}_5$ . (Ouvrard.)

Potassium titanium phosphate,  $\text{K}_2\text{O}$ ,  $4\text{TiO}_2$ ,  $3\text{P}_2\text{O}_5$ .

(Ouvrard, C. R. 111. 177.)

$\text{K}_2\text{O}$ ,  $2\text{TiO}_2$ ,  $\text{P}_2\text{O}_5$ . (Ouvrard.)

Potassium uranous phosphate,  $4\text{UO}_2$ ,  $\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ .

Practically insol. in conc.  $\text{HNO}_3$  and  $\text{HCl}$ , even when the acids are boiling. Attacked by  $\text{HF} + \text{HNO}_3$ . (Colani, A ch 1907, (8) 12. 133.)

Potassium uranous *metaphosphate*,  $\text{UO}_2$ ,  $\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ .

Easily sol. in  $\text{HNO}_3$ . Sol in conc.  $\text{HCl}$ . (Colani.)

Potassium uranous *pyrophosphate*,  $3\text{UO}_2$ ,  $6\text{K}_2\text{O}$ ,  $4\text{P}_2\text{O}_5$ .

Sol. in acids. (Colani)

Potassium uranyl phosphate,  $\text{K}_2\text{O}$ ,  $\text{UO}_2$ ,  $\text{P}_2\text{O}_5$ .

(Ouvrard, C. R. 110. 1333.)

$2\text{K}_2\text{O}$ ,  $\text{UO}_2$ ,  $\text{P}_2\text{O}_5$ . (Ouvrard.)

$\text{K}_2\text{O}$ ,  $2\text{UO}_2$ ,  $\text{P}_2\text{O}_5$ . (Ouvrard.)

- Potassium uranyl orthophosphate**,  $K(UO_2)PO_4 \cdot 3H_2O$   
As  $NH_4$  comp. (Lienau, Dissert. 1898.)
- Potassium vanadium phosphate**.  
See Phosphovanadate, potassium.
- Potassium yttrium phosphate**,  $3K_2O, Y_2O_3, 2P_2O_5$   
 $K_2O, Y_2O_3, 2P_2O_5$ ,  
 $3K_2O, 5Y_2O_3, 6P_2O_5$  (Duboin, C. R. 107. 622)
- Potassium zinc tetrametaphosphate**,  
 $K_4Zn(PO_3)_4 \cdot 6H_2O$   
Sol. in 70 pts  $H_2O$ . (Glatzel, Dissert 1880.)
- Potassium zinc phosphate**,  $KZnPO_4$ .  
Insol. in  $H_2O$ . Sol. in dil acids. (Ouvrard, C. R. 106. 1729)  
 $K_2ZnF_2O_7$  As above.
- Potassium zirconium phosphate**,  $K_2O, 4ZrO_3, 3P_2O_5$ .  
Insol. in acids or aqua regia. (Troost and Ouvrard, C. R. 102. 1422)  
 $K_2O, ZrO_3, P_2O_5$  Insol. in  $H_2O, HNO_3, HCl$ , or aqua regia. Sol. in hot conc.  $H_2SO_4$ . (Troost and Ouvrard.)
- Potassium phosphate selenate**.  
See Selenophosphate, potassium.
- Potassium hydrogen phosphate sulphate**,  
 $KH_2PO_4, KHSO_4$   
Decomp by  $H_2O$  and alcohol (Jacquelin.)
- Rhodium phosphate, basic**,  $4Rh_2O_3, 3P_2O_5 + 32H_2O$ .  
Insol. in  $H_2O$  or acids. (Claus)  
 $Rh_2O_3, P_2O_5 + 6H_2O = Rh_2PO_4 + 3H_2O$ . Sol. in  $H_2O$ . (Claus)
- Rubidium metaphosphate**,  $RbPO_3$ .  
Sol. in  $H_2O$  (von Berg, B. 1901, 34. 4183)
- Rubidium orthophosphate**,  $Rb_3PO_4 + 4H_2O$   
Hydroscopic; sol. in  $H_2O$ ; pptd. by alcohol. (von Berg, B. 1901, 34. 4183)
- Rubidium hydrogen orthophosphate**,  
 $Rb_3HPO_4 + H_2O$ .  
Sol. in  $H_2O$ ; insol. in conc.  $NH_4OH + Aq$ ; insol. in alcohol. (von Berg.)
- Rubidium dihydrogen orthophosphate**,  
 $RbH_2PO_4$ .  
Very sol. in  $H_2O$ ; pptd. by alcohol (von Berg.)
- Rubidium pyrophosphate**,  $Rb_2P_2O_7$ .  
Hydroscopic; sol. in  $H_2O$ . (von Berg.)
- Samarium anhydrometaphosphate**,  $Sm_2O_3, 5P_2O_5$ .  
Insol. in  $H_2O$  or  $HNO_3 + Aq$ . (Cleve.)
- Samarium orthophosphate**,  $SmPO_4$ .  
Scarcely attacked by boiling  $HNO_3 + Aq$ . (Cleve.)  
 $+ 2H_2O$ .
- Samarium pyrophosphate**,  $SmHP_2O_7 + 1\frac{1}{2}H_2O$ .  
(Cleve.)
- Silicon phosphate**.  
See Silicophosphoric acid.
- Silver metaphosphate**,  $Ag_3O, 2P_2O_5 + H_2O$ .  
(Kroll, Z. anorg. 1912, 78. 408.)
- Silver dimetaphosphate**,  $Ag_3P_2O_6$ .  
Very al. sol. in  $H_2O$ . (Fleitmann, Pogg. 78. 253)  
Sol. in cold aniline metaphosphate +  $Aq$ . (Nicholson.)  
Very al. sol. in  $H_2O$ . (Warschauer, Dissert. 1903.)  
 $+ H_2O$ . Very sol. in  $H_2O$ . (Langheld, B. 1912, 45. 3760.)
- Silver trimetaphosphate**,  $Ag_3P_3O_9$ .  
Sol. in 60 pts cold  $H_2O$ . Can be crystallized from conc.  $HNO_3 + Aq$ . (Fleitmann and Henneberg)  
 $+ H_2O$ . (Lindbom)
- Silver hexametaphosphate**,  $Ag_6P_6O_{18}$ .  
Insol. in  $H_2O$ . Sol. in  $HNO_3$  or  $NH_4OH + Aq$ , and in a large excess of sodium hexametaphosphate +  $Aq$ . (Rose)  
Easily decomp. by  $Na_2S + Aq$   
Decomp. gradually by hot  $H_2O$  into  $Ag_3P_3O_9$ .  
When freshly pptd., easily sol. in  $H_2O$   
Easily sol. in dil acids. (Lüder, Z. anorg. 6. 15.)
- Silver orthophosphate**,  $Ag_3PO_4$ .  
Very al. sol. in  $H_2O$  1 l.  $H_2O$  dissolves  $65 \times 10^{-3}$  g.  $Ag_3PO_4$  at  $19.46^\circ$  (Böttger, Z. phys. Ch. 1903, 46. 603)  
Sol. in  $H_2PO_4, HNO_3$ , or  $HCl, H_2O_2 + Aq$ , in  $NH_4OH$  or  $(NH_4)_2CO_3 + Aq$ . Less easily in ammonium nitrate or succinate, and incompletely in  $(NH_4)_2SO_4 + Aq$ . (Lassaigne, J. Pharm. (3) 16. 289.)  
Insol. in  $Na_2HPO_4 + Aq$ . (Stromeyer.)  
Not pptd. in presence of  $Na$  citrate. (Spiller.)  
If 1 mol.  $Ag_3PO_4$  is boiled with 1 mol.  $Na_2CO_3$ , 44% of it is decomp. (Malaguti.)  
Readily sol. in soluble hyposulphites +  $Aq$  with decomp. (Hersehcl)  
Insol. in  $Ag$  salts +  $Aq$ . (Rose.)  
Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)  
Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Silver hydrogen orthophosphate,  $\text{Ag}_3\text{HPO}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  or alcohol into  $\text{H}_3\text{PO}_4$  and  $\text{Ag}_3\text{PO}_4$ . (Joly, C. R. 103. 1071.)

Sol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ ; insol. in ether. (Schwarzenberg, A. 65. 162.)

**Silver pyrophosphate,  $\text{Ag}_2\text{P}_2\text{O}_7$ .**

Insol. in hot or cold  $\text{H}_2\text{O}$  Sol in cold  $\text{HNO}_3 + \text{Aq}$  without decomp. Decomp. by hot  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  into orthophosphate. Decomp. by  $\text{HCl} + \text{Aq}$  into  $\text{AgCl}$  and  $\text{H}_3\text{PO}_4$ . Insol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp. (Stromeyer, Schw. J. 58. 126.)

Insol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . Very sl. sol. in  $\text{AgNO}_3 + \text{Aq}$  (Schwarzenberg, A. 65. 161.)  
Not completely insol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$  (Rosc.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Silver hydrogen pyrophosphate,  $\text{Ag}_2\text{H}_2\text{P}_2\text{O}_7$ .**

Decomp. by  $\text{H}_2\text{O}$  into  $\text{Ag}_2\text{P}_2\text{O}_7$ . (Hurtzig and Geuther, A. 111. 160.)

Decomp. by cold  $\text{H}_2\text{O}$ . (Cavalier, C. R. 1904, 139. 285.)

**Silver hydrogen pyrophosphate metaphosphate,  $2\text{Ag}_2\text{HP}_2\text{O}_7, \text{HPO}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (H. and G.)

**Silver tetraphosphate,  $6\text{Ag}_2\text{O}, 4\text{P}_2\text{O}_5 = \text{Ag}_8\text{P}_4\text{O}_{18}$ .**

Insol. in, but gradually decomp. by boiling  $\text{H}_2\text{O}$ . (Berzelius.)

Sol. in large excess of the corresponding Na salt + Aq.

**Silver dekaphosphate,  $\text{Ag}_{12}\text{P}_{10}\text{O}_{31}$ .**

Easily sol. in sodium dekaphosphate + Aq. (Fleitmann and Henneberg, A. 65. 330.)

**Silver ultraphosphate,  $\text{Ag}_2\text{O}, 3\text{P}_2\text{O}_5$ .**

(Kroll, Z. anorg. 1912, 76. 407.)

**Silver sodium dimetaphosphate,  $\text{AgNaP}_2\text{O}_6$ .**

Sol. in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg, Pogg. 65. 310.)

**Silver sodium pyrophosphate,  $6\text{Ag}_2\text{P}_2\text{O}_7, \text{Na}_4\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$ .**

Not completely sol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (Baer, Pogg. 75. 152.)

Easily sol. in  $\text{H}_2\text{O}$ . (Stromeyer.)

$\text{Ag}_2\text{NaP}_2\text{O}_6 + \frac{1}{2}\text{H}_2\text{O}$ . Ppt. (Stange, Z. anorg. 1896, 12. 460.)

**Silver uranyl phosphate,  $2\text{Ag}_2\text{O}, 6\text{UO}_3, 3\text{P}_2\text{O}_5 + 30\text{H}_2\text{O}$ .**

(Blinkoff, Dissert. 1900.)

**Silver phosphate ammonia,  $\text{Ag}_3\text{PO}_4, 4\text{NH}_3$ .**  
(Widmann, B. 17. 2284.)

**Sodium triphosphate,  $\text{Na}_5\text{P}_3\text{O}_{16}$ .**

Very sol. in  $\text{H}_2\text{O}$ ; decomp. easily in aq. solution at  $100^\circ$ . (Schwarz, Z. anorg. 1895, 9. 253.)

**Sodium monometaphosphate,  $\text{NaPO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. and conc. acids. (Maddrell, A. 61. 63.)

Insol. in acids. (Graham.)

Gradually decomp. by alkalis

**Sodium dimetaphosphate,  $\text{Na}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$ .**

Deliquescent. Sol. in 7.2 pts. of cold or hot  $\text{H}_2\text{O}$ . Very sol. in conc.  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{NaOH} + \text{Aq}$ . Insol. in strong, very sl. sol. in dilute alcohol. (Fleitmann, Pogg. 78. 246.)

**Sodium trimetaphosphate,  $\text{Na}_3\text{P}_3\text{O}_{10} + 6\text{H}_2\text{O}$ .**

Sol. in 4.5 pts. cold  $\text{H}_2\text{O}$ . Insol. in strong, very sl. sol. in dil. alcohol. (Fleitmann and Henneberg, A. 65. 307.)

Decomp. by boiling  $\text{H}_2\text{O}$ . (Lindbom.)

**Sodium tetrametaphosphate,  $\text{Na}_4\text{P}_4\text{O}_{12}$ .**

Sol. in  $\text{H}_2\text{O}$ ; cryst. with about  $4\text{H}_2\text{O}$ . Less sol. in alcohol than in  $\text{H}_2\text{O}$ . (Fleitmann, Pogg. 78. 854.)

**Sodium hexametaphosphate,  $\text{Na}_6\text{P}_6\text{O}_{18}$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Graham, Pogg. 32. 56.)

**Sodium orthophosphate,  $\text{Na}_3\text{PO}_4 + 12\text{H}_2\text{O}$ .**

Not deliquescent in dry air.

100 pts  $\text{H}_2\text{O}$  dissolve 19.6 pts. crystals at  $15.5^\circ$  (Graham.)

100 pts  $\text{H}_2\text{O}$  dissolve 28.3 pts  $\text{Na}_3\text{PO}_4 + 12\text{H}_2\text{O}$  at  $15^\circ$ . (Schiff.)

**Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$ .**

In 1000 g. of the solution, mols	
Na	$\text{PO}_4$
4.28	0.040
3.24	0.183
2.24	0.752
2.73	1.08

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 101.)

**Sp. gr. of  $\text{Na}_3\text{PO}_4 + \text{Aq}$  at  $15^\circ$ .**

$\%$		$\%$		$\%$	
Sp. gr.	%	Sp. gr.	%	Sp. gr.	%
1	1.0043	9	1.0399	17	1.0778
2	1.0086	10	1.0455	18	1.0827
3	1.0130	11	1.0492	19	1.0876
4	1.0174	12	1.0539	20	1.0925
5	1.0218	13	1.0586	21	1.0975
6	1.0263	14	1.0633	22	1.1025
7	1.0308	15	1.0681	23	1.1076
8	1.0353	16	1.0729	24	1.1127

(Schiff, calculated by Gerlach, Z. anal. 8. 280.)

Insol. in  $\text{CS}_2$ . (Aictowski, Z. anorg. 1894, 6, 257.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3700.)

+10 $\text{H}_2\text{O}$ . (Rammelsberg.)

Could not be obtained. (Hall, J. pr. 94, 237.)

+7 $\text{H}_2\text{O}$ . (Hall.)

Melts in crystal water at 76.6°. (Graham.)

Sodium hydrogen phosphate,  $\text{Na}_2\text{HPO}_4$ .

Sol. in  $\text{H}_2\text{O}$  with evolution of heat.

100 pts.  $\text{H}_2\text{O}$  dissolve at t°.

t°	Pts $\text{Na}_2\text{HPO}_4$	t°	Pts $\text{Na}_2\text{HPO}_4$	t°	Pts $\text{Na}_2\text{HPO}_4$
0	1.55	40	30.88	80	81.29
10	4.10	50	43.31	90	95.02
20	11.08	60	55.29	100	108.20
30	19.95	70	68.72	106.2	114.43

(Foggale, J. Pharm (3) 44, 273.)

100 pts.  $\text{H}_2\text{O}$  at 13° dissolve 3.4 pts.  $\text{Na}_2\text{HPO}_4$  (Feron, Ph. Viertel. 7, 244), at 15°, 5.9 pts. (Nesse), at 18°, 9.3 pts. (Mulder), at 16°, 8.4 pts. (Mulder, J. pr. 95 52); at 20°, 6.8 pts. (Nesse, Russ. Z. Pharm. 1, 101); at 25°, 12.5 pts. (ibid.).

Solubility in 100 pts.  $\text{H}_2\text{O}$  at t°.

t°	Pts $\text{Na}_2\text{HPO}_4$	t°	Pts $\text{Na}_2\text{HPO}_4$	t°	Pts $\text{Na}_2\text{HPO}_4$
0	2.5	35	39.3	69	94.8
1	2.6	36	43.6	70	95.0
2	2.6	37	49.5	71	95.1
3	2.7	38	55.5	72	95.2
4	2.7	39	60.6	73	95.4
5	2.8	40	63.9	74	95.6
6	3.0	41	66.2	75	95.8
7	3.2	42	68.6	76	96.0
8	3.4	43	70.8	77	96.1
9	3.6	44	72.9	78	96.3
10	3.9	45	74.8	79	96.5
11	4.2	46	76.5	80	96.6
12	4.5	47	78.2	81	96.8
13	4.9	48	79.7	82	96.9
14	5.3	49	81.2	83	97.0
15	5.8	50	82.5	84	97.1
16	6.3	51	83.7	85	97.2
17	6.9	52	84.8	86	97.4
18	7.6	53	85.8	87	97.5
19	8.4	54	86.7	88	97.6
20	9.3	55	87.7	89	97.7
21	10.3	56	88.6	90	97.8
22	11.4	57	89.4	91	97.9
23	12.6	58	90.2	92	98.0
24	14.0	59	90.9	93	98.1
25	15.4	60	91.6	94	98.2
26	16.9	61	92.2	95	98.4
27	18.5	62	92.7	96	98.5
28	20.2	63	93.1	97	98.6
29	22.0	64	93.5	98	98.7
30	24.1	65	93.8	99	98.8
31	26.4	66	94.1	105	82.5
32	29.1	67	94.4	105.57	80.7
33	32.1	68	94.6	106.4	79.2
34	35.5	...	...	...	...

(Mulder, Scheik. Verhand. 1864, 103.)

Solubility in  $\text{H}_2\text{O}$  at t°.

t°	G. $\text{Na}_2\text{HPO}_4$ in 100 g. $\text{H}_2\text{O}$
10 26	3 55
25 15	12 02
40 29	54.88
60 23	83 00
99 77	102 15

Three breaks in the curve: at 36.45°, transition from dodecahydrate to heptahydrate; at 48°, transition from heptahydrate to the dihydrate; at 95.2°, transition from dihydrate to the monohydrate. (Shiomi, C. C. 1909, II, 106.)

Solubility of  $\text{Na}_2\text{HPO}_4$  in  $\text{H}_2\text{O}$  at t°.

t°	G. $\text{Na}_2\text{HPO}_4$ in 100 g. $\text{H}_2\text{O}$	Solid phase
-0.43	1.42	Ice
-0.24	0 70	"
-0.5*		
+0.05	1 67	$\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$
20.0	7 66	"
25 0	12 0	"
32 0	25.7	"
34.0	33.8	"
35.2*		
39 2	51.8	$\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$
45.0	67.3	"
48 3*		
50.0	80 2	$\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$
60.0		"
80 0	82.9	"
90 0	92.4	"
95*	101 0	"
96.2	104 6	$\text{Na}_2\text{HPO}_4$
105.0	102.3	"
120	99 2	"

(Menzies and Humphery, Int. Cong. App. Chem. 1912, 2, 177.)

\* Transition points

Solubility in  $\text{H}_2\text{O}$  at t°.

t°	100 g. $\text{H}_2\text{O}$ dissolve g. $\text{Na}_2\text{HPO}_4$	Solid phase
0°	2.51	$\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$
25	12.47	
35 4*	46.11	$\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$
40 3	54.80	"
48.35*	79.00	$\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$
59.7	91.3	
71	95 1	
91	98.15	

(D'Ans and Schreiner, Z. phys. Ch. 1911, 75, 99.)

\* Transition points.

The composition of the hydrates formed by this salt at different dilutions is calculated

from determinations of the lowering of the fr. pt. produced by the salt and of the conductivity and sp. gr. of its aqueous solutions. (Jones, Am. Ch. J. 1905, 34, 318.)

$\text{Na}_2\text{HPO}_4 + \text{Aq}$  saturated at  $15^\circ$  has 1.0469 sp. gr. (Michel and Krafft), saturated at  $16^\circ$ , 1.0511 (Stolba).

Sp. gr. of  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  at  $19^\circ$ :

$\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$	Sp. gr.	$\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$	Sp. gr.	$\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$	Sp. gr.
1	1.0041	5	1.0208	9	1.0376
2	1.0083	6	1.0250	10	1.0418
3	1.0125	7	1.0292	11	1.0460
4	1.0166	8	1.0332	12	1.0503

(Schiff, A. 110, 70.)

Saturated solution freezes at  $-0.45^\circ$  (Rüddorff, Pogg. 122, 337), and boils at  $105^\circ$  (Griffiths),  $105-106.4^\circ$  (Mulder),  $105.5^\circ$  (Legrand).

Sat.  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  boils at  $105.5^\circ$  (Griffiths), at  $106.5^\circ$ , and contains 113.2 pts  $\text{Na}_2\text{HPO}_4$  to 100 pts  $\text{H}_2\text{O}$  (Legrand), forms a crust at  $106.4^\circ$ , and contains 108.8 pts  $\text{Na}_2\text{HPO}_4$  to 100 pts  $\text{H}_2\text{O}$ , highest temp. observed,  $106.8^\circ$  (Gerlach, Z. anal. 26, 127.)

B.-pt. of  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  containing pts.  $\text{Na}_2\text{HPO}_4$  to 100 pts.  $\text{H}_2\text{O}$ . G = according to Gerlach (Z. anal. 26, 450); L = according to Legrand (A. ch. (2) 59, 426.)

B.-pt.	G	L	B.-pt.	G	L
100.5°	8.6	11.0	104°	68.4	76.4
101	17.2	21.0	104.5	76.9	84.2
101.5	25.8	31.0	105	85.3	91.5
102	34.4	40.8	105.5	93.7	98.4
102.5	42.9	50.3	106	102.1	105.0
103	51.4	59.4	106.5	110.5	111.4
103.5	59.9	68.1	106.6	.	112.6

+ $\text{H}_2\text{O}$ . Transition point,  $95.2^\circ$ . (Shiomi.)  
+ $2\text{H}_2\text{O}$ . Transition point,  $48.35^\circ$ . (D'Ans and Schreiner);  $48^\circ$  (Shiomi);  $48.3^\circ$  (Menzies and Humphrey).

+ $7\text{H}_2\text{O}$ . Not efflorescent. Sol. in  $\text{H}_2\text{O}$  with absorption of heat.

Sol. in 8 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ . (Neesse, J. D. 1863, 181.)

Transition point,  $35.4^\circ$  (D'Ans and Schreiner);  $36.45^\circ$  (Shiomi);  $35.2^\circ$  (Menzies and Humphrey).

Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$ .

In 1000 g. of the solution, mols	
Na	$\text{PO}_4$
6.31	4.63
6.76	4.88
7.31	5.55

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75, 101.)

See also above.

+ $12\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$  with absorption of heat.

14 pts.  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$  mixed with 100 pts.  $\text{H}_2\text{O}$  at  $10.8^\circ$  lower the temperature  $3.7^\circ$ . (Rüddorff, B. 2, 68.)

Sol. in 8.48 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ , or 100 pts.  $\text{H}_2\text{O}$  dissolve 11.8 pts. at  $17^\circ$ . (Schiff)

Sol. in 4 pts. . . . . (Pagani)

100 pts.  $\text{H}_2\text{O}$  dissolve 6.5 pts.  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$  at  $0^\circ$ ; 27.5 pts. at  $30^\circ$ . (Tilden, Chem. Soc. 45, 409.)

Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$ .

In 1000 g. of the solution, mols	
Na	$\text{PO}_4$
2.62	1.09
1.56	0.78
2.38	1.60
3.18	2.24
4.65	3.55
5.63	3.87

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75, 101.)

See also above

Melts in crystal water below  $100^\circ$ , and easily forms supersaturated solutions. (Gay-Lussac.)

Melts in crystal  $\text{H}_2\text{O}$  at  $34.6^\circ$  (Persoz),  $35^\circ$  (Kopp),  $40-41^\circ$  (Mulder).

Melts in crystal  $\text{H}_2\text{O}$  at  $35^\circ$ . (Tilden, Chem. Soc. 45, 409.)

Supersaturated solutions are brought to crystallization by addition of a crystal of  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$  or an isomorphous substance as  $\text{Na}_2\text{HAsO}_4 + 12\text{H}_2\text{O}$ . (Thomson, Chem. Soc. 35, 200.)

Insol. in alcohol

Sodium dihydrogen phosphate,  $\text{NaH}_2\text{PO}_4 + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  Insol. in alcohol (Graham.)

+ $2\text{H}_2\text{O}$ . Unchanged on air. Very sol. in  $\text{H}_2\text{O}$ , and solubility increases rapidly with the temperature. (Joly and Dufet, C. R. 102, 1391.)

100 pts.  $H_2O$  dissolve 59.9 pts at  $0^\circ$ ; 84.6 pts at  $18^\circ$ . (Joly and Dufet.)

Solubility of  $NaH_2PO_4$  in  $H_2O$  at  $t^\circ$ .

G. of anhydrous  $NaH_2PO_4$  in 100 g  $H_2O$ .

Solid phase;  $NaH_2PO_4 + 2H_2O$ .

$t^\circ$	G. $NaH_2PO_4$	$t^\circ$	G. $NaH_2PO_4$
0 1	57 86	28 0	101 71
1 0	59 08	30.0	106 45
3 0	61 47	31 0	108.93
5 0	63 82	33 0	114.31
10 0	69 87	34.0	117 14
15 0	76 72	35 0	120 44
20.0	85 21	37 0	126 76
25 0	94 63	40 2	138.16
26.0	96 73	40 55	110.83
27.0	99.20		

40  $8^\circ$ ; transition point.

Solid phase;  $NaH_2PO_4 + H_2O$ .

41	142.55	52	163 84
42	143 83	55	170 85
45	148 20	56	173.23
50	158 61	57	175.81

57.4°; transition point.

Solid phase;  $NaH_2PO_4$ .

58	177 24	60	190 24
60	179 33	80	207 29
62	181.35	90	225 31
65	184 99	99 1	246 56

(Imadzu, Chem. Soc. 1912, 33. 359.)

Solubility in  $H_2PO_4 + Aq$  at  $25^\circ$ .

In 1000 g of the solution, mols.	
Na	$PO_4$
6 19	4 68
6 01	4 67
5 12	4 36
4 81	4.22
4 36	4 08
4 06	4.03
4 19	4.38
4.32	4.96
4 65	5 89
4.88	6 40

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 101.)

$Na_3$ sodium trihydrogen phosphate,  
 $Na_3H_2(PO_4)_2$ .

Not hygroscopic. Sol. in  $H_2O$  in all proportions (Jouhe, C. R. 1902, 134. 604)

+ $1\frac{1}{2}H_2O$ . Sol. in  $H_2O$ . (Filhol and Senderens, C. R. 93. 388.)

+ $7H_2O$ . (Salzer, Arch Pharm 1894, 232. 365.)

+ $7\frac{1}{2}H_2O$ . (Jouhe)

Sodium orthophosphate acid,  $NaH_2PO_4$ ,  $H_3PO_4$ .

Hygroscopic. Decomp by alcohol (Staudenmaier, Z. anorg. 1894, 5. 395)

Solubility of  $NaH_2PO_4$ ,  $H_3PO_4$  in  $H_2O$  at  $t^\circ$ .

$t^\circ$	% $NaH_2PO_4$ , $H_3PO_4$	Solid phase
- 5 7	20 77	Ice
- 7 9	26 92	"
-11 4	34 15	"
-38	56 66	"
-34	80 46	$NaH_2PO_4$
+41	81 82	"
51 7	83 68	"
79 7	87 48	"
85	88 65	"
101 7	91 47	" + $NaH_2PO_4$ , $H_3PO_4$
104.5	92 67	$NaH_2PO_4$ , $H_3PO_4$
110	95 79	"
119	97 99	"
128.5	100	"

(Parravano and Mieli, Gazz. ch. it. 38, II 536.)

Solubility in anhydrous  $H_2PO_4$ .

$t^\circ$	% $NaH_2PO_4$ , $H_3PO_4$
98 5	52 72
111	69 59
119	77 55
122	81 71
123	87 20

(Parravano and Mieli)

+ $H_2O$ . Very deliquescent. (Salzer, Arch. Pharm 1894, 232. 369.)

Sodium pyrophosphate,  $Na_2P_2O_7$ , and  
+ $10H_2O$

Less sol in  $H_2O$  than sodium hydrogen orthophosphate. (Clark, Ed. J. Sci. 7. 298.)

100 pts.  $H_2O$  dissolve (a) pts.  $Na_2P_2O_7$ , (b) pts  $Na_4P_2O_7 + 10H_2O$  at:

	$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$	$40^\circ$	$50^\circ$
a.	3.16	3 95	6 23	9.95	13 50	17.45
b.	5 41	6 81	10.92	18.11	24 97	33.25

	$60^\circ$	$70^\circ$	$80^\circ$	$90^\circ$	$100^\circ$
a.	21.83	25 62	30.04	35.11	40.26
b.	44 07	52.11	63.40	77.47	93.11

(Poggiale.)

Sol. in  $H_2SO_4$ . (Walden, Z. anorg. 1902, 29. 384.)

Crystallizes unchanged from  $\text{NH}_4\text{Cl} + \text{Aq}$  (Winkler), or conc.  $\text{NH}_4\text{OH} + \text{Aq}$  (Uelsmann.)

Decomp. into orthophosphate by heating with  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_3\text{PO}_4 + \text{Aq}$ . Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 829.)

Insol. in alcohol. Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

**Sodium hydrogen pyrophosphate**,  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  containing  $\text{HC}_2\text{H}_3\text{O}_2$  without decomp. (Bayer, J. p. 106, 501.)

Sl. sol. in alcohol. Much more sol. in  $\text{H}_2\text{O}$  than  $\text{NaH}_2\text{PO}_4$ .

+  $6\text{H}_2\text{O}$ . (Rammelsberg, B. A. B. 1883, 21.)

100 g. sat. solution contain 14.95 g.  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$  at  $18^\circ$ . (Giran, A. ch. 1902, (7) 30, 249.)

$\text{NaH}_2\text{P}_2\text{O}_7$ . Very hygroscopic. (Salzer, Arch. Pharm. 1894, 232, 369.)

100 g. sat. solution contain 62.7 g. at  $18^\circ$ . (Giran, A. ch. 1902, (7) 30, 249.)

$\text{Na}_4\text{H}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}$ . Sol. in 3 pts.  $\text{H}_2\text{O}$ . (Salzer, Arch. Pharm. 1894, 232, 366.)

+  $6\text{H}_2\text{O}$ . 100 g. sat. solution contain 28.17 g.  $\text{Na}_4\text{H}_2\text{P}_2\text{O}_7$  at  $18^\circ$ . (Giran.)

**Sodium tetraphosphate**,  $\text{Na}_4\text{P}_4\text{O}_{14}$ .

Slowly sol. in 2 pts. cold  $\text{H}_2\text{O}$ . Easily decomp. +  $18\text{H}_2\text{O}$  (Uelsmann.)

**Sodium hydrogen tetraphosphate**,

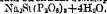


Sol. in  $\text{H}_2\text{O}$ .

**Sodium dekaphosphate**,  $\text{Na}_{12}\text{P}_{10}\text{O}_{31}$ .

Sol. in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg, A. 65, 333.)

**Sodium strontium dincetaphosphate**,



As the  $\text{NaBa}$  comp. (Glatzel, Dissert. 1880.)

**Sodium strontium trimetaphosphate**,



Easily sol. in  $\text{H}_2\text{O}$  and acids. (Fleitmann, A. 65, 315.)

**Sodium strontium orthophosphate**,  $\text{Na}_2\text{SrPO}_4$



Scarcely sol. in  $\text{H}_2\text{O}$ ; sol. in acids.

+  $9\text{H}_2\text{O}$ . (Joly, C. R. 104, 905.)

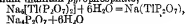
**Sodium strontium pyrophosphate (?)**.

Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ . (Baer, Pogg. 75, 166.)

Easily sol. in  $\text{HCl} + \text{Aq}$ , or  $\text{HNO}_3 + \text{Aq}$ .

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Sodium thallium pyrophosphate**,



Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48, 588.)

**Sodium thorium orthophosphate**,



Insol. in acids. (Wallroth, Bull. Soc. (2) 39, 316.)

**Sodium thorium phosphate**,  $\text{Na}_2\text{O}$ ,  $4\text{ThO}_2$ ,  $3\text{P}_2\text{O}_5$ .

Insol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , or aqua regia. (Troost and Ouvrard, C. R. 105, 30.)

$5\text{Na}_2\text{O}$ ,  $2\text{ThO}_2$ ,  $3\text{P}_2\text{O}_5$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (T and O.)

$\text{Na}_2\text{O}$ ,  $\text{ThO}_2$ ,  $\text{P}_2\text{O}_5$  (T and O.)

**Sodium thorium pyrophosphate**,  $\text{Na}_4\text{P}_2\text{O}_7$ ,  $\text{ThP}_2\text{O}_7 + 2\text{H}_2\text{O}$ .

(Cleve.)

**Sodium tin (stannic) phosphate**,  $\text{Na}_4\text{Sn}_2(\text{PO}_4)_4$ .

(Ouvrard, C. R. 111, 177.)

$\text{Na}_2\text{Sn}(\text{PO}_4)_2$ . (Wunder, J. pr. (2) 4, 339.)

$6\text{Na}_2\text{O}$ ,  $3\text{SnO}_2$ ,  $4\text{P}_2\text{O}_5$ . (Ouvrard.)

**Sodium titanium phosphate**,  $\text{NaTi}_2(\text{PO}_4)_3$ .

Insol. in acids. (Rose, J. B. 1867, 9.)

$6\text{Na}_2\text{O}$ ,  $\text{TiO}_2$ ,  $4\text{P}_2\text{O}_5$ . (Ouvrard, C. R. 111, 177.)

**Sodium uranium phosphate**,  $\text{UO}_2$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ .

Easily attacked by acids. (Colani, A. ch. 1907, (8) 12, 137.)

**Sodium uranium metaphosphate**,  $4\text{UO}_2$ ,  $\text{Na}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ .

Insol. in boiling  $\text{HNO}_3$ . (Colani.)

**Sodium uranium pyrophosphate**,  $3\text{UO}_2$ ,



Sol. in acids. (Colani.)

**Sodium uranyl phosphate**,  $\text{Na}_2\text{O}$ ,  $\text{UO}_2$ ,  $\text{P}_2\text{O}_5$ .

(Ouvrard, C. R. 110, 1333.)

$2\text{Na}_2\text{O}$ ,  $\text{UO}_2$ ,  $\text{P}_2\text{O}_5$ . (Ouvrard.)

$\text{Na}_2\text{O}$ ,  $5\text{UO}_2$ ,  $2\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; decomp. by acetic acid. (Werther, A. 68, 312.)

**Sodium uranyl pyrophosphate**.

Very sol. in  $\text{H}_2\text{O}$ . (Persoz, A. ch. (3) 20, 322.)

**Sodium ytterbium pyrophosphate**,  $\text{NaYbP}_2\text{O}_7$ .

Easily sol. in the strong acids. (Wallroth.)

**Sodium yttrium pyrophosphate**,  $\text{NaYP}_2\text{O}_7$ .

Sol. in  $\text{H}_2\text{O}$ . (Stronmeyer.)

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in strong acids. (Wallroth.)

Sodium zinc triphosphate,  
 $\text{Na}_2\text{O}, 4\text{ZnO}, 3\text{P}_2\text{O}_5 + 19\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Schwarz, Z. anorg. 1895, 9, 266.)

Sodium zinc trimetaphosphate,  $\text{Na}_2\text{O}, 2\text{ZnO}, 3\text{P}_2\text{O}_5$

Ppt. Sol. in  $\text{H}_2\text{O}$ . (Fleischmann and Henneberg, A. 65. 304.)

Sodium zinc tetrametaphosphate,  
 $\text{Na}_2\text{Zn}(\text{PO}_3)_4 + 6\text{H}_2\text{O}$ .  
 As K comp. (Glatzel, Dissert. 1880.)

Sodium zinc octametaphosphate,  
 $\text{Na}_2\text{Zn}_8(\text{PO}_3)_{12}$   
 Insol. in acids.  
 Sol. in conc  $\text{H}_2\text{SO}_4$ . (Tammann, J. pr. 1892, (2) 45. 420.)

Sodium zinc orthophosphate,  $\text{NaZnPO}_4$   
 Difficultly sol. in  $\text{H}_2\text{O}$  or acetic acid. Easily sol. in dil. mineral acids. (Scheffer, A. 145. 53.)  
 $2\text{Na}_2\text{O}, \text{ZnO}, \text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ , sol. in dil. acids. (Ouvrard, C. R. 108. 1796)

Sodium zinc pyrophosphate,  $\text{Na}_2\text{Zn}_2\text{P}_2\text{O}_7$ .  
 Insol. in  $\text{H}_2\text{O}$ , sol. in dil. acids. (Wallroth.)  
 $3\text{Na}_2\text{P}_2\text{O}_7, \text{Zn}_2\text{P}_2\text{O}_7 + 24\text{H}_2\text{O}$ . Very efflorescent. (Pahl.)  
 $\text{Na}_4\text{P}_2\text{O}_7, \text{Zn}_2\text{P}_2\text{O}_7 + 2\frac{1}{2}, 3, 3\frac{1}{2}$ , and  $8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , sol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ . (Pahl, Sv. V. A. F. 30, 7. 35.)  
 $4\text{Na}_2\text{P}_2\text{O}_7, 5\text{Zn}_2\text{P}_2\text{O}_7 + 20\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Pahl.)  
 $\text{Na}_4\text{P}_2\text{O}_7, 4\text{Zn}_2\text{P}_2\text{O}_7 + 12\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$  (Pahl.)

Sodium zirconium phosphate,  $\text{Na}_2\text{O}, 4\text{ZrO}_2, 3\text{P}_2\text{O}_5 = \text{Na}_2\text{Zr}_3(\text{PO}_4)_3$ .  
 Insol. in acids or aqua regia. (Troost and Ouvrard, C. R. 105. 30)  
 $6\text{Na}_2\text{O}, 3\text{ZrO}_2, 4\text{P}_2\text{O}_5$ . Sol. in acids. (T. and O.)  
 $4\text{Na}_2\text{O}, \text{ZrO}_2, 2\text{P}_2\text{O}_5$ . Sol. in acids. (T. and O.)

Sodium phosphate fluoride,  $\text{Na}_2\text{PO}_4, \text{NaF} + 12\text{H}_2\text{O}$   
 100 pts.  $\text{H}_2\text{O}$  dissolve, at  $25^\circ$ , 12 pts. salt and form solution of 1.0329 sp. gr.; at  $70^\circ$ , 57.5 pts. salt and form solution of 1.1091 sp. gr. (Briegleb, A. 97. 95)  
 $2\text{Na}_2\text{PO}_4, \text{NaF} + 10\text{H}_2\text{O}$ , and  $22\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Baumgarten, J. B. 1865. 219.)

Sodium phosphate stannate,  
 $4\text{Na}_2\text{PO}_4, \text{Na}_2\text{SnO}_3 + 48\text{H}_2\text{O}$ .  
 (Prandtl, B. 1907, 40. 2132.)

Sodium phosphate titanate,  
 $\text{Na}_2\text{O}, \text{TiO}_2, \text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$   
 Hygroscopic. (Mazzuchelli and Pantanelli, C. C. 1909, II. 420.)

Sodium phosphate vanadate.  
 See Phosphovanadate, sodium.

Strontium monometaphosphate,  $\text{Sr}(\text{PO}_3)_2$ .  
 Insol. in  $\text{H}_2\text{O}$  and acids. Not decomp. by alkali carbonates + Aq. (Maddrell, A. 61. 61.)

Strontium hexametaphosphate.  
 Nearly insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Ludert, Z. anorg. 5. 15.)

Strontium orthophosphate, basic,  $\text{Sr}(\text{OH})_2, \text{Sr}_3(\text{PO}_4)_2$   
 (Woyczynski, Z. anorg. 1894, 6. 311.)

Strontium orthophosphate,  $\text{Sr}_3(\text{PO}_4)_2$ .  
 Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$  (Erlenmeyer, J. B. 1857. 145.)

Strontium hydrogen phosphate,  $\text{SrHPO}_4$ .  
 Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_3\text{PO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . (Vauquelin.) Easily sol. in cold ammonium nitrate, chloride, or succinate + Aq, but is partly precipitated by a little  $\text{NH}_4\text{OH} + \text{Aq}$ . (Brett)  
 Sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Fuchs, 1894.)  
 Sol. in Na citrate + Aq. (Spiller.)  
 Partly decomp. by boiling  $\text{Na}_2\text{CO}_3$ , and  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Dulong.)  
 $\text{SrH}_2(\text{PO}_4)_2 + 2\text{H}_2\text{O}$  Decomp. by treating with  $\text{H}_2\text{O}$ , leaving 4.29%  $\text{SrHPO}_4$ . (Barthe.)

Strontium phosphate, acid,  $\text{H}_2\text{O}, 2\text{SrO}, 3\text{P}_2\text{O}_5 + x\text{H}_2\text{O}$ .  
 Entirely sol. in  $\text{H}_2\text{O}$  (Barthe, C. R. 114. 1267.)

Strontium pyrophosphate,  $\text{Sr}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}$ .  
 Somewhat sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{HCl}_2\text{H}_3\text{O}_4$  or  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . (Schwarzenberg, A. 65. 144.)  
 $+ 2\frac{1}{2}\text{H}_2\text{O}$  (Knorre and Oppelt, B. 21. 773.)

Strontium hydrogen pyrophosphate,  
 $\text{SrH}_2\text{P}_2\text{O}_7, 2\text{Sr}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$ .  
 Ppt. (Knorre and Oppelt, B. 21. 772)  
 $\text{SrH}_2\text{P}_2\text{O}_7, 3\text{Sr}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}$ , and  $+ 2\text{H}_2\text{O}$ . (Knorre and Oppelt.)  
 $\text{Sr}_2\text{H}_2(\text{P}_2\text{O}_7)_2 + 8\text{H}_2\text{O}$ , and  $+ 12\text{H}_2\text{O}$ .  
 Ppt. (Pahl, Gm. - K. 2, 2. 172)  
 $\text{Sr}_2\text{H}_2(\text{P}_2\text{O}_7)_2 + 5\text{H}_2\text{O}$ , and  $+ 18\text{H}_2\text{O}$  and  $+ 20\text{H}_2\text{O}$ .  
 Insol. in  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  or  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . (Pahl, Gm - K. 2, 2. 171.)

Strontium thorium phosphate,  
 $\text{Th}_2\text{O}, \text{SrO}, \text{P}_2\text{O}_5$   
 (Colani, C. R. 1909, 149. 209.)

**Strontium uranium metaphosphate,**  
 $\text{UO}_2, \text{SrO}, \text{P}_2\text{O}_5$ .  
 (Colant, A. ch. 1907, (8) 12. 141.)

**Strontium uranyl phosphate,**  
 $\text{SrO}, 4\text{UO}_2, 2\text{P}_2\text{O}_5 + 21\text{H}_2\text{O}$   
 (Blinkoff, Dissert 1900.)  
 $2\text{SrO}, 5\text{UO}_2, 2\text{P}_2\text{O}_5 + 24\text{H}_2\text{O}$ . As Ba comp.  
 (Blinkoff.)

**Strontium phosphate chloride,**  $3\text{Sr}_3(\text{PO}_4)_2$ ,  
 $\text{SrCl}_2$ .  
*Strontium apatite* Insol. in  $\text{H}_2\text{O}$ . (De-  
 ville and Caron)

**Tellurium phosphate (?)**.  
 Insol. in  $\text{H}_2\text{O}$ . (Berzelius)

**Thalious metaphosphate,**  $\text{TiPO}_3$ .  
 Two modifications:  
 a. Difficultly sol. in  $\text{H}_2\text{O}$ .  
 b. Extremely easily sol. in  $\text{H}_2\text{O}$ . (Lamy)

**Thalious orthophosphate,**  $\text{Ti}_3\text{PO}_4$ .  
 1 pt. is sol. in 201.2 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 149  
 pts. boiling  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ .  
 (Crookes.) Sl. sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Very  
 easily sol. in solutions of  $\text{NH}_4$  salts (Car-  
 stanjen.) Insol. in alcohol (Lamy)

**Thalious hydrogen phosphate,**  $\text{Ti}_2\text{HPO}_4$ .  
*Anhydrous* Much less sol. in  $\text{H}_2\text{O}$  than  
 the hydrous salt, but easily sol. in a solution  
 of the hydrous salt (Lamy)  
 $+ 1\frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  Insol. in  
 alcohol (Lamy.)  
 Composition is  $\text{HTi}_2\text{PO}_4$ ,  $2\text{H}_2\text{TiPO}_4$ .  
 (Rammelsberg, W. Ann. 16. 694.)

**Thalious dihydrogen phosphate,**  $\text{TiH}_2\text{PO}_4$ .  
 Very easily sol. in  $\text{H}_2\text{O}$  Insol. in alcohol  
 (Rammelsberg, B. 3. 278.)

**Trithalious trihydrogen phosphate,**  $\text{Ti}_3\text{HPO}_4$ ,  
 $2\text{TiH}_2\text{PO}_4$ .  
 True composition of  $\text{Ti}_3\text{HPO}_4$  of Lamy  
 (Rammelsberg)

**Thalious pyrophosphate,**  $\text{Ti}_2\text{P}_2\text{O}_7$ .  
 Sol. in 2.5 pts.  $\text{H}_2\text{O}$  with slight decomposi-  
 tion. (Lamy.)  
 $+ 2\text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{O}$  than the above  
 salt, with partial decomp. (Lamy.)

**Thalious hydrogen pyrophosphate,**  $\text{H}_2\text{Ti}_2\text{P}_2\text{O}_7$ ,  
 $+ \text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . (Lamy.)

**Thallic phosphate, basic,**  $2\text{Ti}_2\text{O}_3, \text{P}_2\text{O}_5 +$   
 $5\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$ .

**Thallic phosphate, basic,**  $\text{Ti}_2\text{P}_2\text{O}_7 + 13\text{H}_2\text{O}$   
 (Rammelsberg, W. Ann. 16. 694.)  
 $\text{Ti}_6\text{P}_4\text{O}_{19} + 12\text{H}_2\text{O}$  (R.)

**Thallic phosphate,**  $\text{TiPO}_4 + 2\text{H}_2\text{O}$   
 Completely insol. in  $\text{H}_2\text{O}$  Sol. in conc  
 $\text{HNO}_3$ , and dil.  $\text{HCl} + \text{Aq}$ . (Willm.)

**Thorium metaphosphate,**  $\text{Th}(\text{PO}_3)_4$ .  
 Insol. in  $\text{H}_2\text{O}$  (Troost, C. R. 101. 210.)

**Thorium metaphosphate,**  $\text{ThO}_2, 2\text{P}_2\text{O}_5$ .  
 Insol. in acids. (Johansson, B. 22. 976)

**Thorium orthophosphate,**  $\text{Th}_4(\text{PO}_4)_4 + 4\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$  and phosphoric acid (Ber-  
 zelius); also acetic acid (Cleve.)  
 Sol. in  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ . (Cleve)

**Thorium hydrogen phosphate,**  $\text{ThH}_2(\text{PO}_4)_2 +$   
 $\text{H}_2\text{O}$ .  
 Precipitate

**Thorium pyrophosphate,**  $\text{ThP}_2\text{O}_7 + 2\text{H}_2\text{O}$ .  
 Precipitate. Insol. in  $\text{H}_2\text{O}$ . Sol. in great  
 excess of pyrophosphoric acid or sodium pyro-  
 phosphate +  $\text{Aq}$ . (Cleve.)

**Thorium phosphate bromide.**  
 See Bromophosphate, thorium.

**Thorium phosphate chloride.**  
 See Chlorophosphate, thorium.

**Tin (stannous) phosphate,**  $5\text{SnO}, 4\text{P}_2\text{O}_5 +$   
 $4\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$ . (Lenssen, A. 114. 113.)  
 $\text{Sn}_2(\text{PO}_3)_2$  Insol. in  $\text{H}_2\text{O}$ . Sol. in mineral  
 acids. (Kühn)  
 Insol. in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . Sol. in  
 $\text{KOH} + \text{Aq}$ .

**Tin (stannic) phosphate,**  $2\text{SnO}_2, \text{P}_2\text{O}_5 +$   
 $10\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . (Reynoso, J.  
 pr. 64. 261.)  
*Anhydrous.* Insol. in acids. (Hautefeuille  
 and Margottet, C. R. 102. 1017)

**Tin (stannic) phosphate,**  $\text{SnP}_2\text{O}_7$ .  
 Insol. in acids. (Hautefeuille and Margot-  
 tet, C. R. 102. 1017)

**Tin (stannous) phosphate chloride,**  $3\text{SnO},$   
 $\text{P}_2\text{O}_5, \text{SnCl}_2 + \text{H}_2\text{O}$ .  
 Not decomp. by hot  $\text{H}_2\text{O}$ . (Lenssen, A.  
 114. 113.)

**Titanium phosphate,**  $\text{Ti}_2\text{P}_2\text{O}_7 = 2\text{TiO}_2, \text{P}_2\text{O}_5$ .  
 Insol. in acids. (Hautefeuille and Margot-  
 tet, C. R. 102. 1017.)  
 (Ouvrard, C. R. 111. 177.)  
 $+ 3\text{H}_2\text{O}$ . Ppt. Insol. in  $\text{H}_2\text{O}$ . (Merz.)

$\text{TiO}_2$ ,  $\text{P}_2\text{O}_5$ . (Knop) Is  $\text{NaTi}_3(\text{PO}_4)_3$   
(Wunder, J. B. 1871. 324)  
 $\text{H}_2\text{TiPO}_4$ . Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ .  
Sl sol in  $\text{H}_2\text{PO}_4$   
Sol in  $\text{KOH}$ ,  $\text{NH}_4\text{OH}$ ,  $(\text{NH}_4)_2\text{CO}_3$  and  
 $(\text{NH}_4)_2\text{HPO}_4 + \text{Aq}$   
Very sl. sol in acetic acid. (Faber, Z.  
anal. 1907, 46. 288.)

**Uranous metaphosphate,  $\text{U}(\text{PO}_3)_2$ .**

Insol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4$ , even  
when hot and conc. (Colani, A. ch. 1907, (8)  
12. 105.)

**\*Uranic metaphosphate,  $\text{U}_2(\text{PO}_3)_4$**

Insol. in  $\text{H}_2\text{O}$  and acids. (Hautefeuille and  
Margottet, C. R. 96. 849.)

**Uranous orthophosphate,  $\text{U}_3(\text{PO}_4)_4$ .**

More easily attacked by acids than the pyro  
and meta phosphates, especially by  $\text{HNO}_3$   
(Colani, A. ch. 1907, (8) 12. 123)

**Uranous hydrogen orthophosphate,  $\text{UHPO}_4 + \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Insol. in dil. sl sol. in  
conc.  $\text{HCl} + \text{Aq}$ . Decomp. by  $\text{KOH} + \text{Aq}$ ,  
not by  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg, Pogg  
59. 1)

**Uranous pyrophosphate,  $\text{UP}_2\text{O}_7$ .**

Insol in  $\text{H}_2\text{O}$ .  
Sl sol in min. acids. (Colani.)

**Uranous phosphate,  $2\text{UO}_3$ ,  $\text{P}_2\text{O}_5$**

Easily attacked by boiling  $\text{HNO}_3$   
(Colani)  
 $\text{UO}_3$ ,  $\text{P}_2\text{O}_5 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{SO}_4$  and  
in  $\text{HCl} + \text{Aq}$  of medium concentration. Sol.  
in very conc.  $\text{HCl} + \text{Aq}$ . (Aloy, Dissert.  
1901.)

**Uranyl metaphosphate,  $\text{UO}_2(\text{PO}_3)_2$**

(Rammelsberg, B. A. B. 1872. 447.)  
 $\text{UO}_3$ ,  $2\text{P}_2\text{O}_5$ . Insol. in acids. (Johnsson,  
B. 22. 976.)

**Uranyl orthophosphate,  $\text{UO}_2\text{HPO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ .  
 $+3\text{H}_2\text{O}$   
 $+4\text{H}_2\text{O}$ .  
 $+4\frac{1}{2}\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ . Sol. in 67,000  
pts.  $\text{HCl} + \text{Aq}$ , 50,000 pts.  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ ,  
and 300,000 pts. of a mixture of the above  
two solutions Sol. in  $\text{K}_2\text{CO}_3$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ .  
(Kitschin, C. N. 27. 199)

**Uranyl dihydrogen phosphate,**

$(\text{UO}_2\text{H}_2(\text{PO}_4)_2 + 3\text{H}_2\text{O}$ .  
Decomp. by  $\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{PO}_4 + \text{Aq}$ .  
(Werther, J. pr. 43. 322.)

**Uranyl pyrophosphate,  $(\text{UO}_2)_2\text{P}_2\text{O}_7 + 5\text{H}_2\text{O}$ .**

Efflorescent Insol in  $\text{H}_2\text{O}$ . Sol. in  
 $\text{HNO}_3 + \text{Aq}$ , and  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . Insol in  
 $\text{Na}_2\text{HPO}_4 + \text{Aq}$ . Insol in alcohol or ether.  
(Garard, C. R. 34. 22.)  
 $+4\text{H}_2\text{O}$ . (Castang, Bull. Soc. (2) 34. 20.)

**Uranyl tetraphosphate (?),  $\text{UO}_2\text{P}_4\text{O}_{11}$ .**

(Johnsson, B. 22. 978.)

**Uranous orthophosphate chloride,  $\text{U}_3(\text{PO}_4)_4$ ,  
 $\text{UCl}_4$**

Sl sol. in  $\text{HCl} + \text{Aq}$  Sol. in  $\text{HNO}_3$  and  
 $\text{HNO}_3 + \text{HCl}$  (Colani, A. ch. 1907, (8) 12.  
127)

**Uranous hydrogen orthophosphate chloride,  
 $\text{U}(\text{HPO}_4)_2$ ,  $\text{UCl}_4$**

Very sl. sol. in  $\text{H}_2\text{O}$ . (Aloy, Dissert. 1901.)

**Vanadium phosphate,  $(\text{VO}_2)_2\text{H}_2\text{PO}_4 + 4\frac{1}{2}\text{H}_2\text{O}$ .**

Sol in  $\text{H}_2\text{O}$   
See Phosphovanadic acid.

**Vanadium pyrophosphate,**

$\text{V}_2(\text{P}_2\text{O}_7)_4 + 30\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$  (Rosenheim, B. 1915. 48.  
500)

**Divanadyl phosphate.**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Insol.  
in alcohol (Berzelius.)

**Ytterbium metaphosphate,  $\text{Yb}(\text{PO}_3)_2$ .**

Insol in  $\text{H}_2\text{O}$  (Cleve, Z. anorg. 1902. 32.  
149.)

**Ytterbium orthophosphate,  $\text{YbPO}_4 + 4\frac{1}{2}\text{H}_2\text{O}$ .**

Ppt. (Cleve)

**Ytterbium phosphate,  $\text{Yb}_2\text{O}_3$ ,  $2\text{P}_2\text{O}_5 + 5\text{H}_2\text{O}$ .**

Sol in  $\text{H}_2\text{O}$  (Cleve)

**Yttrium metaphosphate,  $\text{Y}(\text{PO}_3)_3$ .**

Insol in  $\text{H}_2\text{O}$  or acids (Cleve.)

**Yttrium orthophosphate,  $\text{YPO}_4$ .**

*Anhydrous.* Insol. in  $\text{H}_2\text{O}$  or acids after  
ignition.

*Mm Xenotime.* Insol. in conc. acids. Sl.  
sol in much conc.  $\text{HCl} + \text{Aq}$ , but easily sol.  
therein when first heated with a little  $\text{HCl} + \text{Aq}$ .  
(Wartha, A. 139. 237.)

**Yttrium hydrogen orthophosphate,  $\text{Y}_2(\text{HPO}_4)_3$**

Decomp. by boiling with  $\text{H}_2\text{O}$  into insol.  
 $\text{YPO}_4$  and sol. acid salt.

**Yttrium pyrophosphate,  $\text{YHP}_2\text{O}_7 + 3\frac{1}{2}\text{H}_2\text{O}$ .**

Difficultly sol in acids Decomp. by  
 $\text{H}_2\text{SO}_4$ . Sol in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . (Cleve.)  
 $2\text{Y}_2\text{O}_3$ ,  $3\text{P}_2\text{O}_5$ . Insol. in acids. (Johnsson,  
B. 22. 976.)

**Zinc metaphosphate.**Sol in  $H_2O$ . (Berzelius.)**Zinc dimetaphosphate,  $Zn_2P_2O_6$ .**Sol. only in boiling  $H_2SO_4$ . (Fleitmann, Pogg. 78, 350.)Not decomp. by boiling  $Na_2S$  or  $(NH_4)_2S$  + Aq. +  $4H_2O$ . Insol. in  $H_2O$ , but decomp. by boiling therewith. (Fleitmann, Pogg. 78, 258.)Sol. in 4 pts.  $H_2O$ . Conc.  $H_2SO_4$  decomp. it easily; other acids act slightly. (Glatzel, Dissert. 1880.)

Difficultly decomp. by boiling acids

**Zinc trimetaphosphate,  $Zn_3(PO_3)_3 + 9H_2O$ .**1 l.  $H_2O$  dissolves 0.1 g. at  $20^\circ$ . (Tammann, J. pr. 1892, (2) 45, 426.)**Zinc tetrametaphosphate,  $Zn_4(PO_3)_4 + 10H_2O$ .**Sol. in 55 pts.  $H_2O$ . Decomp. by acids only on boiling. (Glatzel, Dissert. 1880.)Somewhat sol. in  $HNO_3$  + Aq. Sol in boiling  $H_2SO_4$ . (Glatzel.)**Zinc orthophosphate,  $Zn_3(PO_4)_2 + 4H_2O$ .**Insol. in  $H_2O$ . Easily sol. in acids,  $NH_4OH$ ,  $(NH_4)_2CO_3$ ,  $(NH_4)_2SO_4$ , or  $NH_4NO_3$  + Aq. (Hantz, A. 143, 356.)Sol. in  $NH_4Cl$  + Aq. (Fuchs.)

Easily sol. in Zn salts + Aq. (Rose.)

Insol. in liq.  $NH_3$ . (Franklin, Am. Ch. J. 1808, 20, 830.)Min. *Hopetite*+  $6H_2O$ . (Roynoso.)**Zinc hydrogen phosphate,  $ZnHPO_4 + H_2O$** Insol. in  $H_2O$ ; sol. in  $H_3PO_4$  + Aq. (Gram.)**Zinc tetrahydrogen phosphate,  $ZnH_4(PO_4)_2 + 2H_2O$ .**Nearly insol. in  $H_2O$ , but decomp. thereby into  $H_3PO_4$  and  $10ZnO$ ,  $4P_2O_5 + 10H_2O$  (Demel, B. 12, 1171.)**Zinc phosphate,  $10ZnO, 4P_2O_5 + 10H_2O$** Insol. in  $H_2O$ . (Demel, B. 12, 1171.)**Zinc pyrophosphate,  $Zn_2P_2O_7 + \frac{1}{2}H_2O$ .**Ppt. Sol. in  $H_2SO_4$  + Aq. Sol. in acids,  $KOH$  + Aq.,  $NH_4OH$  + Aq. (Schwarzenberg, A. 65, 151.)Sol. in  $Na_2P_2O_7$  + Aq. (Gladstone), and in  $ZnSO_4$  + Aq. (Rose.)

Insol. in acetic acid. (Knorre, Z. anorg. 1900, 24, 389.)

+  $5H_2O$ . Insol. in  $H_2O$ . (Pahl, J. B. 1873, 229.)**Zinc hydrogen pyrophosphate.**Sol. in  $H_2O$ . (Pahl, Sv. V. A. F. 30, 7, 45.)**Zinc metaphosphate ammonia.**

Ppt. (Bette.)

**Zinc orthophosphate ammonia,  $2ZnO, P_2O_5, 3NH_3 + 8H_2O$ .**

(Rother, A. 143, 356.)

 $6ZnO, 3P_2O_5, 8NH_3 + 4H_2O$ . (Schweikert, A. 145, 517.)**Zinc pyrophosphate ammonia,  $3Zn_2P_2O_7, 4NH_3 + 9H_2O$ .**Ppt. Insol. in  $H_2O$ . (Bette.)**Zirconium orthophosphate,  $5ZrO_2, 4P_2O_5 + 8H_2O$** 

Somewhat sol. in acids. (Hermann, J. pr. 97, 321.)

Insol. in acids. (Paykull, Bull. Soc. (2) 20, 65.)

 $2ZnO, P_2O_5$ . Not attacked by acids. (Hautefeuille and Margottet, C. R. 102, 1017.)**Zirconium pyrophosphate,  $Zr(PO_3)_2$ .**

(Knop, A. 159, 36.)

**Phosphoricovanadicotungstic acid.****Ammonium phosphoricovanadicotungstate,  $14(NH_4)_2O, 2P_2O_5, 7V_2O_5, 31WO_3 + 78H_2O$ .**Sol. in  $H_2O$ . Insol. in alcohol, ether,  $CS_2$  and benzene. (Rogers, J. Am. Chem. Soc. 1903, 25, 305.)**Phosphorimidamide,  $PN_2H_2$** 

(Joannis, C. R. 1904, 139, 365.)

**Phosphorimide,  $P_2(NH)_2$ .**Very sol. in ammoniacal solution of  $NH_4I$  (Hugot, C. R. 1905, 141, 1236.)**Phosphornitryl,  $PON$** 

See Phosphoryl nitride.

**Phosphorosomolybdic acid,  $P_2O_5$ ,** $24MoO_3 + 63H_2O$ .

(Rosenheim and Pinsker, Z. anorg. 1911, 70, 77.)

**Ammonium phosphorosomolybdate,** $2(NH_4)_2O, 2H_3PO_4, 12MoO_3 + 12\frac{1}{2}H_2O$ .Insol. in cold, slightly sol. in hot  $H_2O$ . (Gibbs, Am. Ch. J. 5, 361.)**Phosphorosophosphomolybdic acid.****Ammonium phosphorosophosphomolybdate,  $9(NH_4)_2O, 2H_3PO_3, 3P_2O_5, 72MoO_3 + 38H_2O$ .**Nearly insol. in  $H_2O$ . (Gibbs.)

**Phosphorosophotungstic acid.**

**Potassium phosphorosophotungstate**,  
 $5K_2O, 2H_2PO_3, P_2O_5, 24WO_3 + 13H_2O$   
 Sol in much boiling  $H_2O$  (Gibbs, Am. Ch. J. 7. 313)

**Phosphorosotungstic acid.**

**Ammonium phosphorosotungstate**,  $6(NH_4)_2O,$   
 $4H_2PO_3, 22WO_3 + 25H_2O$   
 Sl. sol. in cold  $H_2O$

**Potassium —**,  $5K_2O, 16H_2PO_3, 32WO_3 +$   
 $46H_2O$   
 Sl. sol. in hot  $H_2O$ .

**Sodium —**,  $2Na_2O, 8H_2PO_3, 22WO_3 +$   
 $35H_2O$   
 Nearly insol. in cold, sl. sol. in hot  $H_2O$   
 (Gibbs, Am. Ch. J. 7. 313).

**Phosphorous anhydride,  $P_2O_3$** 

See Phosphorus trioxide.

**Phosphorous acid,  $H_3PO_3$** 

Deliquescent Very sol in  $H_2O$

**Phosphites.**

The neutral alkali phosphites are sol. in  $H_2O$ ; most of the others are sl. sol. in  $H_2O$ , but sol. in  $H_2PO_3 + Aq$ ; all are insol. in alcohol

**Aluminum phosphite, basic**,  $Al_2(HPO_3)_3,$   
 $Al_2(OH)_6$

Ppt. (Grützner, Arch. Pharm. 1897, 235. 698.)

**Aluminum phosphite.**

Precipitate. (Rose, Pogg. 9. 39)  
 Sl. sol. in  $H_2O$ .

**Ammonium phosphite**,  $(NH_4)_2HPO_3 + H_2O$ .

Very deliquescent, and sol. in  $H_2O$  (Rose, Pogg. 9. 28.)

Sol in 2 pts. cold, and less hot  $H_2O$ . Insol. in alcohol (Berzelius.)

Insol. in acetone. (Eidmann, C. C. 1899, II 1014; Naumann, B. 1904, 37. 4328.)

**Ammonium hydrogen phosphite**, \*  
 $(NH_4)H_2PO_3$ .

Very deliquescent, and sol. in  $H_2O$ . 1 pt.  $H_2O$  dissolves 1.71 pts. salt at  $0^\circ$ ; 1.9 pts. at  $14.5^\circ$ ; and 2.60 pts. at  $31^\circ$  (Amat, C. R. 106. 809.)

**Ammonium hydroxylamine phosphite**,  
 $NH_4(NH_2OH)HPO_3$ .

Sol. in  $H_2O$  and abs. alcohol. (Hofmann, Z. anorg. 1898, 18. 466.)

**Ammonium magnesium phosphite**,  
 $(NH_4)_2Mg_2(PO_3)_4 + 16H_2O$

Slightly sol. in  $H_2O$ . (Rammelsberg, Pogg. 131. 367)

**Antimonyl phosphite**,  $(SbO)_2H_2PO_3$ .

Very sol. in  $H_2O$  containing HCl. (Grützner, Arch. Pharm. 1897, 235. 694.)

**Barium phosphite**,  $BaHPO_3$ .

100 pts.  $H_2O$  dissolve 0.25 pt. (Ure.)  
 Very slightly sol. in  $H_2O$ , and decomp. by boiling  $H_2O$ . (Dulong)

Easily sol. in  $H_2O$  containing  $NH_4Cl$ . (Wackenroder, A. 41. 315.)

Sol in  $H_2PO_3 + Aq$  or  $HCl + Aq$ . (Raulton.)

**Barium hydrogen phosphite**,  $Ba_2H_2(HPO_3)_2 + 8H_2O$ .

Easily sol. in  $H_2O$ , but decomp. by boiling therewith. Insol. in alcohol (Rammelsberg, Pogg. 132. 496.)

**Barium dihydrogen phosphite**,  $BaH_2(HPO_3)_2 + 1\frac{1}{2}H_2O$ .

Easily sol. in  $H_2O$ . (Rose, Pogg. 9. 215)  
 $+ H_2O$ . Sol. in  $H_2O$ ; decomp. by boiling  $H_2O$  into a neutral insol. and an acid sol. salt.

(Wurtz, A. 58. 66.)

$+ 2H_2O$ . Easily sol. in  $H_2O$  (Rammelsberg, Pogg. 132. 496.)

Insol. in alcohol. (Wurtz)

**Bismuth phosphite**,  $2Bi_2O_3, 3P_2O_3$ .

Insol. in  $H_2O$   
 $Bi_2(HPO_3)_3 + 3H_2O$ . Ppt. (Grützner, Arch. Pharm. 1897, 235. 696.)

Decomp. by  $H_2S$ . Not decomp. by  $KOH + Aq$ . (Vanino, J. pr. 1906, (2) 74. 151.)

**Cadmium phosphite**,  $CdHPO_3 + 3H_2O$ .

Ppt. (Rose, Pogg. 9. 41)

**Calcium phosphite**,  $CaHPO_3 + \frac{1}{2}H_2O$ .

Sl. sol. in  $H_2O$ ; the aqueous solution is decomp. by boiling

$+ H_2O$ . Sol. in  $NH_4Cl + Aq$ . (Wackenroder, A. 41. 315)

Insol. in alcohol.

**Calcium hydrogen phosphite**,  $CaH_2(HPO_3)_2 + H_2O$ .

Sol. in  $H_2O$ . Aqueous solution is decomp. by alcohol (Wurtz, A. ch (3) 7. 212)

**Chromic phosphite.**

Precipitate. Almost insol. in  $H_2O$  (Rose, Pogg. 9. 40.)

**Cobaltous phosphite**,  $CoHPO_3 + 2H_2O$

Ppt. Sl. sol. in  $H_2O$ . (Rose)

Cupric phosphite,  $\text{CuHPO}_3 + 2\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . (Wurtz, A. ch. (3) 16. 213.)

Didymum phosphite,  $\text{Di}_2(\text{HPO}_3)_2$ .

Precipitate (Frerichs and Smith, A. 191. 331.)

Glucinum phosphite.

Precipitate Insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 9. 39.)

Iron (ferrous) phosphite,  $\text{FeHPO}_3 + x\text{H}_2\text{O}$ .

Ppt. Nearly insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 9. 35.)

Iron (ferric) phosphite, basic,  $\text{Fe}_2(\text{HPO}_3)_2 \cdot \text{Fe}_2(\text{OH})_2$ .

(Grützner, Arch. Pharm. 1897, 235. 697.)  
 $\text{Fe}_2(\text{HPO}_3)_2 \cdot \text{Fe}_2(\text{OH})_2 + 5\text{H}_2\text{O}$  Hydrioscopic (Berger, C. R. 1904, 138. 1500.)

Iron (ferric) phosphite,  $\text{Fe}_2(\text{HPO}_3)_2 + 9\text{H}_2\text{O}$ .

Ppt. Sol. in uon alum + Aq. (Rose)

Lanthanum phosphite,  $\text{La}_2(\text{HPO}_3)_2$ .

Precipitate. (Smith)

Lead phosphite, basic,  $4\text{PbO} \cdot \text{P}_2\text{O}_5 + 2\text{H}_2\text{O}$ .

Ppt. (Rose, Pogg. 9. 222.)  
 $3\text{PbO} \cdot \text{P}_2\text{O}_5 + \text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ . Sol in warm dil.  $\text{H}_3\text{PO}_4 + \text{Aq}$ , from which it is pptd by  $\text{NH}_4\text{OH} + \text{Aq}$  (Wurtz, A. ch. (3) 16. 211.)

Lead phosphite,  $\text{PbHPO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in a solution of phosphorous acid; easily sol in cold  $\text{HNO}_3 + \text{Aq}$ . (Wurtz.)

Lead hydrogen phosphite,  $\text{PbH}_2(\text{PO}_3)_2$ .

Decomp. by  $\text{H}_2\text{O}$  (Amat, C. R. 110. 901.)

Lead pyrophosphite,  $\text{PbH}_2\text{P}_2\text{O}_5$ .

Gradually decomp. by  $\text{H}_2\text{O}$  into  $\text{H}_3\text{PO}_3$  and  $\text{PbHPO}_3$  (Amat, C. R. 110. 903.)

Lithium hydrogen phosphite,  $\text{LiH}_2\text{PO}_3$ .

Very sol. in  $\text{H}_2\text{O}$ . (Amat, A. ch. (6) 24. 309.)

Lithium pyrophosphite,  $\text{Li}_2\text{H}_2\text{P}_2\text{O}_5$ .

Very sol. in  $\text{H}_2\text{O}$ . (Amat, A. ch. 1891, (6) 24. 352.)

Magnesium phosphite,  $\text{MgHPO}_3 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 9. 28.)

Sol. in 400 pts.  $\text{H}_2\text{O}$ . (Berzelius.)  
 $+ 4\text{H}_2\text{O}$ .

Magnesium pyrophosphite,  $\text{Mg}(\text{H}_2\text{P}_2\text{O}_5)_2$ .

Very sol. in  $\text{H}_2\text{O}$  (Amat, A. ch. 1891, (6) 24. 313.)

Manganous phosphite,  $\text{MnHPO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ , easily in  $\text{MnCl}_2$  or  $\text{MnSO}_4 + \text{Aq}$  (Rose, Pogg. 9. 33.)

Nickel phosphite,  $\text{NiHPO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ .

Ppt. Sl sol in  $\text{H}_2\text{O}$

Potassium phosphite,  $\text{K}_2\text{HPO}_3$ .

Very deliquescent. Very sol in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Dulong.)

Potassium hydrogen phosphite,  $(\text{KH})\text{HPO}_3$ .

1 pt.  $\text{H}_2\text{O}$  dissolves about 1.72 pts. salt at  $20^\circ$  (Amat, C. R. 106. 1351.)

$\text{K}_2\text{HPO}_3 \cdot 2\text{H}_2\text{PO}_3$  Very sol in  $\text{H}_2\text{O}$  (Wurtz, A. 58. 63.)

Sol in 3 pts. cold, and in less hot  $\text{H}_2\text{O}$  (Fourcroy and Vauquelin.)

Potassium pyrophosphite,  $\text{K}_2\text{H}_2\text{P}_2\text{O}_5$ .

Very sol in  $\text{H}_2\text{O}$  (Amat, A. ch. (6) 24. 351.)

Sodium phosphite, basic,  $\text{Na}_2\text{HPO}_3$ ,  $\text{NaOH}$  (?)

Not obtained in pure state (Zimmerman, B. 7. 290), =  $\text{Na}_2\text{PO}_3$  (Wischeenus.)

Does not exist (Amat)

Sodium phosphite,  $\text{Na}_2\text{HPO}_3 + 5\text{H}_2\text{O}$

Deliquescent, and very sol in  $\text{H}_2\text{O}$ . Insol in alcohol

Correct formula for  $\text{Na}_2\text{PO}_3$  of Rose and Dulong.

Sodium hydrogen phosphite,  $(\text{NaH})\text{HPO}_3 + 2\frac{1}{2}\text{H}_2\text{O}$

0.56 pt. salt dissolves in 1 pt.  $\text{H}_2\text{O}$  at  $0^\circ$ ; 0.66 pt. at  $10^\circ$ ; 1.93 pts at  $42^\circ$  (Amat, C. R. 106. 1351.)

$\text{Na}_2\text{H}_2(\text{HPO}_3)_2 + \text{H}_2\text{O}$ . Deliquescent in moist air. Sol in 2 pts. cold, and about the same amt hot  $\text{H}_2\text{O}$ . Sl sol in spirit (Fourcroy and Vauquelin.)

Sodium pyrophosphite,  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_5$ .

Very sol. in  $\text{H}_2\text{O}$  with gradual decomp. into  $\text{Na}_2\text{HPO}_3$ . (Amat.)

Strontium phosphite,  $\text{SrHPO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp on heating into a sol. acid salt and an insol basic salt

Strontium hydrogen phosphite,  $\text{SrH}_2(\text{PO}_3)_2$ .

Very sol in  $\text{H}_2\text{O}$ . (Amat, A. ch. (6) 24. 312.)

Thallous hydrogen phosphite,  $\text{TlH}_2\text{PO}_3$ .

Very sol. in  $\text{H}_2\text{O}$ . (Amat, A. ch. (6) 24. 310.)

Thallous pyrophosphite,  $\text{Tl}_2\text{H}_2\text{P}_2\text{O}_5$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$  (Amat)

**Tin (stannous) phosphite,  $\text{SnHPO}_3$**   
Ppt Sol in  $\text{HCl} + \text{Aq.}$  (Rose, Pogg. 9. 45)

**Tin (stannic) phosphite,  $2\text{SnO}_3, \text{P}_2\text{O}_3$**   
Ppt. (Rose, Pogg. 9. 47.)

**Titanium phosphite (?)**  
Precipitate (Rose, Pogg. 9. 47)

**Uranyl phosphite,  $(\text{UO}_2)_3\text{H}_2(\text{HPO}_3)_4 + 12\text{H}_2\text{O}$**   
Precipitate (Rammelsberg Pogg. 132. 500)

**Zinc phosphite,  $\text{ZnHPO}_3$**   
Sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 132. 481)  
 $+ 2\frac{1}{2}\text{H}_2\text{O}$  More easily sol in cold than warm  $\text{H}_2\text{O}$  (Rammelsberg.)

**Zinc phosphite, acid,  $\text{Zn}_2\text{H}_3\text{P}_3\text{O}_8$**   
Sol. in  $\text{H}_2\text{O}$ .  
 $+ 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 132. 498.)  
 $\text{Zn}_2\text{H}_3\text{P}_3\text{O}_{11}$  Sol in  $\text{H}_2\text{O}$   
 $+ 3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rammelsberg)  
 $\text{Zn}_2\text{H}_3\text{P}_3\text{O}_{14}$  Sol. in  $\text{H}_2\text{O}$ .  
 $+ \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Zirconium phosphite,  $\text{Zr}(\text{PO}_3)_2 + \text{H}_2\text{O}$**   
Ppt Nearly insol. in dil. mineral acids (Hauser, Z anorg. 1913, 84. 92)

**Phosphorous anhydride,  $\text{P}_2\text{O}_3$**   
See Phosphorus trioxide.

## Phosphorus, P.

(a) *Ordinary white phosphorus* Insol. in  $\text{H}_2\text{O}$ , but slowly decomp. thereby (G. K.); very sl. sol in  $\text{H}_2\text{O}$ . (Berzelius and others)

A pure aqueous solution containing 0.1 g. P in 500 cc.  $\text{H}_2\text{O}$  can be obtained by dissolving 0.1 g. P in  $\text{CS}_2$  mixed with ether and hot alcohol; this solution is poured into 500 cc boiling  $\text{H}_2\text{O}$  free from air, and the boiling continued with stirring until the alcohol, ether and  $\text{CS}_2$  are boiled off. (Bokorny, Ch. Ztg. 1896, 20. 1022)

100 g  $\text{H}_2\text{O}$  sat. with P contains 0.0003 g P (Stach, C C 1903, I. 1291)

Sol. with decomp. in hot conc.  $\text{HNO}_3 + \text{Aq}$   
Decomp. by boiling caustic alkalis +  $\text{Aq}$   
Easily sol in  $\text{SCl}_2$ , especially if hot. (Wöhler.)

Sol. in sulphur phosphides.

Largely sol in  $\text{PCl}_3$ .

Easily sol in  $\text{PCl}_5$ .

Sol. in  $\text{PBr}_3$ . Sol in  $\text{PSCl}_3$ , easily on warming, separating on cooling. (Serullas, A. ch. 1829, 42. 25.)

Sol. in liquid  $\text{SO}_2$ . (Sestini, Bull Soc 1868, (2) 10. 226.)

Sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828)

Sol. in  $\text{S}_2\text{Cl}_2$  without foaming. (Nicolardot, C R. 1908, 147. 1304.)

Sol. in  $\text{PS}_2\text{Cl}_4$ . (Gladstone, A 1850, 74. 91)

Sol in 320 pts. cold alcohol of 0.799 sp. gr., and in 240 pts. of the same when warm  
Pptd from alcoholic solution by  $\text{H}_2\text{O}$  (Büchner)

One grain P dissolves in 1 ounce abs alcohol (Schacht)

Sol. in 20 pts. absolute ether at  $20^\circ$  and 240 pts ordinary ether at  $20^\circ$ . (Bucholz.)

Sol in 80 pts. absolute ether at  $15.5^\circ$ , and 240 pts. ordinary ether at  $15.6^\circ$  (Brugnatelli, A. ch. 24. 73)

Solubility of  $\text{P}_2$  in 100 g. ether at  $t^\circ$ .

$t^\circ$	G phosphorus	Sp gr
0	0.4335	.
5	0.62	.
8	0.79	..
10	0.85	.
15	0.9	at $13^\circ$ 0.7257
18	1.005	.
20	1.04	at $19^\circ$ 0.7187
23	1.121	.
25	1.39	0.7283
28	1.601	.
30	1.75	.
33	1.8	.
35	1.9984	.

(Christomanos, Z. anorg. 1905, 45. 136.)

Solubility of  $\text{P}_4$  in 100 g. benzene at  $t^\circ$ .

$t^\circ$	G phosphorus	Sp gr
0	1.513	.
5	1.99	.
8	2.31	.
10	2.4	.
15	2.7	at $13^\circ$ 0.8959
18	3.1	..
20	3.21	at $19^\circ$ 0.8912
23	3.3995	at $22^\circ$ 0.8875
25	3.7	0.8861
28	4.35	...
30	4.601	...
33	5.0	...
35	5.17	..
40	5.75	..
45	6.105	.
50	6.8	.
55	7.315	.
60	7.9	.
65	8.4	.
70	8.898	.
75	9.4	.
81	10.027	.

(Christomanos.)

Sol. to about 1% in acetic acid. (Vulpinus, Arch. Pharm. 1878, 213. 38.)

100 g. 96% acetic acid dissolve 0.105% P. (Stich, Pharm. Ztg. 1903, 48. 343.)

Sol. in 0.05 pt. CS<sub>2</sub> (Böttger), 0.125 pt (Trommsdorff)

Alcohol ppts. P from CS<sub>2</sub> solution  
1 pt CS<sub>2</sub> dissolves 17-18 pts P. (Vogel, J. B. 1868. 149)

Solubility in CS<sub>2</sub> at t°.  
(g. per 100 g. of solution.)

t°	G. P.	t°	G. P.
-10	31.40	-2 5	75.00
-7 5	35.85	0 0	81.27
-5	41.95	+5 0	86.30
-3 5	66.14	+10.0	89.80
-3 2	71.72		

(Cohen and Inouye, Z. phys. Ch. 1910, 72. 418.)

Very sol. in methylene iodide (Retgers, Z. anorg. 3. 343.)

Strong vinegar dissolves P. (Beudet.)

Sol. in considerable amount in stearic acid. (Vulpinus, Arch. Pharm. (3) 13. 38.)

Sol. in ethyl chloride, benzoyl chloride, stannic chloride, and in liquid cyanogen.

Sl. sol. in ethyl nitrate, and wood-spirit  
Sl. sol. in acetone, with gradual decomposition.

Insol. in nicotine, and conune

Sl. sol. in cold, more sol. in hot benzene. (Mansfield.)

Sol. in 14 pts. hot, and less in cold petroleum from Amiano. (Saussure)

Sl. sol. in "liquid paraffine" (Crismer, B. 17. 649.)

Sl. sol. in warm essential oils, as oil of turpentine, and in the fatty oils.

Sol. in hot oil of copaiba, separating out on cooling

Sol. in hot oil of caraway, and mandarin oil. (Luca.)

Sl. sol. in cold, more sol. in hot caoutchou, depositing on cooling.

Readily sol. in warm, less in cold styrene

Sol. in aniline, and quinaline (Hofmann.)

Sl. sol. in cold creosote.

Somewhat sol. in fusel oil.

Easily sol. in valeric acid, and amyl valerate.

Sol. in hexyl alcohol, ethylene chloride, allyl sulphocyanide, mercury methyl, chloroform, bromoform, warm chloral, acetic ether, aldehyde, hot caecodyl sulphide, and in caecodyl oxide.

100 g. oil of almonds sat with P contain 1.25 g. (Stich, C. C. 1903, I. 1291.)

100 g. oleic acid sat. with P contain 1.06 g (Stich.)

100 g. paraffine sat with P contain 1. g. (Stich.)

(b) *Amorphous phosphorus*. Insol. in H<sub>2</sub>O. Insol. in NH<sub>4</sub>OH + Aq. (Fluckiger.)

Sol. in boiling KOH + Aq.

The statement of Burgess and Chapman, (Chem. Soc. 79. 1235) that red P is sol. in aqueous alcoholic alkali is incorrect. Both ordinary crystalline and amorphous red P are insol. in aqueous alcoholic alkali. (Michaels, A. 1902, 325. 367.)

Insol. in liquid NH<sub>3</sub> (Hugot, A. ch 1900 (7) 21, 31); (Franklin, Am. Ch. J. 1898, 20. 828.)

Bright red variety is sol. in liquid NH<sub>3</sub> at ord. temp leaving a black residue. (Stoch, Böttcher and Lenger, B. 1909, 42. 2854.)

*Red Amorphous*.

Sol. in S<sub>2</sub>Cl<sub>2</sub> with foaming. (Nicolaïdote, C. R. 1908, 147. 1304.)

Solubility of amorphous bright red P, in PBr<sub>3</sub> is diminished by long heating as follows.

	172°	185°
Initial concentration	0.555	0.476
Final concentration	0.374	0.397
Length of expt in hours	34	24
	198°	218°
	0.592	0.476
	0.416	0.592
	18	17

(Buck, Dissert. 1904.)

Ordinary amorphous P<sub>4</sub> is sol. in PBr<sub>3</sub>.

A sample prepared by heating bright red amorphous P with 94.2% P dissolved by heating in PBr<sub>3</sub> as follows

% P	0.106	0.121	0.178
hours	10	20	42

A finely pulverized commercial product containing 98.0% P:

% P	0.92	0.116
hours	10	20

An ordinary commercial product with 98% P.

% P	0.056	0.108
hours	10	42

(Buck.)

100 g. PBr<sub>3</sub> dissolve 0.2601 g. bright red phosphorus at 172°; 0.3634 g at 184° (Sehenk, B. 1902, 35. 353.)

Insol. in KOH + Aq.

Conc. H<sub>2</sub>SO<sub>4</sub> does not act upon it in the cold, but dissolves easily when hot.

Insol. in dil., easily sol. in conc. HNO<sub>3</sub> + Aq. with decomposition.

Much more sol. in HNO<sub>3</sub> + Aq. than ordinary P. (Personne, C. R. 45. 115.)

Insol. in methylene iodide (Retgers)

Appreciably sol. in isobutyl alcohol. (Svedberg.)

Insol. in CS<sub>2</sub>, alcohol, ether, naphtha,

ligroine, PCl<sub>3</sub>, etc.

Sl. sol. in boiling oil of turpentine and

other high-boiling liquids, with conversion into ordinary phosphorus.

Insol in oil of turpentine even at 270°.

(Colson, A. ch. 1908, (8) 14. 554.)

(c) *Crystalline*. Insol. m, and not attacked by dil  $\text{HNO}_3 + \text{Aq}$

Sol. in  $\text{CS}_2$

Phosphorus tetrabromide,  $\text{PBr}_4$

Decomposed by  $\text{H}_2\text{O}$ , slowly at 8°, but very rapidly at 25°. (Löwig, Pogg. 14. 485)

Sol. in liquid  $\text{H}_2\text{S}$  (Antony and Magri, Gazz. ch. it. 1905, 35, (1) 206.)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84. 27.)

Sol. in ether, acetone,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$  and  $\text{CS}_2$ . (Christomanos, Z. anorg 1904, 41. 287.)

Phosphorus pentabromide,  $\text{PBr}_5$ .

Fumes on air; and is violently decomp by  $\text{H}_2\text{O}$ .

Phosphorus tribromide ruthenium bromide,  $\text{Ru}_2\text{P}_2\text{Br}_{12}$

Decomp by boiling  $\text{H}_2\text{O}$ .

Slowly sol. in hot alcohol with decomp.

Insol in benzene,  $\text{CCl}_4$ , ligroin and cold alcohol. (Strecker, B. 1900, 42. 1775)

Phosphorus thiophosphoryl bromide,  $\text{PBr}_3$ ,  $\text{PSBr}_3$

Decomp. by  $\text{H}_2\text{O}$  into  $\text{PSBr}_3$ . (Michaelis.)

Phosphorus tribromide ammonia,  $3\text{PBr}_3$ ,  $9\text{NH}_3$ .

Slowly but completely sol with decomp. in  $\text{H}_2\text{O}$ . (Storei's Dict.)

Phosphorus pentabromide ammonia,  $\text{PBr}_3$ ,  $9\text{NH}_3$ .

(Besson, C. R. 111. 972.)

Phosphorus monobromotetrachloride,  $\text{PBrCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Prinvalet, C. R. 74. 868.)

Phosphorus dibromotrichloride,  $\text{PBr}_2\text{Cl}_3$ .

Very unstable. (Michaelis, B. 5. 9.)

Phosphorus tetrabromotrichloride,  $\text{PBr}_4\text{Cl}_3$ .

Decomp. with  $\text{H}_2\text{O}$ . (Geuther.)

Phosphorus heptabromodichloride,  $\text{PBr}_7\text{Cl}_2$ .

Very unstable. (Prinvalet, C. R. 74. 868.)

Phosphorus octobromotrichloride,  $\text{PBr}_8\text{Cl}_3$ .

Very easily decomp. (Michaelis, B. 5. 9.)

Phosphorus bromefluoride,  $\text{PF}_2\text{Br}_2$ .

Decomp. violently with  $\text{H}_2\text{O}$ . (Moissan, Bull. Soc. (2) 43. 2.)

Phosphorus bromonitride.

See Nitrogen bromophosphide.

Phosphorus dichloride,  $\text{P}_2\text{Cl}_4$ .

Decomp by  $\text{H}_2\text{O}$  (Besson, C. R. 1910, 150. 103)

Phosphorus trichloride,  $\text{PCl}_3$

Gradually decomp by  $\text{H}_2\text{O}$

0.11 g. is sol in 100 ccm liquid  $\text{H}_2\text{S}$ . (Antony, Gazz. ch. it. 1905, 35 (1) 206)

Acted upon by liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828)

Miscible with  $\text{CS}_2$ ,  $\text{C}_6\text{H}_6$ ,  $\text{CHCl}_3$ , and ether.

Decomp with alcohol.

Phosphorus pentachloride,  $\text{PCl}_5$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  with violent decomp and evolution of heat

Sol. in liquid  $\text{HCl}$  Acted upon by liquid  $\text{NH}_3$ . Somewhat sol without decomp. in  $\text{CS}_2$ .

(Schiff, A. 102. 118. (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. without decomp. in benzoyl chloride. (Gerhardt)

Sol in oil of turpentine with evolution of heat.

Monophosphorus platinous chloride,  $\text{PtCl}_2$ ,  $\text{PtCl}_4$ .

Deliquescent. Sol in  $\text{H}_2\text{O}$  with formation of chloroplatinophosphoric acid.

Similarly decomp. by alcohol. Abundantly sol. in hot benzene, toluene, chloroform, or carbon tetrachloride, and crystallizes on cooling.

(Schützenberger, Bull. Soc. (2) 17. 482.)

Diphosphorus platinous chloride,  $2\text{PtCl}_2$ ,  $\text{PtCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$  with formation of chloroplatinodiphosphoric acid.

Similarly decomp. by alcohol. Sol. without decomp. in  $\text{PCl}_3$ ,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ , or  $\text{C}_7\text{H}_8$ .

(Schützenberger.)

Sol in propyl alcohol with formation of the propyl ether of the platinochlorophosphorous acid and  $\text{HCl}$ . (Poincy, C. R. 104. 364.)

Phosphorus diplatinous chloride,  $\text{PtCl}_2$ ,  $2\text{PtCl}_4$ .

Sol. in alcohol, with formation of ether ( $\text{PtCl}_2$ ) $_2\text{P}(\text{OC}_2\text{H}_5)_2$  (Cochin, C. R. 86. 1402.)

Phosphorus platonic chloride,  $\text{PtCl}_2$ ,  $\text{PtCl}_4$ .

(Schützenberger.)

Phosphorus pentachloride platonic chloride,  $\text{PtCl}_2$ ,  $\text{PtCl}_4$ , or  $(\text{PtCl}_4)_2\text{PtCl}_2$ .

Decomp. at once by  $\text{H}_2\text{O}$ . (Baudrimont, A. ch. (4) 2. 47.)

Phosphorus pentachloride selenium tetrachloride,  $2\text{PCl}_5, \text{SeCl}_4$ .

Sol. in  $\text{H}_2\text{O}$  with decomp (Baudrimont, A. ch. (4) 2. 5.)

Phosphorus trichloride ruthenium chloride,  $\text{Ru}_2\text{P}_2\text{Cl}_{10}$ .

Slowly decomp. by boiling  $\text{H}_2\text{O}$

Sol. in benzene and  $\text{CHCl}_3$

Sl. sol. in  $\text{CCl}_4$ . Insol. in ligom. (Strecker, B. 1909, 42. 1774.)

Phosphorus tellurium chloride,  $\text{PCl}_5, 2\text{TeCl}_4$ .

Very deliquescent

Sol. in  $\text{H}_2\text{O}$ . (Metzner, A. ch. 1898, (7) 15. 203.)

Phosphorus pentachloride stannic chloride,  $\text{PCl}_5, \text{SnCl}_4$ .

Very deliquescent. Sol. in much  $\text{H}_2\text{O}$  with evolution of heat, forming  $\text{SnCl}_4, \text{HCl}$ , and  $\text{H}_3\text{PO}_4$ , and soon separates out stannic phosphate. (Casselman, A. 83. 257)

Phosphorus trichloride titanium chloride,  $\text{PCl}_5, \text{TiCl}_4$ .

(Bertrand, Bull Soc (2) 33. 565.)

Phosphorus pentachloride titanium chloride,  $\text{PCl}_5, \text{TiCl}_4$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$  and alcohol. Sol. in ether. Sl. sol. in  $\text{PCl}_5$  (Tüttschew, A. 141. 111)

Completely sol. in dil. acids (Weber)

Phosphorus uranium pentachloride,  $\text{PCl}_5, \text{UCl}_6$ .

Decomp. with  $\text{H}_2\text{O}$ .

Phosphorus pentachloride zirconium chloride,  $\text{PCl}_5, \text{ZrCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$  with pptn. of Zr phosphate. (Paykull)

Phosphorus trichloride ammonia,  $\text{PCl}_3, 5\text{NH}_3$ .

Insol. as such in  $\text{H}_2\text{O}$ , but slowly decomp. by boiling  $\text{H}_2\text{O}$ . More easily sol. with decomp. in acids. Sol. with decomp. by boiling with  $\text{KOH}$  or  $\text{NaOH} + \text{Aq.}$  (Berzelius.)

Phosphorus pentachloride ammonia,  $\text{PCl}_5, 5\text{NH}_3$ .

Properties as  $\text{PCl}_3, 5\text{NH}_3$ . (Berzelius.)  $\text{PCl}_5, 8\text{NH}_3$ . Sl. decomp. on air. (Besson, C. R. 111. 972.)

Phosphorus pentachloride tungsten trioxide,  $2\text{PCl}_5, \text{WO}_3(?)$ .

(Persoz and Bloch, C. R. 28. 389.)

Phosphorus chlorobromide.

See Phosphorus bromochloride.

Phosphorus chlorofluoride,  $\text{PCl}_2\text{F}_2$ .

Absorbed by  $\text{H}_2\text{O}$  with decomp. Absorbed by alcohol or ether (Poulenc, A. ch. (6) 24. 555.)

Phosphorus chloriodide,  $\text{PCl}_2\text{I}_2$ .

Decomp. by moist air or  $\text{H}_2\text{O}$ . Sol. in  $\text{CS}_2$ . (Most, B. 13. 2029.)

Phosphorus chloronitride.

See Nitrogen chlorophosphide.

Phosphorus trifluoride,  $\text{PF}_3$ .

Decomp. slowly by  $\text{H}_2\text{O}$ . (Moissan, Bull. Soc (2) 43. 2.)

Rapidly absorbed by  $\text{KOH}$  or  $\text{NaOH} + \text{Aq.}$ , slowly by  $\text{BaO}_2\text{H}_2$  and  $\text{K}_2\text{CO}_3 + \text{Aq.}$ . Absorbed by absolute alcohol with decomp. (Moissan, C. R. 99. 655.)

Phosphorus pentafluoride,  $\text{PF}_5$ .

Fumes on air. (Thorpe, A. 182. 20.)

Phosphorus pentafluoride ammonia,  $2\text{PF}_5, 5\text{NH}_3$ .

(Moissan, C. R. 101. 1490.)

Phosphorus pentafluoride nitrogen peroxide.

Decomp. by  $\text{H}_2\text{O}$ . (Tassel, C. R. 110. 1264)

Phosphorus fluobromide.

See Phosphorus bromofluoride.

Phosphorus fluochloride.

See Phosphorus chlorofluoride.

Phosphorus subiodide,  $\text{P}_2\text{I}_2$ .

Sol. in dil.  $\text{HNO}_3$  and in alkalies +  $\text{Aq.}$  (Boulouch, C. R. 1905, 141. 257.)

Phosphorus diiodide,  $\text{P}_2\text{I}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{CS}_2$ . (Corenwinder, A. ch. (3) 30. 242.)

0.09 g. is sol. in 100 cc. liquid  $\text{H}_2\text{S}$  (Antony, C. C. 1905, I. 1692.)

Phosphorus triiodide,  $\text{PI}_3$ .

Very deliquescent. Decomp. in moist air and by  $\text{H}_2\text{O}$ . (Corenwinder, A. ch. (3) 30. 242.)

Very sol. in  $\text{CS}_2$ .

Phosphorus pentiodide,  $\text{PI}_5(?)$ .

(Hampton, C. N. 42. 180.)

Phosphorus iodosulphide.

See Phosphorus sulphoiodide.

Phosphorus nitride,  $\text{P}_3\text{N}_3$ .

Very slightly decomp. by long boiling with  $\text{H}_2\text{O}$

Completely insol. in any solvent (Stock, B. 1903, 36. 317.)

**Phosphorus suboxide,  $P_2O$ .**

Unchanged in dry, gradually oxidized in moist air. Insol. in  $H_2O$ , alcohol, ether, and oils, not acted on by  $HCl + Aq$ ; oxidized by  $HNO_3$  or  $H_2SO_4$ . (Marchand, J. p. 13. 442.) Sl sol in  $H_2O$ . (le Verrier, A. 27. 167.)

Forms hydrate  $P_2O, 2H_2O$ , which gives up its  $H_2O$  when dried.

Two modifications (a) decomp. slowly by  $H_2O$  or alkalis, (b) not decomp. by  $H_2O$  or alkalis. (Reintzer and Goldschmidt, B. 13. 847.)

Is oxyphosphuretted hydrogen (?),  $P_2H(OH)$  (Franke, J. p. (2) 35. 341.)

**—  $H_2P_2O$ .**

Insol. in all solvents. Decomp. by  $H_2O$ . Not attacked by non-oxidizing acids. Decomp. by dil alkalis (Gautier, C. R. 76. 173.)

**—  $P_2HO$ .**

Insol. in nearly all substances. Not attacked by dilute acids, oxidized by ordinary  $HNO_3$  and conc  $H_2SO_4$  at  $200^\circ$ . Attacked by very dil alkaline solutions. Perhaps identical with phosphorus suboxide  $P_2O$  (Gautier, C. R. 76. 49.)

**Phosphorus oxide,  $P_2O$** 

Decomp by heating with  $H_2O$  at  $100^\circ$ . (Besson, C. R. 1897, 124. 764.)

**Phosphorus trioxide,  $P_2O_3$  (formerly  $P_2O_2$ ).**

Deliquescent, but very slowly dissolved by cold  $H_2O$  to form  $H_3PO_3$ . Violently decomp by hot  $H_2O$  or alcohol.

Sol without decomp. in ether, carbon disulphide, benzene, or chloroform. (Thorpe and Tutton, Chem. Soc. 57. 545.)

**Phosphorus tetroxide,  $P_2O_4$ .**

Very deliquescent. Sol. with evolution of heat in  $H_2O$ . (Thorpe and Fulton, Chem. Soc. 49. 833.)

**Phosphorus pentoxide,  $P_2O_5$ .**

Very deliquescent. Sol. in  $H_2O$  with great evolution of heat, forming  $H_3PO_4$ .

Insol. in liquid  $NH_3$  (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in acetone (Edmann, C. C. 1899, (I. 1014); Naumann, B. 1904, 37. 4329.)

**Phosphorus sulphur oxide,  $P_2O_5, 3SO_2 = (PO)_2(SO_2)_3$  (phosphoryl sulphate) (?).**

Decomp. by  $H_2O$ . Sol. in cold, more sol. in warm  $SO_2$ . (Weber, B. 20. 86.)

**Phosphorus oxy-compounds.**

See under Phosphoryl compounds.

**Phosphorus oxysulphide.**

See Phosphorus sulphoxide.

**Phosphorus semiselenide,  $P_2Se$ .**

Decomp. with  $H_2O$ . Insol. in cold, decomp. by boiling  $KOH + Aq$ . Insol. in, but apparently decomp. by alcohol and ether. Easily sol. in  $CS_2$ . (Hahn, J. p. 93. 430.)

**Phosphorus monoselenide,  $P_2Se$ .**

Stable in dry, decomp. in moist air and by  $H_2O$ . Insol. in alcohol and ether. Decomp. by boiling  $KOH + Aq$ .  $CS_2$  dissolves out P. (Hahn, J. p. 93. 430.)

Sl sol. in  $CS_2$ . (Gore, Phil. Mag. (4) 30. 414.)

**Phosphorous sesquiselenide,  $P_4Se_3$ .**

Sol. in  $CCl_4$ ; sl. sol. in  $CS_2$ . (Meyer, Z. anorg. 1902, 30. 258.)

**Phosphorus triselenide,  $P_2Se_3$ .**

Decomp. by boiling  $H_2O$  and slowly in moist air. Easily sol. in cold  $KOH + Aq$ , less easily in  $M_2CO_3 + Aq$ . Insol. in alcohol, ether, and  $CS_2$ . (Hahn, J. p. 93. 430.)

**Phosphorus pentaselenide,  $P_4Se_5$ .**

Slowly decomp. in moist air or by  $H_2O$ , easily by  $KOH + Aq$  or alcohol. Insol. in  $CS_2$ . Sol. in  $CCl_4$ . (Hahn, J. p. 93. 430.)

**Phosphorus selenides with  $M_2Se$ .**

See M phosphoselenide, under M.

**Phosphorus semisulphide,  $P_2S(?)$ .**

1. *Liquid*. Not decomp. by, and insol. in boiled  $H_2O$ . Insol. in alcohol and ether. Sl. sol. in fats and volatile oils; decomp. by alkalis. Dissolves P on warming, with separation on cooling. Sol. in  $CS_2$ .

2. *Red modification*. Not attacked at first by  $HNO_3 + Aq$  (sp. gr. 1.22), but after a time is attacked with the greatest violence. Weak acids attack only when hot (Berzelius, A. 46. 129.)

Existence is doubtful. (Schulze, B. 13. 1862; Isambert, C. R. 95. 1628.)

**Phosphorus monosulphide,  $P_2S(?)$** 

1. *Ordinary*. Same properties as phosphorus semisulphide, 1.

2. *Red modification*. Unchanged by air,  $H_2O$ , or alcohol. Decomp. by conc  $KOH + Aq$ , not by dilute. Sl. sol. in  $NH_4OH + Aq$ . (Berzelius, A. 46. 129.)

Existence is doubtful (Schulze; Isambert.)

Does not exist (Helff, Z. phys. Ch. 12. 206.)

**Phosphorus sesquisulphide,  $P_4S_3$ .**

Not attacked by cold, slowly by hot  $H_2O$ . Cold  $KOH + Aq$  dissolves with decomp.

Oxidized by  $\text{HNO}_3$  and aqua regia. Sol. in alcohol and ether with decomp. Sol. in  $\text{CS}_2$  (100 pts  $\text{CS}_2$  dissolve 60 pts.  $\text{P}_2\text{S}_2$ ),  $\text{PCl}_3$ , and  $\text{PSCl}_3$ , and in  $\text{K}_2\text{S}$  or  $\text{Na}_2\text{S} + \text{Aq.}$  (Lemome, Bull. Soc. (2) 1. 407.)

Very sol. in  $\text{CS}_2$ . (Rebs, A. 246. 367.)

Decomp. by dil. and conc.  $\text{KOH} + \text{Aq.}$

1 pt.  $\text{P}_2\text{S}_2$  is sol. in 9 pts.  $\text{CS}_2$  at  $-20^\circ$ , in 3.7 pts.  $\text{CS}_2$  at  $0^\circ$ ; in 1 pt.  $\text{CS}_2$  at  $17^\circ$ , in 40 pts. benzene at  $17^\circ$ , in 9 pts. benzene at  $80^\circ$ ; in 32 pts. toluene at  $17^\circ$ ; in 6.5 pts. toluene at  $111^\circ$ . (Stock, B. 1910, 43. 156.)

#### Phosphorus trisulphide, $\text{P}_2\text{S}_3$ .

Decomp. by water. (Kekulé, A. 90. 310.)

Sol. in  $\text{M}_2\text{CO}_3 + \text{Aq}$  with separation of S. Easily sol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  (Berzelius, A. 46. 129.)

Sol. in alcohol and ether. (Lemome.)

Correct formula is  $\text{P}_4\text{S}_6$  (Isambert, C. R. 102. 1386.)

Extremely sl. sol. in  $\text{CS}_2$  (Rebs, A. 246. 368.)

Existence doubtful. (Helff, Z. phys. Ch. 12. 210.)

#### Phosphorus sulphide, $\text{P}_2\text{S}_7$ .

Sl. sol. in  $\text{CS}_2$  (Mai, A. 265. 192.)

Slowly decomp. by cold, rapidly by hot  $\text{H}_2\text{O}$ .

Sol. in cold alkalies

1 pt. is sol. in 3500 pts.  $\text{CS}_2$  at  $17^\circ$ ; in 20,000 pts. at  $0^\circ$  (Stock, B. 1910, 43. 416.)

#### Phosphorus disulphide, $\text{P}_2\text{S}_2$ (formerly $\text{P}_2\text{S}_4$ )

Almost insol. in  $\text{CS}_2$ . (Helff.)

#### Phosphorus pentasulphide, $\text{P}_2\text{S}_5$

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Very sol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $\text{M}_2\text{CO}_3 + \text{Aq}$  with separation of S at low temp. Decomposes alcohol, acetic acid, etc. (Kekulé, A. 106. 331.)

Sol. in  $\text{CS}_2$ . (Isambert, C. R. 102. 1386.)

Not very sol. in  $\text{CS}_2$ . (Rebs, A. 246. 367.)

Mpt.,  $290^\circ$ ; bpt.,  $513-515^\circ$  at 760 mm.

Decomp. by  $\text{H}_2\text{O}$ .

Easily sol. in warm  $\text{NaOH} + \text{Aq.}$

1 pt. is sol. in 450 pts.  $\text{CS}_2$  at room temp.; in 550 pts. at  $0^\circ$ ; in 1200 pts. at  $-20^\circ$ . (Stock, B. 1910, 43. 1225.)

Ordinary form.

Sol. in 195 pts. boiling  $\text{CS}_2$ .

New form.

Sol. in 32 pts.  $\text{CS}_2$ . (Stock, B. 1905, 38. 2722.)

#### Phosphorus persulphide, $\text{P}_2\text{S}_{10}$ (?).

Decomp. by  $\text{H}_2\text{O}$ , alkalies, etc. Consists of S, and mechanically united P. (Ramme, B. 12. 941.)

#### Phosphorus sulphides with $\text{M}_2\text{S}$ .

See M Phosphosulphide, under M.

#### Phosphorus zinc sulphide, $\text{ZnP}_2\text{S}_2$ .

Sol. in  $\text{HCl} + \text{Aq}$  with separation of  $\text{P}_2\text{S}$  (?). (Berzelius, A. 46. 150.)

#### Phosphorus trisulphide ammonia, $\text{P}_2\text{S}_3, 2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Bincau.)

#### Phosphorus pentasulphide ammonia,

$\text{P}_2\text{S}_5, 6\text{NH}_3$

Sol. in liquid  $\text{NH}_3$ . (Stock, B. 1903, 36. 314.)

$\text{P}_2\text{S}_5, 7\text{NH}_3$ . (Stock.)

#### Phosphorus sulphobromide.

See Thiophosphoryl bromide.

#### Phosphorus sulphochloride.

See Thiophosphoryl chloride.

#### Phosphorus sulphiodide, $\text{P}_2\text{S}_2\text{I}$ .

Sl. attacked by cold, rapidly by hot  $\text{H}_2\text{O}$ ; violently decomp. by fuming  $\text{HNO}_3$ . Easily sol. in  $\text{CS}_2$ . Sl. sol. in  $\text{C}_6\text{H}_6$  or  $\text{CHCl}_3$ , and still less in ether or absolute alcohol (Ouvrard, C. R. 115. 1301.)

$\text{P}_2\text{S}_2\text{I}_2$ . Easily sol. in  $\text{CS}_2$ . More easily than  $\text{P}_2\text{S}_2\text{I}_2$  and less than  $\text{PI}_3$ . (Ouvrard, A. ch. 1894, (7) 2. 224.)

$\text{P}_2\text{SI}_4$ . Easily decomp. (Ouvrard.)

$\text{P}_2\text{S}_2\text{I}_2$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in warm ether. Sl. sol. in benzene,  $\text{CHCl}_3$ , and glacial acetic acid; sol. in toluene and xylene. (Wolter, Ch. Ztg. 1907, 31. 640.)

Easily sol. in  $\text{CS}_2$ . Sl. sol. in benzene, ether, absolute alcohol and  $\text{CHCl}_3$ . (Ouvrard, C. R. 1892, 115. 1301.)

#### Phosphorus sulphoxide, $\text{P}_4\text{O}_6\text{S}_4$

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in 2 pts  $\text{CS}_2$  without decomp. Sol. in benzene with decomp. (Thorpe and Tutton, Chem. Soc. 59. 1019.)

$\text{P}_2\text{O}_2\text{S}_2$ . Slowly decomp. by  $\text{H}_2\text{O}$ . Violently attacked by fuming  $\text{HNO}_3$ . (Besson, C. R. 1897, 124. 152.)

$\text{P}_2\text{S}_4\text{O}_4$ . Deliquescent; sol. in  $\text{H}_2\text{O}$  with decomp.; insol. in most solvents. (Stock, B. 1913, 46. 1382.)

#### Phosphoryl triamide, $\text{PO}(\text{NH}_2)_3$ .

Insol. in boiling  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq}$ , or dil. acids. Decomp. by long boiling with  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . More easily decomp. with aqua regia. Easily sol. in warm  $\text{H}_2\text{SO}_4$  or nitrosulphuric acid. (Schiff, A. 101. 300.)

Does not exist. (Gladstone; Mente, A. 248. 238.)

#### Phosphoryl bromide, $\text{POBr}_3$ .

Not miscible with  $\text{H}_2\text{O}$ , but gradually decomp. in contact with it. Sol. in  $\text{H}_2\text{SO}_4$ , ether, oil of turpentine (Gladstone, Phil. Mag. (3) 35. 345); in  $\text{CHCl}_3$ ,  $\text{CS}_2$  (Baudrimont, Bull. Soc. 1861. 118).

Easily sol in  $\text{AsBr}_3$  (Walden, Z anorg. 1902, 29, 374.)  
Sol. in  $\text{CCl}_4$ , and in  $\text{C}_6\text{H}_6$  (Oddo, Chem. Soc. 1900, 78, (2) 75.)

**Phosphoryl bromide sulphide.**

See Thiophosphoryl bromide.

**Phosphoryl bromochloride,  $\text{POCl}_2\text{Br}$ .**

Decomp. by  $\text{H}_2\text{O}$  (Menschutkin, A. 139, 343.)

**Phosphoryl dibromochloride,  $\text{POClBr}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Geuther, Jena Zeit. 10, 130.)

**Phosphoryl chloride,  $\text{POCl}$ .**

Very hygroscopic. Sol. in  $\text{H}_2\text{O}$  with decomp. Insol. in most solvents. Sol. in  $\text{PCl}_5$ . (Besson, C. R. 1897, 125, 772.)

$\text{POCl}_2$ . Decomp. by  $\text{H}_2\text{O}$ . Not acted on by liquid  $\text{CO}_2$ ,  $\text{P}$ ,  $\text{PH}_3$ ,  $\text{CS}_2$ ,  $\text{I}$ ,  $\text{Br}$ ,  $\text{Cl}$ , etc. Sol. in  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_6$ ,  $\text{CS}_2$ ,  $\text{CHCl}_3$  and ether. (Oddo, Gazz. ch. it. 1899, 29, (2) 318; Chem. Soc. 1900, 78 (2) 74.)

**Phosphoryl boron chloride,  $\text{POCl}_2\text{B}$ ,  $\text{BCl}_3$ .**

See Boron phosphoryl chloride.

**Phosphoryl stannous chloride,  $\text{POCl}_2$ ,  $\text{SnCl}_2$ .**

Deliquescent. Decomp. by  $\text{H}_2\text{O}$  (Casselmann, A. 81, 242.)

**Phosphoryl stannic chloride,  $\text{POCl}_2$ ,  $\text{SnCl}_4$ .**

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Casselmann.)

**Phosphoryl titanium chloride,  $\text{POCl}_2$ ,  $\text{TiCl}_4$ .**

Deliquescent, and decomp. by  $\text{H}_2\text{O}$  (Weber, Pogg. 132, 453.)

**Pyrophosphoryl chloride,  $\text{P}_2\text{O}_5\text{Cl}_2$ .**

Decomp. violently with  $\text{H}_2\text{O}$ . (Geuther and Michaelis, B. 4, 786.)

Very sol. in  $\text{H}_2\text{O}$  with decomp.; very unstable. (Besson, C. R. 1897, 124, 1100.)

**Metaphosphoryl chloride,  $\text{PO}_2\text{Cl}$**

Decomp. by  $\text{H}_2\text{O}$ . (Gustavson.)

Does not exist. (Michaelis.)

**Phosphoryl fluoride,  $\text{POF}_3$**

Absorbed and decomp. at once by  $\text{H}_2\text{O}$  or alcohol. (Moissan, C. R. 102, 1245.)

**Phosphoryl imidoamide,  $\text{PN}_2\text{H}_3\text{O} = \text{PO}(\text{NH})\text{NH}_2$ .**

Insol. in  $\text{H}_2\text{O}$ ; gradually decomp. by boiling with  $\text{H}_2\text{O}$ , more rapidly in presence of  $\text{KOH}$ . Insol. in boiling conc.  $\text{HCl} + \text{Aq}$ . Insol. in cold, decomp. by hot  $\text{H}_2\text{SO}_4$ . Moderately sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$  dissolves without evolution

of gas. Insol. in boiling nitric or nitrosulphuric acid. (Gerhardt, A. ch. (3) 20, 255.)  
Insol. in alcohol, oil of turpentine, etc.

**Phosphoryl iodide,  $\text{P}_2\text{I}_4\text{O}_5$  (?)**

Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. (Burton, Am. Ch. J. 3, 280.)  
 $\text{POI}_3$ . (Burton.)

**Phosphoryl nitride,  $\text{PON}$**

Insol. in  $\text{H}_2\text{O}$ , acids, or alkalis. (Gladstone, Chem. Soc. 2, 121.)

**Phosphoryl chlorosulphide,  $\text{P}_2\text{O}_5\text{SCl}_4$ .**

Slowly decomp. in contact with  $\text{H}_2\text{O}$ . (Besson, C. R. 1897, 124, 153.)

**Phosphoryl thio-compounds.**

See Thiophosphoryl compounds.

**Phosphoselenic acid.**

See Selenophosphoric acid.

**Phosphoselenide,  $\text{M}$ .**

See under  $\text{M}$ .

**Phosphosilicic acid.**

See Silicophosphoric acid.

**Phosphosilicosovanadicotungstic acid.**

**Ammonium phosphosilicosovanadicotungstate.**

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, 25, 1225.)

**Phosphosilicosvanadic acid,  $3\text{SiO}_2$ ,  $2\text{V}_2\text{O}_5$ ,  $2\text{P}_2\text{O}_5 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Phosphostannosovanadicotungstic acid.**

**Ammonium phosphostannosovanadicotungstate.**

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, 25, 1226.)

**Phosphosulphide,  $\text{M}$ .**

See under  $\text{M}$ .

**Phosphosulphuric anhydride,  $\text{P}_2\text{O}_5$ ,  $3\text{SO}_2$ .**

Very easily decomp. (Weber, B. 19, 3190.)

**Phosphotelluric acid.**

**Ammonium phosphotellurate,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $\text{TeO}_2 + 4\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1901, 28, 61.)

$4(\text{NH}_4)_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ ,  $2\text{TeO}_2 + 11\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Weinland.)

Potassium phosphotellurate,  $15K_2O, P_2O_5, TeO_3$ .  
 $+17.5 H_2O$  Very sol. in  $H_2O$   
 $+4.5 H_2O$  Ppt. (Weinland.)

Rubidium phosphotellurate,  $15Rb_2O, P_2O_5, TeO_3+4.5H_2O$   
 Ppt. (Weinland.)

Sodium phosphotellurate,  $2Na_2O, P_2O_5, 2TeO_3+9H_2O$ .  
 Difficultly sol in cold  $H_2O$ . (Weinland.)

### Phosphothorosovanadicotungstic acid.

Ammonium phosphothorosovanadicotungstate.

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1226.)

### Phosphotitanosovanadicotungstic acid.

Ammonium phosphotitanosovanadicotungstate.

Formula not known (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1226.)

### Phosphotungstic acid, $P_2O_5, 12WO_3+42H_2O$

Not efflorescent. Sol. in  $H_2O$ , alcohol, and ether. (Péchar, C. R. 110. 754.)

$P_2O_5, 16WO_3+69H_2O$ . Very efflorescent. Sol. in  $H_2O$ , alcohol, and ether (Péchar, C. R. 109. 301.)

$+xH_2O = H_4PW_6O_{20}+xH_2O$  ( $\alpha$ -phosphotungstic acid). Known only in aqueous solution. (Kehrmann, B. 20. 1808.)

$+48H_2O = H_2PW_6O_{28}+16H_2O$  ( $\alpha$ -anhydrophosphotungstic acid). Sol. in its crystal  $H_2O$  by warmth of the hand; sol. in less than  $\frac{1}{3}$  pt.  $H_2O$ . (Kehrmann.)

Correct composition is represented by  $H_4PW_6O_{21}+9H_2O$  (Kehrmann, Z. anorg. 1. 422.)

$P_2O_5, 20WO_3+8H_2O$  Very efflorescent. (Gibbs, B. 10. 1386.)

$+19H_2O = H_{11}PW_{10}O_{28}+8H_2O$ . Sol. in  $H_2O$ . (Scheibler, B. 5. 801.)

$+50$ , and  $62H_2O$  Very efflorescent. (Péchar, C. R. 109. 301.)

$3H_2O, P_2O_5, 21WO_3+30H_2O$ . Efflorescent. Sol. in  $H_2O$  in nearly every proportion

$P_2O_5, 22WO_3+28H_2O = H_2PW_{11}O_{43}+18H_2O$ . Efflorescent. (Scheibler, B. 5. 801.)

Composition is  $6H_2O, 22WO_3, P_2O_5+45H_2O$ . (Gibbs.)

$H_2PO_4, 12WO_3+18H_2O$ , or  $P_2O_5, 24WO_3+39H_2O$ . Sol. in  $H_2O$ , alcohol and ether. (Soboleff, Z. anorg. 1896, 12. 18.)

$P_2O_5, 24WO_3+40H_2O = 6H_2O, P_2O_5, 24WO_3+34H_2O$ . Very efflorescent. Sol. in  $H_2O$ . (Gibbs.)

$+45H_2O$ .

### Solubility in $H_2O$ at $t^\circ$

$t^\circ$	100 com. $H_2O$ dissolve g. of the cryst. acid	Sp. gr. of the solution
0	16.206	1.1890
22	49.718	1.6913
43	53.64	1.8264
92	86.75	2.5813

(Soboleff, Z. anorg. 1896, 12. 31.)

### Solubility in ether at $t^\circ$ .

$t^\circ$	100 com. ether dissolves g. of the cryst. acid
0	81.196
7.8	85.327
18.2	96.017
24.2	101.348

(Soboleff.)

$+53H_2O = 6H_2O, P_2O_5, 24WO_3+47H_2O$   
 Sol. in  $H_2O$  (Gibbs.)

Sol. in ether. If an equal vol. of ether is placed above a layer of conc. aqueous solution of acid, only drops form between the two layers, which sink to bottom, forming a third layer. The sp. gr. of the latter is 1.525. The crystallized acid dissolved in smallest amt. ether forms an oil of sp. gr. = 2.083. Ethereal solution is miscible with alcohol, and also with a large quantity of  $H_2O$ . (Drechsel, B. 20. 1452.)

$+61H_2O$ . Sol. in  $H_2O$ . (Gibbs, Proc. Am. Acad. 16. 116.)

### Aluminum ammonium phosphotungstate.

See Aluminicophosphotungstate, ammonium.

Ammonium phosphotungstate,  $3(NH_4)_2O, P_2O_5, 7WO_3+Aq$ .

Sl. sol. in cold  $H_2O$  without decomp. Decomp. by hot  $H_2O$ . (Kehrmann, Z. anorg. 1892, 1. 438.)

$2(NH_4)_2O, P_2O_5, 12WO_3+5H_2O$ . Insol. in cold  $H_2O$ . (Péchar, C. R. 110. 754.)

$6(NH_4)_2O, P_2O_5, 16WO_3+10H_2O$ . Easily sol. in hot  $H_2O$ . (Péchar.)

$5(NH_4)_2O, P_2O_5, 16WO_3+xH_2O = (NH_4)_5PW_6O_{23}+xH_2O$ . (Ammonium  $\alpha$ -phosphotungstic acid). Sl. sol. in  $H_2O$ . (Kehrmann.)

$3(NH_4)_2O, P_2O_5, 16WO_3+16H_2O = (NH_4)_3PW_6O_{28}+8H_2O$ . (Ammonium  $\alpha$ -anhydrophosphotungstic acid). Efflorescent.

Easily sol. in  $H_2O$ . (Kehrmann.)

$5(NH_4)_2O, P_2O_5, 17WO_3+16H_2O$  Very sl. sol. in cold  $H_2O$ . (Kehrmann, Z. anorg. 1894, 6. 387.)

$3(NH_4)_2O, P_2O_5, 18WO_3+14H_2O$ . (Phosphotungstic acid). (Kehrmann, Z. anorg. 1893, 4. 140.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $21\text{WO}_3 + x\text{H}_2\text{O}$  Rather sol. in cold, easily in hot  $\text{H}_2\text{O}$  and alcohol. Insol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Kehrmann and Freinkel, B. 25. 1972)

$3(\text{NH}_4)_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 18\text{H}_2\text{O}$  Sl. sol. in cold  $\text{H}_2\text{O}$  (Gibbs)

$3(\text{NH}_4)_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 26\text{H}_2\text{O}$  Very sl. sol. even in hot  $\text{H}_2\text{O}$  (Gibbs, Proc. Am. Acad. 16. 122)

**Ammonium barium  $\alpha$ -anhydrophosphotungstate**,  $\text{NH}_4\text{BaPW}_9\text{O}_{38} + x\text{H}_2\text{O} = (\text{NH}_4)_2\text{O}$ ,  $2\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3 + x\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

**Barium phosphotungstate**,  $2\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 15\text{H}_2\text{O}$ .

Very efflorescent. Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Péchar, C. R. 110. 754.)

$3\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3 + x\text{H}_2\text{O} = \text{Ba}_3(\text{PW}_9\text{O}_{38}) + x\text{H}_2\text{O}$ . (Barium  $\alpha$ -anhydrophosphotungstate). Not efflorescent. Quite difficultly sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

$2\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3 + 10\text{H}_2\text{O}$ . Efflorescent (Péchar, A. ch. (6) 22. 240)

$2\text{BaO}$ ,  $6\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 24\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Gibbs, B. 10. 1386.)

$6\text{BaO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 46\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 16. 126)

$7\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 59\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , (Sprenger, J. pr. (2) 22. 418.)

$+53\text{H}_2\text{O}$  (Kehrmann, B. 24. 2335)

$4\text{BaO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 39\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Gibbs)

$\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 59\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Sprenger)

$2\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 59\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Sprenger)

$3\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 46\text{H}_2\text{O} = 3\text{BaO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 43\text{H}_2\text{O}$  Easily sol. in hot  $\text{H}_2\text{O}$ . (Gibbs)

$3\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 48\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Soboleff, Z. anorg. 1896, 12. 18.)

$+58\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Sprenger)

Efflorescent. Sl. sol. in dil.  $\text{BaCl}_2 + \text{Aq}$  (Kehrmann, Z. anorg. 1. 423.)

**Barium potassium phosphotungstate**,  $5\text{BaO}$ ,  $2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 48\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Kehrmann and Freinkel, B. 25. 1968.)

**Barium silver phosphotungstate**,  $4\text{BaO}$ ,  $3\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 34\text{H}_2\text{O}$

Very sl. sol. in  $\text{H}_2\text{O}$ . (Kehrmann and Freinkel, B. 25. 1966.)

**Barium sodium phosphotungstate**,  $2\text{BaO}$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 46\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , forming cloudy liquid, which clears up. Solution in  $\text{HCl}$  is not cloudy. (Brandhorst and Kraut, A. 249. 380.)

**Calcium phosphotungstate**,  $\text{CaO}$ ,  $5\text{H}_2\text{O}$ ,  $16\text{WO}_3$ ,  $\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

Readily sol. in  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 16. 130.)

$2\text{CaO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 19\text{H}_2\text{O}$  Efflorescent. Insol. in alcohol. (Péchar, C. R. 110. 754.)

$2\text{CaO}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 22\text{H}_2\text{O}$ . Efflorescent (Péchar, A. ch. (6) 22. 233.)

**Cadmium phosphotungstate**,  $2\text{CdO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 13\text{H}_2\text{O}$ .

Sl. efflorescent. Very sol. in  $\text{H}_2\text{O}$  (Péchar, C. R. 110. 754.)

**Cupric phosphotungstate**,  $3\text{CuO}$ ,  $24\text{WO}_3$ ,  $\text{P}_2\text{O}_5 + 58\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Sprenger, J. pr. (2) 22. 418.)

$2\text{CuO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 11\text{H}_2\text{O}$ . Very efflorescent. (Péchar, C. R. 110. 754.)

$2\text{CuO}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 13\text{H}_2\text{O}$  Efflorescent (Péchar, A. ch. (6) 22. 235)

**Lead phosphotungstate**,  $2\text{PbO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 6\text{H}_2\text{O}$

Insol. in cold, sol. in boiling  $\text{H}_2\text{O}$ . (Péchar, C. R. 110. 754.)

$2\text{PbO}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 6\text{H}_2\text{O}$ . Sol. in boiling  $\text{H}_2\text{O}$ . (Péchar, A. ch. (6) 22. 236.)

**Lithium phosphotungstate**,  $\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 21\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Péchar, C. R. 110. 754.)

**Magnesium phosphotungstate**,  $2\text{MgO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3$

Sl. efflorescent. (Péchar, C. R. 110. 754.)

$2\text{MgO}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 19\text{H}_2\text{O}$ . Sl. efflorescent. (Péchar, A. ch. (6) 22. 234)

**Mercurous phosphotungstate**.

Insol. in dil.  $\text{HNO}_3 + \text{Aq.}$  (Péchar, C. R. 110. 754.)

**Potassium phosphotungstate**,  $\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 9\text{H}_2\text{O}$ .

Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$  (Péchar, C. R. 110. 754.)

$5\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3 + x\text{H}_2\text{O} = \text{K}_5\text{PW}_9\text{O}_{38} + x\text{H}_2\text{O}$ . (Potassium  $\alpha$ -phosphotungstate).

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Sol. in cold dil.  $\text{HNO}_3 + \text{Aq.}$  (Kehrmann.)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3 + 16\text{H}_2\text{O} = \text{K}_3\text{PW}_9\text{O}_{38} + 8\text{H}_2\text{O}$ . (Potassium  $\alpha$ -anhydrophosphotungstate). Efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

$5\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $17\text{WO}_3 + 21$  or  $22\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1894, 6. 387.)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{WO}_3 + 28\text{H}_2\text{O}$ . (Duparc and Pearce, Bull. Soc. Min. 1895, 18. 42.)

$\text{K}_2\text{O}$ ,  $5\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{WO}_3 + 14\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$  (Gibbs.)

$6\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{WO}_3 + 30\text{H}_2\text{O}$ , and  $23\text{H}_2\text{O}$ .

The  $23\text{H}_2\text{O}$  salt is more sol. in  $\text{H}_2\text{O}$  than the  $30\text{H}_2\text{O}$  salt (Gibbs.)

$7\text{K}_2\text{O}, \text{H}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 27\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, B. 10. 1386.)

$\text{K}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 5\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Péchar, A. ch. (6) 22. 231.)

$8\text{K}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 18\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

$3\text{K}_2\text{O}, \text{P}_2\text{O}_5, 21\text{WO}_3 + 31\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$  or alcohol. Much less sol. in very dil.  $\text{HCl} + \text{Aq}$  or  $\text{KCl} + \text{Aq}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Kehrmann and Frankel, B. 25. 1971.)

$2\text{K}_2\text{O}, 4\text{H}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 2\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

$7\text{K}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 31\text{H}_2\text{O}$ . Easily sol. in cold or hot  $\text{H}_2\text{O}$ . Insol. in alcohol (Kehrmann, B. 25. 1966.)

$3\text{K}_2\text{O}, 3\text{H}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 8$ , and  $14\text{H}_2\text{O}$  Sol. in a large amount of  $\text{H}_2\text{O}$  with partial decomp. (Gibbs, Proc. Am. Acad. 16. 120.)

Practically insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH}$ , alkalies, or alkali carbonates +  $\text{Aq}$ . (Kehrmann, B. 24. 2329.)

$6\text{K}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 15. 1.)

#### Potassium lead $\alpha$ -phosphotungstate.

Sl. sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

Silver phosphotungstate,  $\text{Ag}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 8\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . (Péchar, C. R. 110. 754.)

$5\text{Ag}_2\text{O}, \text{P}_2\text{O}_5, 16\text{WO}_3 + x\text{H}_2\text{O} = \text{Ag}_x\text{PW}_{12}\text{O}_{40} + x\text{H}_2\text{O}$  (Silver  $\alpha$ -phosphotungstate). Ppt. (Kehrmann.)

$3\text{Ag}_2\text{O}, \text{P}_2\text{O}_5, 16\text{WO}_3 + 16\text{H}_2\text{O} = \text{Ag}_x\text{PW}_{12}\text{O}_{40} + 8\text{H}_2\text{O}$  (Silver  $\alpha$ -anhydrophosphotungstate). Easily sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

$\text{Ag}_2\text{O}, 24\text{WO}_3, \text{P}_2\text{O}_5 + 60\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .

$3\text{Ag}_2\text{O}, 24\text{WO}_3, \text{P}_2\text{O}_5 + 58\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Sprenger, J. pr. (2) 22. 418.)

Sodium phosphotungstate,  $3\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 7\text{WO}_3 + \text{Aq}$ .

Sol. in  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1. 437.)

$5\text{Na}_2\text{O}, 11\text{H}_2\text{O}, 2\text{P}_2\text{O}_5, 12\text{WO}_3 + 26\text{H}_2\text{O} = \text{Na}_x\text{H}_{12-x}\text{P}_2\text{W}_{12}\text{O}_{41} + 13\text{H}_2\text{O}$  (?). (Scheibler, B. 5. 801.)

$2\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Péchar, C. R. 110. 754.)

$5\text{Na}_2\text{O}, 14\text{WO}_3, 2\text{P}_2\text{O}_5 + 42\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

$\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3, 2\text{H}_2\text{O} + 19\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 1895, 17. 183.)

$\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 23\text{H}_2\text{O} = \text{Na}_x\text{O}, 7\text{H}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 16\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

+  $25\text{H}_2\text{O}$ . Sl. efflorescent; very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Péchar, A. ch. (6) 22. 227.)

$2\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Péchar.)

+  $30\text{H}_2\text{O}$ . (P.)

$3\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 32\text{H}_2\text{O}$  As above. (P.)

$2\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 9\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

$3\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 22\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Bianthorst and Kraut, A. 249. 379.)

+  $30\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Soboleff, Z. anorg. 1896, 12. 18.)

+  $42\text{H}_2\text{O}$

#### Solubility in $\text{H}_2\text{O}$ at $t^\circ$ .

$t^\circ$	100 ccm. $\text{H}_2\text{O}$ dissolve g of the crystal salt
0	22.04
22	59.65
93	98.184

(Soboleff, Z. anorg. 1896, 12. 31.)

$2\text{Na}_2\text{O}, 4\text{H}_2\text{O}, 24\text{WO}_3, \text{P}_2\text{O}_5 + 23\text{H}_2\text{O}$ . Readily sol. in  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 16. 118.)

Sp. gr. at  $20^\circ$  of solutions of  $2\text{Na}_2\text{O}, 4\text{H}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 23\text{H}_2\text{O}$  containing

10.22	20.94	31.13% salt,
1.085	1.190	1.316

42.61	52.92	64.11% salt.
1.496	1.702	2.001

or, by calculation,  $a = \text{sp. gr. if } \% \text{ is crystallized salt}$ ,  $b = \text{sp. gr. if } \% \text{ is anhydrous salt}$ :

5	10	15	20	25% salt,
a. 1.040	1.084	1.131	1.181	1.237
b. 1.044	1.092	1.143	1.199	1.262

30	35	40	45	50% salt,
a. 1.299	1.370	1.440	1.538	1.640
b. 1.333	1.414	1.507	1.613	1.734

55	60	64% salt.
a. 1.754	1.884	1.998
b. 1.872		..

(Bianthorst and Kraut, A. 249. 377.)

Strontium phosphotungstate,  $2\text{SrO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 17\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Péchar, C. R. 110. 754.)

Thallium phosphotungstate,  $\text{Tl}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 4\text{H}_2\text{O}$ .

Ppt. (Péchar, C. R. 110. 754.)

Zinc phosphotungstate,  $2\text{ZnO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 7\text{H}_2\text{O}$ .

Efflorescent. (Péchar, C. R. 110. 754.)

#### Monometaphosphotungstic acid.

Ammonium monometaphosphotungstate,  $(\text{NH}_4)_2\text{O}, 2\text{NH}_4\text{PO}_3, 18\text{WO}_3 + 11\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ .

**Potassium monometaphosphotungstate,**  
 $3K_2O, 2KPO_3, 24WO_3 + 20H_2O$ .

Very sol in  $H_2O$ . (Gibbs, Am. Ch. J. 7, 319)

**Orthometaphosphotungstic acid.****Potassium sodium orthometaphosphotungstate,**  
 $2K_2O, 4Na_2O, 6NaPO_3, 6K_2PO_3, 22WO_3 + 42H_2O$ .

Sl. sol. in  $H_2O$  (Gibbs, Am. Ch. J. 7, 319)

**Pyrophosphotungstic acid.****Ammonium manganous sodium pyrophosphotungstate,**  
 $5(NH_4)_2O, 6MnO, 2Na_2O, 2P_2O_5, 28WO_3 + 48H_2O$ 

Very sol. in cold and in hot  $H_2O$ . (Gibbs, Am. Ch. J. 1895, 17, 90)

**Ammonium sodium pyrophosphotungstate,**  
 $6(NH_4)_2O, 3Na_2P_2O_7, 2(NH_4)_2O, 22WO_3 + 31H_2O$ .

Nearly insol. in cold  $H_2O$  or  $NH_4OH + Aq$ . Sol. in a large amount of hot  $H_2O$ .

**Manganous sodium pyrophosphotungstate,**  
 $6Na_2O, 3MnO, P_2O_5, 14WO_3 + 36H_2O$ .

Efflorescent in dry air. Sol. in  $H_2O$  and can be recryst. therefrom. (Gibbs)

**Potassium pyrophosphotungstate,**  
 $9K_2P_2O_7, 22WO_3 + 49H_2O$ .

Very sl. sol. in cold  $H_2O$ .  
 $6K_2P_2O_7, 3H_2P_2O_7, 22WO_3, K_2O, H_2O + 42H_2O$ . Sl. sol. in cold. Sol. in much boiling  $H_2O$ . (Gibbs, Am. Ch. J. 7, 392.)

**Phosphovanadic acid,**  
 $P_2O_5, V_2O_5, 2H_2O + 9H_2O$ .

Sol. in  $H_2O$ .  
Composition is vanadium phosphate  $(VO_2)_2H_2PO_4 + 4\frac{1}{2}H_2O$ . (Friedheim, B. 23, 1531.)

This is the only "acid" which exists. (F.)  
 $P_2O_5, V_2O_5 + 14H_2O$ . Sol. in  $H_2O$ ; can be recryst. from dil.  $H_2PO_4 + Aq$ . (Ditte, C. R. 102, 757)

$3P_2O_5, 2V_2O_5 + 9H_2O$ . Sol. in  $H_2O$ . (Ditte)  
 $P_2O_5, 3V_2O_5$ . (Berzelius.)  
 $3H_2O, 7P_2O_5, 6V_2O_5 + 34H_2O$ . Sol. in  $H_2O$ .  
Decomp. by much  $H_2O$  into—  
 $6H_2O, P_2O_5, 20V_2O_5 + 53H_2O$ . Sol. in  $H_2O$ . (Gibbs, Am. Ch. J. 7, 209.)

**Ammonium phosphovanadate,**  
 $(NH_4)_2O, P_2O_5, V_2O_5 + H_2O$ 

Sl. sol. in cold  $H_2O$ . (Gibbs, Am. Ch. J. 7, 209.)  
 $+ 3H_2O$ . Composition is  $(VO_2)(NH_4)HPO_4 + H_2O$  (Friedheim.)  
 $(NH_4)_2O, P_2O_5, 2V_2O_5 + 7H_2O$ . Easily sol. in  $H_2O$ . (Gibbs.) Sl. sol. in  $H_2O$ . (Fried-

heim) Composition is  $(NH_4)_2O, V_2O_5, + 2(VO_2)_2H_2PO_4 + 5H_2O$  (Friedheim)

$5(NH_4)_2O, 2P_2O_5, 3V_2O_5 + 24H_2O$ . Easily sol. in  $H_2O$  (Ditte, C. R. 102, 1019.) Could not be obtained (Friedheim)

$5(NH_4)_2O, 4P_2O_5, 2V_2O_5 + 24H_2O$ . As above. (Ditte) Could not be obtained. (Friedheim.)

$7(NH_4)_2O, P_2O_5, 12V_2O_5 + 26H_2O$ . Easily sol. in  $H_2O$ . Composition is  $2(NH_4)_2HPO_4 + 5(NH_4)_2O, 12V_2O_5 + 25H_2O$  (Friedheim.)

**Potassium phosphovanadate,**  
 $K_2O, P_2O_5, 2V_2O_5 + 7H_2O$ .

Sl. sol. in  $H_2O$ ; decomp. thereby to  $7K_2O, 12V_2O_5, P_2O_5 + 26H_2O$

Composition is  $K_2O, V_2O_5 + 2(VO_2)_2H_2PO_4 + 5H_2O$ . (Friedheim)

$3K_2O, 4P_2O_5, 6V_2O_5 + 21H_2O$ . Sl. sol. in  $H_2O$ . (Gibbs.)

$7K_2O, P_2O_5, 12V_2O_5 + 26H_2O$ . Easily sol. in  $H_2O$ . Composition is  $2K_2HPO_4 + 5K_2O, 12V_2O_5 + 25H_2O$  (Friedheim)

$2K_2O, P_2O_5, V_2O_5$   
 $3K_2O, 2P_2O_5, 2V_2O_5 + 5H_2O$ .

$13K_2O, 2P_2O_5, 22V_2O_5 + 58H_2O$ .

$15K_2O, 2P_2O_5, 25V_2O_5 + 76H_2O$ . (Friedheim, Z. anorg. 1894, 5, 446)

$16K_2O, 2P_2O_5, 27V_2O_5 + 57H_2O$ .

$6K_2O, P_2O_5, 11V_2O_5 + 33H_2O$ .

$7K_2O, P_2O_5, 13V_2O_5 + 38H_2O$ .

$4K_2O, P_2O_5, 3V_2O_5 + 3H_2O$ . (Friedheim, Z. anorg. 1894, 5, 459-465)

**Silver phosphovanadate,**  
 $2Ag_2O, P_2O_5, V_2O_5 + 5H_2O$ 

Sl. sol. in cold or hot  $H_2O$ . (Gibbs)

**Phosphovanadicotungstic acid.****Ammonium phosphovanadicotungstate,**  
 $(NH_4)_2O, P_2O_5, V_2O_5, WO_3 + zH_2O$ .

Ppt. (Smith, J. Am. Chem. Soc. 1902, 24, 577.)

$15(NH_4)_2O, 2P_2O_5, 6V_2O_5, 44WO_3 + 106H_2O$ . Sol. in  $H_2O$ . Insol. in alcohol, ether or benzene. (Rogers, J. Am. Chem. Soc. 1903, 25, 303)

**Phosphovanadicozanadotungstic acid.****Ammonium phosphovanadicozanadotungstate,**  
 $14(NH_4)_2O, 2P_2O_5, 3V_2O_5, 7V_2O_5, 27WO_3 + 66H_2O$ .

Sparingly sol. in cold  $H_2O$ . Sol. in hot  $H_2O$ . (Rogers, J. Am. Chem. Soc. 1903, 25, 309.)

**Phosphovanadicozirconosotungstic acid.****Ammonium phosphovanadicozirconosotungstate.**

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, 25, 1226.)

**Phosphovanadicovanadic acid.**

**Ammonium phosphovanadicovanadate,**  
 $7(\text{NH}_4)_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $\text{VO}_2$ ,  $18\text{V}_2\text{O}_5 + 50\text{H}_2\text{O}$   
 Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 209.)  
 $7(\text{NH}_4)_2\text{O}$ ,  $14\text{P}_2\text{O}_5$ ,  $16\text{VO}_2$ ,  $6\text{V}_2\text{O}_5 + 65\text{H}_2\text{O}$ .  
 Decomp. by boiling with  $\text{H}_2\text{O}$  into—  
 $5(\text{NH}_4)_2\text{O}$ ,  $10\text{P}_2\text{O}_5$ ,  $11\text{VO}_2$ ,  $\text{V}_2\text{O}_5 + 41\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Potassium —**,  $5\text{K}_2\text{O}$ ,  $12\text{P}_2\text{O}_5$ ,  $12\text{VO}_2$ ,  $6\text{V}_2\text{O}_5 + 40\text{H}_2\text{O}$ .  
 Decomp. by hot  $\text{H}_2\text{O}$  into—  
 $7\text{K}_2\text{O}$ ,  $12\text{P}_2\text{O}_5$ ,  $14\text{VO}_2$ ,  $6\text{V}_2\text{O}_5 + 52\text{H}_2\text{O}$ .  
 Sol in  $\text{H}_2\text{O}$  (Gibbs.)

**Sodium —**,  $4\text{Na}_2\text{O}$ ,  $5\text{P}_2\text{O}_5$ ,  $\text{VO}_2$ ,  $4\text{V}_2\text{O}_5 + 37\text{H}_2\text{O}$   
 Insol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Phosphovanadiomolybdic acid.**

**Ammonium phosphovanadiomolybdate,**  
 $7(\text{NH}_4)_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5$ ,  $48\text{MoO}_3 + 30\text{H}_2\text{O}$ .  
 Sl. sol. in cold, somewhat more in hot  $\text{H}_2\text{O}$  with partial decomp. (Gibbs, Am. Ch. J. 5. 301.)  
 $8(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $8\text{V}_2\text{O}_5$ ,  $14\text{MoO}_3 + 50\text{H}_2\text{O}$ .  
 Easily sol in hot  $\text{H}_2\text{O}$  without decomp. (Gibbs.)  
 $5(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\frac{1}{2}\text{V}_2\text{O}_5$ ,  $21\frac{1}{2}\text{MoO}_3 + 50\text{H}_2\text{O}$ .  
 $8(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{V}_2\text{O}_5$ ,  $18\text{MoO}_3 + 45\text{H}_2\text{O}$ .  
 $7(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\frac{1}{2}\text{V}_2\text{O}_5$ ,  $16\frac{1}{2}\text{MoO}_3 + 50\text{H}_2\text{O}$ .  
 $8(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $7\text{V}_2\text{O}_5$ ,  $15\text{MoO}_3 + 50\text{H}_2\text{O}$ .  
 All above compounds are sol. in  $\text{H}_2\text{O}$ . (Blum, J. Am. Chem. Soc. 1908, 30. 1859.)  
 $6(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $7\text{V}_2\text{O}_5$ ,  $9\text{MoO}_3 + 28\text{H}_2\text{O} + 33\text{H}_2\text{O}$ , and  $+37\text{H}_2\text{O}$ .  
 Can be recryst. from  $\text{H}_2\text{O}$ . (Hinsen, Dissert. 1904.)

$4(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5$ ,  $11\text{MoO}_3 + 37\text{H}_2\text{O}$  (Jacoby, Dissert. 1900.)  
 $6(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $7\text{V}_2\text{O}_5$ ,  $11\text{MoO}_3 + 34\text{H}_2\text{O}$  and  $+43\text{H}_2\text{O}$ . (Hinsen, Dissert. 1904.)  
 $8(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $7\text{V}_2\text{O}_5$ ,  $11\text{MoO}_3 + 30\text{H}_2\text{O}$ . (Hinsen.)  
 $5(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 39\text{H}_2\text{O}$ .  
 1 cc. of solution in  $\text{H}_2\text{O}$  contains 0.2624 g. of hydrous salt Sp. gr. of solution at  $18^\circ = 1.0932$ . (Lahrman, Dissert. 1904.)  
 $6(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 24\text{H}_2\text{O}$   
 Nearly insol. in cold  $\text{H}_2\text{O}$  (Lahrman.)  
 $7(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $6\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 33\text{H}_2\text{O}$ . (Stamm, Dissert. 1905.)  
 $6(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5$ ,  $13\text{MoO}_3 + 37\text{H}_2\text{O}$ .  
 1 cc. of solution sat. at  $18^\circ$  contains 0.1543 g. hydrous salt and has sp. gr. = 1.0900. (Toggenburg, Dissert. 1902.)  
 $6(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{V}_2\text{O}_5$ ,  $13\text{MoO}_3 + 29\text{H}_2\text{O}$ .  
 1 cc. solution sat. at  $18^\circ$  contains 0.2533 g. hydrous salt Sp. gr. = 1.0797. (Stamm, Dissert. 1905.)

$+32\text{H}_2\text{O}$ . (Stamm.)  
 $+34\text{H}_2\text{O}$ . (Stamm.)  
 $6(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5$ ,  $14\text{MoO}_3 + 28\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$  with decomp. (Toggenburg, Dissert. 1902.)  
 $8(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5$ ,  $14\text{MoO}_3 + 24\text{H}_2\text{O}$ .  
 Decomp. by cold  $\text{H}_2\text{O}$ . (Lahrman, Dissert. 1904.)  
 $5(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{V}_2\text{O}_5$ ,  $5\text{MoO}_3 + 39\text{H}_2\text{O}$   
 1 cc. of solution sat. at  $18^\circ$  contains 0.2445 g. hydrous salt and has sp. gr. = 1.144. (Jacoby, Dissert. 1900.)  
 $6(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{V}_2\text{O}_5$ ,  $15\text{MoO}_3 + 41\text{H}_2\text{O}$   
 Extraordinarily easily sol. in  $\text{H}_2\text{O}$ . (Jacoby.)  
 $7(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{V}_2\text{O}_5$ ,  $18\text{MoO}_3 + 31\text{H}_2\text{O}$ . (Schulz, Dissert. 1905.)  
 $6(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{V}_2\text{O}_5$ ,  $18\text{MoO}_3 + 40\text{H}_2\text{O}$ . (Schulz.)  
 $8(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{V}_2\text{O}_5$ ,  $73\text{MoO}_3 + 26\text{H}_2\text{O} + 33\text{H}_2\text{O}$ . (Stamm, Dissert. 1905.)

**Ammonium barium —**,  $0.5(\text{NH}_4)_2\text{O}$ ,  $5.5\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $6\text{V}_2\text{O}_5$ ,  $8\text{MoO}_3 + 38\text{H}_2\text{O}$ . (Hinsen, Dissert. 1904.)  
 $2(\text{NH}_4)_2\text{O}$ ,  $4\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $7\text{V}_2\text{O}_5$ ,  $10\text{MoO}_3 + 43\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$  Decomp. on heating. (Toggenburg, Dissert. 1902.)  
 $(\text{NH}_4)_2\text{O}$ ,  $5\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $6\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 49\text{H}_2\text{O}$ . Less sol in  $\text{H}_2\text{O}$  than  $\text{NH}_4$  comp. (Jacoby, Dissert. 1900.)  
 $2(\text{NH}_4)_2\text{O}$ ,  $4\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5$ ,  $13\text{MoO}_3 + 37\text{H}_2\text{O}$ . Sol. in much hot  $\text{H}_2\text{O}$  with decomp. (Toggenburg, Dissert. 1902.)  
 $2(\text{NH}_4)_2\text{O}$ ,  $4\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{V}_2\text{O}_5$ ,  $13\text{MoO}_3 + 46\text{H}_2\text{O}$  (Stamm, Dissert. 1905.)  
 $3(\text{NH}_4)_2\text{O}$ ,  $4\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{V}_2\text{O}_5$ ,  $13\text{MoO}_3 + 40\text{H}_2\text{O}$  (Stamm.)  
 $3(\text{NH}_4)_2\text{O}$ ,  $3\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5$ ,  $14\text{MoO}_3 + 39\text{H}_2\text{O}$ . (Stamm.)  
 $2(\text{NH}_4)_2\text{O}$ ,  $4\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{V}_2\text{O}_5$ ,  $17\text{MoO}_3 + 46\text{H}_2\text{O}$  (Schulz, Dissert. 1905.)

**Ammonium potassium —**,  $(\text{NH}_4)_2\text{O}$ ,  $6\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $6\text{V}_2\text{O}_5$ ,  $10\text{MoO}_3 + 38\text{H}_2\text{O}$ . (Jacoby, Dissert. 1900.)  
 $(\text{NH}_4)_2\text{O}$ ,  $6\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $7\text{V}_2\text{O}_5$ ,  $11\text{MoO}_3 + 25\text{H}_2\text{O}$ . (Jacoby, Dissert. 1900.)  
 $(\text{NH}_4)_2\text{O}$ ,  $5\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $6\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 46\text{H}_2\text{O}$  (Jacoby.)  
 $(\text{NH}_4)_2\text{O}$ ,  $5\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{V}_2\text{O}_5$ ,  $13\text{MoO}_3 + 25\text{H}_2\text{O} + 29\text{H}_2\text{O}$ ;  $+30\text{H}_2\text{O}$ . Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$  (Stamm, Dissert. 1905.)  
 $5\text{K}_2\text{O}$ ,  $(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5$ ,  $14\text{MoO}_3 + 31\text{H}_2\text{O}$  (Stamm.)  
 $(\text{NH}_4)_2\text{O}$ ,  $4\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{V}_2\text{O}_5$ ,  $15\text{MoO}_3 + 36\text{H}_2\text{O}$ . (Jacoby, Dissert. 1900.)  
 $(\text{NH}_4)_2\text{O}$ ,  $6\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{V}_2\text{O}_5$ ,  $18\text{MoO}_3 + 43\text{H}_2\text{O}$  (Schulz, Dissert. 1905.)  
 $5(\text{NH}_4)_2\text{O}$ ,  $\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5$ ,  $20\text{MoO}_3 + 52\text{H}_2\text{O}$  (Schulz.)

**Barium potassium —**,  $2\text{BaO}$ ,  $2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5$ ,  $18\text{MoO}_3 + 47\text{H}_2\text{O}$ . (Schulz, Dissert. 1905.)

**Potassium phosphovanadomolybdate**,  $7K_2O$ ,  $P_2O_5$ ,  $7V_2O_5$ ,  $9MoO_3 + 26H_2O$ .  
(Hinsen, Dissert. 1904.)  
 $5K_2O$ ,  $P_2O_5$ ,  $2V_2O_5$ ,  $20MoO_3 + 53H_2O$ .  
(Schulz, Dissert. 1905.)

### Phosphovanadiotungstic acid.

**Ammonium phosphovanadiotungstate**,  
 $10(NH_4)_2O$ ,  $3P_2O_5$ ,  $V_2O_5$ ,  $60WO_3 + 60H_2O$ .

Nearly insol in cold, sl. sol in hot  $H_2O$ .  
Sol. in  $(NH_4)_2HPO_4 + Aq$ , and in  $NH_4OH + Aq$ .

$5(NH_4)_2O$ ,  $P_2O_5$ ,  $3V_2O_5$ ,  $16WO_3 + 37H_2O$ .  
Easily sol in  $H_2O$  (Gibbs, Am Ch. J. 5. 391.)

$13(NH_4)_2O$ ,  $2P_2O_5$ ,  $8V_2O_5$ ,  $34WO_3 + 86H_2O$ .  
Very sol. in cold and hot  $H_2O$ .  
Insol. in alcohol, ether,  $CS_2$ , benzene and nitrobenzene (Rogers, J. Am. Chem. Soc. 1903, 25. 299.)

**Barium** —,  $18BaO$ ,  $3P_2O_5$ ,  $2V_2O_5$ ,  $60WO_3 + 144H_2O$ .

Easily sol in hot  $H_2O$  with decomp (Gibbs, Am Ch. J. 5. 391.)

**Potassium** —,  $3K_2O$ ,  $P_2O_5$ ,  $V_2O_5$ ,  $7WO_3 + 11H_2O$ .

Sol. in  $H_2O$ .  
 $8K_2O$ ,  $3P_2O_5$ ,  $4V_2O_5$ ,  $18WO_3 + 23H_2O$ . Sol. in hot  $H_2O$  with decomp into preceding salt. (Gibbs, Am Ch. J. 5. 391.)

**Silver** —,  $13Ag_2O$ ,  $2P_2O_5$ ,  $8V_2O_5$ ,  $33WO_3 + 41H_2O$ .

Somewhat sol. in  $H_2O$ .  
Completely sol. in  $H_2O$  containing a few drops  $HNO_3$  (Rogers, J. Am. Chem. Soc. 1903, 25. 302.)

### Phosphovanadiovanadicotungstic acid.

**Barium phosphovanadiovanadicotungstate**,  
 $18BaO$ ,  $3P_2O_5$ ,  $V_2O_5$ ,  $VO_3$ ,  $60WO_3 + 150H_2O$ .

Sl. sol in cold, easily sol. in hot  $H_2O$  (Gibbs, Am Ch. J. 5. 391.)

### Phosphuretted hydrogen.

See Hydrogen phosphide.

### Platibromonitrous acid.

**Potassium platibromonitrite**,  $K_2Pt(NO_2)_2Br_2$ .  
Rather sl. sol. in  $H_2O$  (Blomstrand, J. pr. (2) 3. 214.)

Sol. in about 40 pts. cold, and 20 pts. boiling  $H_2O$ . Insol. in alcohol. Sl. sol in  $KBr$  or  $KNO_3 + Aq$  (Vèzes, A. ch. (6) 29. 198.)

$K_2Pt(NO_2)_2Br_2$ . Sol. in about 5 pts. warm  $H_2O$  with decomp (Vèzes.)

$K_2Pt(NO_2)_2Br_2$ . Sol. in less than 5 pts.  $H_2O$  with decomp. (Vèzes.)

### Platichloronitrous acid.

**Potassium platichloronitrite**,  $K_2Pt(NO_2)_2Cl_2$ .  
Rather sl. sol. in  $H_2O$  (Blomstrand, J. pr. (2) 3. 214.)

Sol. in 40 pts. cold, and 20 pts. boiling  $H_2O$ .  
Insol. in alcohol. Sl. sol. in  $KCl$  or  $KNO_3 + Aq$  (Vèzes, A. ch. (6) 29. 183.)

$K_2Pt(NO_2)_2Cl_2$ . Very sol. in  $H_2O$ . (Vèzes.)  
 $K_2Pt(NO_2)_2Cl_2 + H_2O$ . Sol. in  $H_2O$  with decomp. (Vèzes.)

### Platiodonitrous acid.

**Potassium platiodonitrite**,  $K_2Pt(NO_2)_2I_4$ .

Sl. sol. in cold, more easily in hot  $H_2O$ ; decomp by boiling. (Vèze, A. ch. (6) 29. 207.)

$K_2Pt(NO_2)_2I_4$ . As above (Vèzes.)

### Platin-.

See also *Platino-*, *plato-*, *p'at-*, and *platos-*.

### Platindiamine compounds.

See Chloro-, bromo-, hydroxylo-, iodo-, nitro-, nitrito-, sulphato-, etc., platindiamine compounds.

### Platindiamine carbonate,

$Pt(NH_3)_4(CO_3)_2$ .  
Ppt. Sol. in  $NaOH + Aq$ . (Geddes, J. pr. (2) 26. 257.)

— chloride  $Pt(NH_3)_4Cl_4$ .

Sol. in hot  $H_2O$  (Gerdes.)

— chloroplatinate,  $Pt(NH_3)_4Cl_4$ ,  $PtCl_4 + 2H_2O$ .

Very sl. sol. in  $H_2O$ . (Gerdes.)

— nitrate,  $Pt(NH_3)_4(NO_3)_4$ .

Easily sol in  $H_2O$ , sl. sol in  $HNO_3 + Aq$ . (Gerdes.)

— sulphate,  $Pt(NH_3)_4(SO_4)_2 + H_2O$ .

Nearly insol in  $H_2O$  (Gerdes.)

### Tetraplatinamine iodide, $Pt_4(NH_3)_{16}I_{10}$

(Blomstrand, B. 16. 1469.)

### Ocloplatinamine iodide, $Pt_3(NH_3)_{18}I_{18}$ .

(Blomstrand.)

### Platinic acid.

**Barium platinate, basic (?)**,  $3BaO$ ,  $2PtO_2$ .

Insol. in  $HC_2H_3O_2 + Aq$ ; easily sol. in  $HCl + Aq$  (Rousseau.)

**Barium platinate, BaPtO<sub>6</sub>**

(Rousseau, C R. 109. 144.)

+H<sub>2</sub>O. Insol. in dil. HNO<sub>3</sub>+Aq; sol in warm HCl+Aq. (Topsoe, B. 3. 464.)+4H<sub>2</sub>O Very sl. sol in H<sub>2</sub>O, BaO<sub>2</sub>H<sub>2</sub>, or NaOH+Aq. Easily sol. in dil. acids, except HClO<sub>4</sub>, in which it is insol. in the cold, but decomp on heating. (Topsoe, l. c.)Composition is 3BaPtO<sub>6</sub>, BaCl<sub>2</sub>, PtCl<sub>2</sub>O+4H<sub>2</sub>O (?). (Johannsen, A. 155. 204.)**Calcium platinate chloride (?)**, 2Ca<sub>2</sub>Pt<sub>2</sub>O<sub>3</sub>Cl<sub>2</sub>+7H<sub>2</sub>O (?).

"Herschel's precipitate."

Easily sol. in HCl+Aq, and in HNO<sub>3</sub>+Aq, if freshly pptd. (Herschel.)Very sol. in HNO<sub>3</sub>+Aq (Weiss and Döbereiner, A. 14. 252.)Composition is CaPtO<sub>6</sub>, PtCl<sub>2</sub>O, CaO+7H<sub>2</sub>O (?). (Johannsen, A. 155. 204.)**Potassium platinate.**Sol. in H<sub>2</sub>O. (Berzelius)K<sub>2</sub>O, PtO<sub>3</sub>+3H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Blondel, A. ch. 1905, (8) 6. 90.)K<sub>2</sub>Pt(OH)<sub>6</sub>. Sol. in H<sub>2</sub>O; insol. in alcohol. (Bellucci, Z. anorg. 1905, 44. 173.)**Sodium platinate**, Na<sub>2</sub>O, 3PtO<sub>3</sub>+6H<sub>2</sub>O.Dil. acids dissolve out Na<sub>2</sub>O and leave PtO<sub>3</sub>. Sol. in HNO<sub>3</sub>+Aq. (Döbereiner, Pogg. 28. 180.)Na<sub>2</sub>O, PtO<sub>3</sub>+3H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Blondel.)**Metaplatinic acid**, 5PtO<sub>3</sub>, 5H<sub>2</sub>O.Insol. in H<sub>2</sub>O. (Blondel, A. ch. 1905, (8) 6. 103.)**Sodium metaplatinate**, Na<sub>2</sub>O, 5PtO<sub>3</sub>+9H<sub>2</sub>O.Insol. in H<sub>2</sub>O. (Blondel.)**Platinimolybdic acid**, 4H<sub>2</sub>O, PtO<sub>3</sub>, 10MoO<sub>3</sub>. (Gibbs.)**Ammonium platinimolybdate**,8MoO<sub>3</sub>, 2PtO<sub>3</sub>, 3(NH<sub>4</sub>)<sub>2</sub>O+12H<sub>2</sub>O.4MoO<sub>3</sub>, 2PtO<sub>3</sub>, 2(NH<sub>4</sub>)<sub>2</sub>O+19H<sub>2</sub>O.Sol. in hot H<sub>2</sub>O (Gibbs, Am. Ch. J. 1895, 17. 80-82.)**Potassium platinimolybdate**, 60MoO<sub>3</sub>, PtO<sub>3</sub>, 10K<sub>2</sub>O+40H<sub>2</sub>O.Sol. in hot H<sub>2</sub>O. (Gibbs.)**Silver platinimolybdate.****Sodium platinimolybdate**, 4Na<sub>2</sub>O, PtO<sub>3</sub>, 10 MoO<sub>3</sub>+29H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Gibbs, Sil. Am. J. (3) 14. 61.)**Platinungstic acid.****Ammonium platinungstate**, 4(NH<sub>4</sub>)<sub>2</sub>O, PtO<sub>3</sub>, 10WO<sub>3</sub>+12H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Gibbs, B. 10. 1384.)**Potassium platinungstate**, 4K<sub>2</sub>O, PtO<sub>3</sub>, 10WO<sub>3</sub>+9H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Gibbs.)**Sodium platinungstate**, 4Na<sub>2</sub>O, PtO<sub>3</sub>, 10WO<sub>3</sub>+25H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Gibbs.)5Na<sub>2</sub>O, 7WO<sub>3</sub>, 2PtO<sub>3</sub>+35H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Gibbs.)Is double salt 3Na<sub>2</sub>O, 7WO<sub>3</sub>+2Na<sub>2</sub>PtO<sub>3</sub>. (Rosenheim, B. 24. 2397.)10WO<sub>3</sub>, PtO<sub>3</sub>, 4Na<sub>2</sub>O+23H<sub>2</sub>O.10WO<sub>3</sub>, PtO<sub>3</sub>, 6Na<sub>2</sub>O+28H<sub>2</sub>O.20WO<sub>3</sub>, PtO<sub>3</sub>, 9Na<sub>2</sub>O+58H<sub>2</sub>O.30WO<sub>3</sub>, 2PtO<sub>3</sub>, 15Na<sub>2</sub>O+89H<sub>2</sub>O.30WO<sub>3</sub>, PtO<sub>3</sub>, 12Na<sub>2</sub>O+72H<sub>2</sub>O.All are sol in boiling H<sub>2</sub>O. (Gibbs, Am. Ch. J. 1895, 17. 74-80.)**Platino-**

See also Plato—.

**Platinochlorophosphoric acid.**

See Chloroplatinophosphoric acid.

**Platinocyanhydric acid**, H<sub>2</sub>Pt(CN)<sub>4</sub>.Deliquescent. Very sol in H<sub>2</sub>O, alcohol, and ether.**Ammonium platinocyanide**, (NH<sub>4</sub>)<sub>2</sub>Pt(CN)<sub>4</sub>+3H<sub>2</sub>O.Very sol. in H<sub>2</sub>O.+2H<sub>2</sub>O. Sol. in 1 pt. H<sub>2</sub>O, and still more easily in alcohol.+H<sub>2</sub>O.**Ammonium hydroxylamine platinocyanide**, NH<sub>4</sub>(NH<sub>4</sub>O)Pt(CN)<sub>4</sub>+3½H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Scholz, M. Ch. 1. 900.)**Ammonium magnesium platinocyanide**, (NH<sub>4</sub>)<sub>2</sub>MgPt(CN)<sub>4</sub>+6H<sub>2</sub>O.**Barium platinocyanide**, BaPt(CN)<sub>4</sub>+4H<sub>2</sub>OSol. in 33 pts. H<sub>2</sub>O at 16°, and in much less at 100°. Sol. in alcohol.**Barium potassium platinocyanide**, BaK<sub>2</sub>Pt(CN)<sub>4</sub>·xH<sub>2</sub>O.Sol. in H<sub>2</sub>O.**Barium rubidium platinocyanide**, BaRb<sub>2</sub>Pt(CN)<sub>4</sub>·xH<sub>2</sub>O.Sol. in H<sub>2</sub>O.

Cadmium platinoeyanide, $\text{CdPt}(\text{CN})_4$ Ppt Sol. in $\text{NH}_4\text{OH} + \text{Aq.}$ (Martius, A. 117. 376) $\text{CdPt}(\text{CN})_4, 2\text{NH}_3 + \text{H}_2\text{O}$ (M)	Lanthanum platinoeyanide, $\text{La}_2[\text{Pt}(\text{CN})_4]_3 + 18\text{H}_2\text{O}$ . Easily sol. in $\text{H}_2\text{O}$ . (Cleve)
Calcium platinoeyanide, $\text{CaPt}(\text{CN})_4 + 5\text{H}_2\text{O}$ Very sol. in $\text{H}_2\text{O}$ .	Magnesium platinoeyanide, $\text{MgPt}(\text{CN})_4 + 2\text{H}_2\text{O}$ . Solubility in $\text{H}_2\text{O}$ . 100 g. of the sat. solution contain at: 98 4° 100° 44.33 43 96 g. $\text{MgPt}(\text{CN})_4$ (Buxhoeveden, Z anorg 1897, 15. 325.)
Calcium potassium platinoeyanide, $\text{CaK}_2[\text{Pt}(\text{CN})_4]_2$ . Sol. in $\text{H}_2\text{O}$ .	+4 $\text{H}_2\text{O}$ . Solubility in $\text{H}_2\text{O}$ . 100 g. of the sat. solution contain at: 42.2° 46.3° 48.7° 55° 40 21 39.79 40 75 40 02 g. $\text{MgPt}(\text{CN})_4$ , 58 1° 69° 77.8° 87.4° 42 01 43.48 44.88 45.52 g. $\text{MgPt}(\text{CN})_4$ , 90° 45 50 45.04 g. $\text{MgPt}(\text{CN})_4$ . (Buxhoeveden.)
Cerium platinoeyanide, $\text{Ce}_2[\text{Pt}(\text{CN})_4]_3 + 18\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ .	+7 $\text{H}_2\text{O}$ . Sol. in 3.4 pts. $\text{H}_2\text{O}$ at 16°. Easily sol. in alcohol and ether. Solubility in $\text{H}_2\text{O}$ 100 g. of the sat. solution contain at -4 12° +0 5° 5 5° 18 0° 24 9 26 33 28 07 31 23 g. $\text{MgPt}(\text{CN})_4$ , 36 6° 45 0° 46 2° 38 36 41 32 41 96 g. $\text{MgPt}(\text{CN})_4$ . (Buxhoeveden.)
Cobaltous platinoeyanide ammonia, $\text{CoPt}(\text{CN})_4, 2\text{NH}_3$ . Insol. in $\text{H}_2\text{O}$ , but sol. in hot $\text{NH}_4\text{OH} + \text{Aq.}$	Magnesium potassium platinoeyanide, $\text{MgK}_2[\text{Pt}(\text{CN})_4]_2 + 7\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ .
Cupric platinoeyanide, $\text{CuPt}(\text{CN})_4 + x\text{H}_2\text{O}$ Ppt.	Mercuric platinoeyanide, $\text{HgPt}(\text{CN})_4$ . Ppt.
Cupric platinoeyanide ammonia, $\text{CuPt}(\text{CN})_4, 2\text{NH}_3 + \text{H}_2\text{O}$ . $\text{CuPt}(\text{CN})_4, 4\text{NH}_3$ . Sol. in $\text{H}_2\text{O}$ , alcohol, and ether.	Mercuric platinoeyanide nitrate, $5\text{HgPt}(\text{CN})_4, \text{Hg}(\text{NO}_3)_2 + 10\text{H}_2\text{O}$ . Ppt.
Didymium platinoeyanide, $\text{Dy}_2[\text{Pt}(\text{CN})_4]_3 + 18\text{H}_2\text{O}$ . Efflorescent in dry air. Sol. in $\text{H}_2\text{O}$ . (Cleve.)	Nickel platinoeyanide ammonia, $\text{NiPt}(\text{CN})_4, 2\text{NH}_3 + \text{H}_2\text{O}$ .
Dysprosium platinoeyanide, $\text{Dy}_2[\text{Pt}(\text{CN})_4]_3 + 21\text{H}_2\text{O}$ Easily sol. in $\text{H}_2\text{O}$ . (Jantsch, B 1911, 44. 1277.)	Potassium platinoeyanide, $\text{K}_2\text{Pt}(\text{CN})_4 + 3\text{H}_2\text{O}$ . Extremely efflorescent. Sl. sol. in cold, easily in hot $\text{H}_2\text{O}$ . (Willm, B. 19. 950) Sol. in alcohol and ether.
Erbium platinoeyanide, $\text{Er}_2[\text{Pt}(\text{CN})_4]_3 + 21\text{H}_2\text{O}$ Sol. in $\text{H}_2\text{O}$ . (Cleve)	Potassium sodium platinoeyanide, $\text{K}_2\text{Pt}(\text{CN})_4, \text{Na}_2\text{Pt}(\text{CN})_4 + 6\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ . (Willm, B. 19. 950)
Gadolinium platinoeyanide, $2\text{Gd}(\text{CN})_3, 3\text{Pt}(\text{CN})_4 + 18\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ ; decomp. in the air. (Benedicks, Z. anorg. 1900, 22. 405.)	Praseodymium platinoeyanide, $2\text{Pr}(\text{CN})_3, 3\text{Pt}(\text{CN})_4$ . Sol. in $\text{H}_2\text{O}$ . (Von Scheele, Z anorg. 1898, 18. 355)
Glucinum platinoeyanide, $\text{GhPt}(\text{CN})_4$ . (Toozynski, Dissert. 1871.)	
Hydroxylamine platinoeyanide, $(\text{NH}_2\text{O})_2\text{Pt}(\text{CN})_4 + 2\text{H}_2\text{O}$ . Deliquescent Very sol. in $\text{H}_2\text{O}$ . (Scholz.)	
Hydroxylamine lithium platinoeyanide, $(\text{NH}_4\text{O})\text{LiPt}(\text{CN})_4 + 3\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$	
Indium platinoeyanide, $\text{In}_2[\text{Pt}(\text{CN})_4]_3 + 2\text{H}_2\text{O}$ Hydrosopic; sol. in $\text{H}_2\text{O}$ . (Renz, B. 1901, 34. 2765)	

**Samarium platincyanide**,  $\text{Sm}_2[\text{Pt}(\text{CN})_4]_2 + 18\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  (Cleve.)

**Scandium platincyanide**,  $\text{Sc}_2[\text{Pt}(\text{CN})_4]_2 + 21\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  and insol. in alcohol; when boiled in alcohol it is dehydrated. (Crookes, Phil. Trans 1910, 210. A, 368.)

+21 $\text{H}_2\text{O}$  (Orlow, Ch. Z. 1912, 36. 1407.)

**Silver platincyanide**,  $\text{Ag}_2\text{Pt}(\text{CN})_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Silver platincyanide ammonia**,  $\text{Ag}_2\text{Pt}(\text{CN})_4 \cdot 2\text{NH}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Silver platincyanide bromide**.

See Bromoplatincyanide, silver.

**Silver platincyanide chloride**.

See Chloroplatincyanide, silver.

**Silver platincyanide iodide**.

See Iodoplatincyanide, silver.

**Sodium platincyanide**,  $\text{Na}_2\text{Pt}(\text{CN})_4 \cdot 3\text{H}_2\text{O}$ . Easily sol in  $\text{H}_2\text{O}$  (Willm, Z anorg. 4. 298.)

Sol. in alcohol.

**Strontium platincyanide**,  $\text{SrPt}(\text{CN})_4 \cdot 5\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ .

**Thallous platincyanide**,  $\text{Tl}_2\text{Pt}(\text{CN})_4$ .

Nearly insol in cold, sl sol. in hot  $\text{H}_2\text{O}$  (Friswell, Chem. Soc. 24. 461.)

**Thallous platincyanide carbonate**,

$2\text{Tl}_2\text{Pt}(\text{CN})_4 \cdot \text{Tl}_2\text{CO}_3$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . (F)

**Thorium platincyanide**,  $\text{Th}[\text{Pt}(\text{CN})_4]_3 + 16\text{H}_2\text{O}$ .

Somewhat difficultly sol in cold, easily in hot  $\text{H}_2\text{O}$ . (Cleve, Sv. V A. H Bih 2. No. 6.)

**Uranyl platincyanide**,  $(\text{UO}_2)\text{Pt}(\text{CN})_4 \cdot x\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (Levy, Chem. Soc. 1908, 93. 1459.)

**Ytterbium platincyanide**,  $2\text{Yb}(\text{CN})_3 \cdot 3\text{Pt}(\text{CN})_4 + 18\text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve, Z. anorg. 1902, 32. 139.)

**Yttrium platincyanide**,  $\text{Y}_2[\text{Pt}(\text{CN})_4]_3 + 21\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  Insol. in absolute alcohol. (Cleve and Höglund.)

**Zinc platincyanide ammonia**,  $\text{ZnPt}(\text{CN})_4 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$

**Platinonitrous acid**.

See Platinonitrous acid.

**Platinoplatinicyanhydric acid**,  $\text{HPt}(\text{CN})_4 + x\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Levy, Chem. Soc. 1912, 101. 1093.)

**Platinoselenocyanhydric acid**.

**Potassium platinoselenocyanide**,  $\text{K}_2\text{Pt}(\text{SeCN})_6$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Clarke and Dudley, B. 1878, 11. 1325.)

**Platinoselenostannic acid**.

See under Selenostannate, platinum.

**Platinosulphocyanhydric acid**,  $\text{H}_2\text{Pt}(\text{SCN})_4$ .

Known only in aqueous solution.

**Potassium platinosulphocyanide**,  $\text{K}_2\text{Pt}(\text{SCN})_4$ .

Permanent Sol in 25 pts.  $\text{H}_2\text{O}$  at 15°, and more readily at higher temp. Very sol. in warm alcohol.

**Silver —**,  $\text{Ag}_2\text{Pt}(\text{SCN})_4$ .

Insol in  $\text{H}_2\text{O}$  Sol. in  $\text{KSCN} + \text{Aq}$ , and partly sol in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Platinosulphocyanhydric acid**,  $\text{H}_2\text{Pt}(\text{SCN})_6$ .

Known only in aqueous, and alcoholic solutions

**Ammonium platinosulphocyanide**,  $(\text{NH}_4)_2\text{Pt}(\text{SCN})_4$ .

Sol in  $\text{H}_2\text{O}$  and alcohol.

**Barium —**,  $\text{BaPt}(\text{SCN})_6$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol.

**Ferrous —**,  $\text{FePt}(\text{SCN})_6$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol Not attacked by dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ .

**Lead —**,  $\text{PbPt}(\text{SCN})_6$ .

Sl. sol. in cold, decomp by hot  $\text{H}_2\text{O}$ . Sol. in alcohol

$\text{PbPt}(\text{SCN})_6$ ,  $\text{PbO}$ . Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol in acetic or nitric acids

**Mercurous —**,  $\text{Hg}_2\text{Pt}(\text{SCN})_6$ .

Ppt. Insol. in  $\text{H}_2\text{O}$

**Potassium platinosulphocyanide,**  
 $K_2Pt(SCN)_4$ 

Sol in 12 pts  $H_2O$  at  $60^\circ$ . Much more easily in boiling  $H_2O$ , and still more easily in hot alcohol.

+  $2H_2O$ . (Miolati and Bellucci, Gazz. Ch. it. 1900, 30, II. 592)

**Silver —,  $Ag_2Pt(SCN)_4$ .**

Insol. in  $H_2O$  or  $K_2Pt(SCN)_4 + Aq$ . Sol in cold  $NH_4OH + Aq$  and in  $KCN + Aq$

**Sodium —,  $Na_2Pt(SCN)_4$ .**

Sol. in  $H_2O$  and alcohol

**Platinosulphostannic acid.**

See under Sulphostannate, platinum.

**Platinosulphurous acid.**

See Platosulphurous acid.

**Platinum, Pt.**

Not attacked by  $H_2O$ ,  $H_2SO_4$ ,  $HCl$ , or  $HNO_3 + Aq$ . Slowly sol in aqua regia, or a mixture of  $HBr$  and  $HNO_3$ , but much less easily than Au.

Precipitated Pt is remarkably sol. in  $HCl + Aq$  in presence of air (Wilm, B. 1881, 14, 636.)

Pure Pt foil is attacked by fuming  $HCl$  under influence of light, but not in the dark. (Berthelot, C. R. 1904, 138, 1297.)

Dil.  $HCl + Aq$  dissolves 10–15% Pt from active Pt black. (Wohler, B. 1903, 36, 3482.)

Conc.  $HNO_3$  oxidizes Pt black; Pt sponge, less easily; sheet Pt, slightly. (Wohler, Dissert. 1901.)

Pt in presence of Hg is more or less sol. in conc.  $HNO_3$ . (Tarugi, Gazz. ch. it. 1903, 33, II. 171.)

Pt vessels are attacked by evaporating  $HNO_3$  therein (Jaunek and Meyer, Z. anorg. 1913, 83, 71.)

Sl sol in conc  $H_2SO_4$  containing small amounts of nitrogen oxides (Scheurer-Kestner, C. R. 86, 1082.)

Pt black, pptd. by formic acid, is easily sol in boiling  $H_2SO_4$ . (Deville and Stas, Paris, 1873.)

Thin sheet Pt is attacked by boiling  $H_2SO_4$  containing  $K_2SO_4$ ; 1 sq. cm loses 0.01 g. in 1 hour and velocity of the reaction is not accelerated by addition of  $HNO_3$ . Pt black is completely dissolved under the above conditions in 50 hours. (Delépine, C. R. 1905, 141, 1013.)

Further data on solubility of Pt in  $H_2SO_4$  are given by Delépine. (C. R. 1906, 142, 631.)

95%  $H_2SO_4$  dissolves 0.04 g. Pt from commercial Pt at  $250$ – $260^\circ$  in 28 hours. (Conroy, J. Soc. Chem. Ind. 1903, 22, 465.)

See also Quenessen. (Bull. Soc. 1906, (3) 35, 620)

0.0038 g is dissolved by 10 cc. of boiling  $H_2SO_4$ . (McCoy, Eighth Inter Cong. App. Chem. 1912, 2.)

$HCl + HNO_3$ , so long as they are sufficiently dil or the temperature is so low that they cannot react on each other, have no action on Pt. Addition of  $Cl$  does not bring about reaction, but a few drops of  $KNO_3$  or  $Na_2O_2 + Aq$  bring about an immediate reaction. (Millon) Slowly sol in  $HI + Aq$  (Deville, C. R. 42, 896)

Conc.  $H_3PO_4$  attacks Pt when heated in presence of air, but not in its absence. (Hüttner, Z. anorg. 1903, 59, 216)

Pt dissolves easily in most acids when they contain  $H_2O_2$ . (Fairley, B. 1875, 8, 1600.)

Slowly sol in boiling  $PoCl_3 + Aq$  (Saint-Pierre, C. R. 64, 1077.)

$FeCl_3$  in acid solution is without influence on Pt. (Marie, C. R. 1908, 146, 476.)

Pt is completely insol. in  $KCN + Aq$ . (Rössler, Z. Chem. 1866, 175.)

Pt is attacked by boiling conc.  $KCN + Aq$ . (Deville and Debray, C. R. 82, 241.)

Solubility of Pt in 10%  $KCN + Aq$  is very small at ord. temp. (1.4 mg. in 8 days) but is considerably greater in boiling conc.  $KCN + Aq$  (71.5 mg in 5 hours). (Glaser, Z. Elektrochem. 1903, 9, 15.)

Pt foil is dissolved in boiling  $KCN + Aq$  (0.030 g. for 1 cc. in 1 hour). Insol. in cold  $KCN + Aq$  (Brochet and Pettit, C. R. 1904, C. R. 138, 1255.)

Sol in  $RbCl_4I + Aq$  (Erdmann, Arch. Pharm. 1894, 232, 30)

Insol in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20, 828.)

**Platinum ammonium compounds.**

Data published since the first edition of this work have not been included in this edition.

See —

Platosamine comps.,  $Pt < \begin{matrix} NH_3, R \\ NH_3, R \end{matrix}$

Platosamidamine comps.,

$Pt < \begin{matrix} NH_3, NH_3, R \\ R \end{matrix}$

Platomonodiamine comps.,

$Pt < \begin{matrix} NH_3, NH_3, R \\ NH_3, R \end{matrix}$

Platodiamine comps.,  $Pt < \begin{matrix} NH_3, NH_3, R \\ NH_3, NH_3, R \end{matrix}$

Platosesamidamine comps.,  $Pt < \begin{matrix} NH_3, R \\ R \end{matrix}$

Diplatodiamine comps.,

$Pt - NH_3, NH_3, R$

$Pt - NH_3, NH_3, R$

Bromoplatinamine comps.,

$Br_2Pt < \begin{matrix} NH_3, R \\ NH_3, R \end{matrix}$

Chloroplatinamine comps.,

$Cl_2Pt < \begin{matrix} NH_3, R \\ NH_3, R \end{matrix}$

Chloronitratoplatinamine comps.,  
 $\text{Cl}(\text{NO}_3)\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Iodoplatinamine comps.,  $\text{I}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Hydroxyloplatinamine comps.,  
 $(\text{OH})_2\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Nitratoplatinamine comps.,  
 $(\text{NO}_3)_2\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Sulphatoplatinamine comps.,  
 $\text{SO}_4\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Bromoplatin $\text{semidiamine}$  comps.,  
 $\text{Br}_2\text{PtNH}_3, \text{NH}_3, \text{R}$

Bromonitritoplatin $\text{semidiamine}$  comps.,  
 $\text{Br}_2(\text{NO}_2)\text{PtNH}_3, \text{NH}_3, \text{R}$

Chloroplatin $\text{semidiamine}$  comps.,  
 $\text{Cl}_2\text{PtNH}_3, \text{NH}_3, \text{R}$

Chlorohydroxylonitrosoplatin $\text{semidiamine}$  comps.,  
 $\text{Cl}(\text{OH})(\text{NO})\text{PtNH}_3, \text{NH}_3, \text{R}$

Chloronitritoplatin $\text{semidiamine}$  comps.,  
 $\text{Cl}_2(\text{NO}_2)\text{PtNH}_3, \text{NH}_3, \text{R}$

Iodoplatin $\text{semidiamine}$  comps.,  
 $\text{I}_2\text{PtNH}_3, \text{NH}_3, \text{R}$

Hydroxylo $\text{semidiamine}$  comps.,  
 $(\text{OH})_2\text{PtNH}_3, \text{NH}_3, \text{R}$

Bromoplatin $\text{monodiamine}$  comps.,  
 $\text{Br}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Bromohydroxyloplatin $\text{monodiamine}$  comps.,  
 $\text{Br}(\text{OH})\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Chloroplatin $\text{monodiamine}$  comps.,  
 $\text{Cl}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Iodonitratoplatin $\text{monodiamine}$  comps.,  
 $\text{I}(\text{NO}_3)\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Hydroxyloplatin $\text{monodiamine}$  comps.,  
 $(\text{OH})_2\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Bromoplatin $\text{diamine}$  comps.,  
 $\text{Br}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{NH}_3, \text{R} \\ \text{NH}_3, \text{NH}_3, \text{R} \end{smallmatrix}$

Bromocarbonatoplatin $\text{diamine}$  comps.,  
 $\text{CO}_3 > [\text{Pt}(\text{NH}_3)_2\text{R}]_2$

Bromochloroplatin $\text{diamine}$  comps.,  
 $\text{BrClPt}(\text{NH}_3)_2, \text{R}_2$

Bromohydroxyloplatin $\text{diamine}$  comps.,  
 $\text{Br}(\text{OH})\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Bromonitratoplatin $\text{diamine}$  comps.,  
 $\text{Br}(\text{NO}_3)\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Bromosulphatoplatin $\text{diamine}$  comps.,  
 $\text{Br}_2(\text{SO}_4)[\text{Pt}(\text{NH}_3)_2, \text{R}_2]_2$

Carbonatohydroxyloplatin $\text{diamine}$  comps.,  
 $(\text{CO}_3)_2[\text{Pt}(\text{NH}_3)_2, \text{R}_2]_2$

Carbonatoplatin $\text{diamine}$  comps.,  
 $(\text{CO}_3)_2(\text{NO}_3)_2[\text{Pt}(\text{NH}_3)_2, \text{R}_2]_2$

Carbonatoplatin $\text{diamine}$  comps.,  
 $(\text{CO}_3)_2(\text{NO}_3)_2[\text{Pt}(\text{NH}_3)_2, \text{R}_2]_2$

Carbonatoplatin $\text{diamine}$  comps.,  
 $(\text{CO}_3)_2(\text{NO}_3)_2[\text{Pt}(\text{NH}_3)_2, \text{R}_2]_2$

Carbonatoplatin $\text{diamine}$  comps.,  
 $(\text{CO}_3)_2(\text{NO}_3)_2[\text{Pt}(\text{NH}_3)_2, \text{R}_2]_2$

Chloroplatin $\text{diamine}$  comps.,  
 $\text{Cl}_2\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Chlorohydroxyloplatin $\text{diamine}$  comps.,  
 $\text{Cl}(\text{OH})(\text{NH}_3)_2, \text{R}_2$

Chloriodoplatin $\text{diamine}$  comps.,  
 $\text{ClIPt}(\text{NH}_3)_2, \text{R}_2$

Chloronitratoplatin $\text{diamine}$  comps.,  
 $\text{Cl}(\text{NO}_3)\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Hydroxyloplatin $\text{diamine}$  comps.,  
 $(\text{OH})_2\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Hydroxylonitratoplatin $\text{diamine}$  comps.,  
 $(\text{OH})(\text{NO}_3)\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Hydroxylsulphatoplatin $\text{diamine}$  comps.,  
 $(\text{OH})_2\text{SO}_4\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Iodoplatin $\text{diamine}$  comps.,  $\text{I}_2\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Iodonitritoplatin $\text{diamine}$  comps.,  
 $\text{I}(\text{NO}_2)\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Nitratoplatin $\text{diamine}$  comps.,  
 $(\text{NO}_3)_2\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Nitritoplatin $\text{diamine}$  comps.,  
 $(\text{NO}_2)_2\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Sulphatoplatin $\text{diamine}$  comps.,  
 $(\text{SO}_4)_2\text{Pt}(\text{NH}_3)_2, \text{R}_2$

Iododiplatin $\text{diamine}$  comps.,  
 $\text{I}-\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

$\text{I}-\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{R} \\ \text{NH}_3, \text{R} \end{smallmatrix}$

Bromodiplatin $\text{diamine}$  comps.,  
 $\text{Br}-\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{NH}_3, \text{R} \\ \text{NH}_3, \text{NH}_3, \text{R} \end{smallmatrix}$

$\text{Br}-\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{NH}_3, \text{R} \\ \text{NH}_3, \text{NH}_3, \text{R} \end{smallmatrix}$

Hydroxyiodoplatin $\text{diamine}$  comps.,  
 $(\text{OH})_2\text{Pt}_2(\text{NH}_3)_4, \text{R}_4$

Iododiplatin $\text{diamine}$  comps.,  
 $\text{I}_2\text{Pt}_2(\text{NH}_3)_4, \text{R}_4$

Nitratodiplatin $\text{diamine}$  comps.,  
 $(\text{NO}_3)_2\text{Pt}_2(\text{NH}_3)_4, \text{R}_4$

Platin $\text{triamine}$  comps.,  
 $\text{R}_4\text{Pt} < \begin{smallmatrix} \text{NH}_3, \text{NH}_3, \text{NH}_3, \text{R} \\ \text{NH}_3, \text{NH}_3, \text{NH}_3, \text{R} \end{smallmatrix}$

Tetraplatin $\text{amine}$  comps.,  $\text{Pt}_4(\text{NH}_3)_8, \text{R}_{16}$

Octoplatin $\text{amine}$  comps.,  $\text{Pt}_8(\text{NH}_3)_{16}, \text{R}_{16}$

Platinum antimonide,  $\text{PtSb}_3$ .  
 (Christoffe, 1863.)

Platinum arsenide,  $\text{Pt}_3\text{As}_2$ .  
 (Tivoli, Gazz. ch. it. 14. 487.)

$\text{PtAs}_2$ . Min. *Sperryite*. Sil. attacked by aqua regia. (Wells, Sil. Am. J. (3) 37. 67.)

Platinum arsenic hydroxide (?),  $\text{PtAsOH}$ .

Insol. in, and slowly decomp. by  $\text{H}_2\text{O}$  and alcohol. Easily decomp. by  $\text{HCl} + \text{Aq}$ ; not attacked by  $\text{HNO}_3 + \text{Aq}$ . Sol. in aqua regia; not attacked by cold conc.  $\text{H}_2\text{SO}_4$ , but decomp. on heating. - (Tivoli, Gazz. ch. it. 14. 487.)

**Platinum potassium azoimide.**

Ppt. Explodes violently even in aq. solution (Curtius, J pr 1898, (2) 58. 304)

**Platinum boride,  $Pt_3B_2$** 

Very slowly sol. in aqua regia (Martius, A. 109. 79.)

**Platinous bromide,  $PtBr_2$** 

Insol. in  $H_2O$ . Sol. in  $HBr + Aq$ . Sl sol. in  $KBr + Aq$ . (Topsoe, J. B. 1868. 274.)

**Platinic bromide,  $PtBr_4$** 

Not deliquescent, sol. in  $H_2O$ . (Meyer and Zühlke, B. 13. 404)

Sl. sol. in  $H_2O$ . 100 g.  $PtBr_4 + Aq$  sat. at  $20^\circ$  contain 0.41 g.  $PtBr_4$ . (Halberstadt, B. 17. 2962.)

Easily sol. in  $HBr + Aq$ , sl. sol. in  $HCl + H_2O_2 + Aq$ . Sol. in considerable amount in  $K$  or  $NH_4$  oxalate  $+ Aq$

Very sl. sol. in alcohol or ether, also in glycerine. (Halberstadt.)

**Platinic hydrogen bromide.**

See Bromoplatinic acid.

**Platinous bromide carbonyl.**

See Carbonyl platinous bromide.

**Platinic bromide with  $MBr$ .**

See Bromoplatinate, M.

**Platinum carbide,  $PtC_2$** 

Hot aqua regia dissolves out nearly all the Pt. (Zeise, J pr 20. 209.)

**Platinum carbon disulphide,  $PtCS_2$** 

See Platinum sulphocarbide.

**Platinum monochloride,  $PtCl + xH_2O$** 

Easily sol. in  $HCl$ ; mod. sol. in hot dil.  $H_2SO_4$  without decomp. (Sonstadt, Proc. Chem. Soc. 1898, 14. 179.)

**Platinous chlorids,  $PtCl_2$** 

Insol. in  $H_2O$ , conc.  $H_2SO_4$ , or  $HNO_3$ . Sol. in hot  $HCl + Aq$  with exclusion of air. (Berzelius)

Insol. in alcohol or ether; sol. in  $NH_4OH + Aq$ . (Raewsky, A. ch. (3) 22. 280) Sol. in aqua regia with formation of  $PtCl_4$ .

Insol. in cold conc.  $KI + Aq$ , but sol. when heated. (Lassaigne, A. ch. (2) 51. 117.)

Sl. sol. in liquid  $NH_3$  (Gore, Am. Ch. J. 1898, 20. 828.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

**Platinum trichloride,  $PtCl_3$** 

Sl. sol. in cold, more sol. in hot  $H_2O$ . Partially hydrolyzed by boiling with  $H_2O$ .

Insol. in cold conc.  $HCl$ . Sol. in hot conc.  $HCl$  with decomp.

Sol. in  $KI + Aq$ . (Wöhler, B. 1809, 42. 3961.)

**Platinic chloride,  $PtCl_4$** 

Not deliquescent. Very sol. in  $H_2O$ . (Pulinger, Chem. Soc. 61. 420)

Sp. gr. of aqueous solution containing.

5	10	15	20	25 % $PtCl_4$
1.046	1.097	1.153	1.214	1.285
30	35	40	45	50 % $PtCl_4$
1.362	1.450	1.546	1.666	1.785

(Precht, Z. anal. 18. 512.)

Insol. in conc.  $H_2SO_4$ . (Dumas.)

Sl. sol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 828)

Sol. in alcohol and ether; sol. in anhydrous acetone. (Zeise, A. 33. 34)

Insol. in ether. (Willstätter, B. 1903, 36. 1830)

Sl. sol. in methyl acetate. (Naumann, B. 1909, 42. 3790)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

$+ H_2O$ . Sol. in  $H_2O$ . (Gutbier and Heinrich, Z. anorg. 1913, 81. 378)

$+ 4H_2O$ . Sol. in  $H_2O$ . (Pigeon, C. R. 1891, 112. 792)

$+ 5H_2O$  Not deliquescent. Sol. in  $H_2O$  or  $HCl + Aq$ .

Composition is probably  $H_2PtCl_6O + 4H_2O$ . (Norton, J. pr. 110. 469.)

$+ 7H_2O$ . Sol. in  $H_2O$ . (Pigeon.)

$+ 8H_2O$ . (Blondel, A. Ch. 1905, (8) 6. 98.)

**Platinic thallium chloride,  $Tl_2Pt_2Cl_5H_2O_4$** 

Ppt.; insol. in  $H_2O$ . (Miolati, Z. anorg. 1900, 22. 460)

**Platinous hydrogen chloride.**

See Chloroplatinous acid.

**Platinic hydrogen chloride.**

See Chloroplatinic acid.

**Platinous chloride with  $MCl$ .**

See Chloroplatinite, M.

**Platinic chloride with  $MCl$ .**

See Chloroplatinate, M.

**Platinous phosphorus chloride.**

See Phosphorus platinous chloride.

**Platinic phosphorus chloride.**

See Phosphorus platinic chloride.

**Platinous chloride carbonyl.**

See Carbonyl platinous chloride.

**Platinum chloride hydroxylamine,**

Ppt Sol in alcohol and in ether. Decomp. in aq. solution

$\text{Pt}(\text{NH}_2\text{OH})_2\text{Cl}_2$  Sol in  $\text{H}_2\text{O}$ . (Uhlenhuth, A 1900, 311. 124.)

**Platinous chloride sulphocarbamide,**

Sl. sol in  $\text{H}_2\text{O}$ ; very sol. in hot  $\text{H}_2\text{O}$ , decomp. sl. on boiling (Kurnakow, J pr. 1894, (2) 50. 483.)

**Platinum chloroiodide,  $\text{PtCl}_2\text{I}_2$** 

Very deliquescent (Kammerer, A 148. 329.)

$\text{PtClI}_3$  Insol in  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. Sol. in  $\text{KOH} + \text{Aq}$ , from which it is pptd by  $\text{H}_2\text{SO}_4$ . (Mather, Sill Am J 27. 257.)

**Platinum chloronitride,  $\text{PtNCl}$** 

(Alexander, C C 1887. 1254.)

**Platinous cyanide with  $\text{MCN}$ .**

See Platinocyanide, M.

**Platinous fluoride,  $\text{PtF}_2$ ?**

Insol in  $\text{H}_2\text{O}$  (Moissan, A. ch. (6) 24. 287.)

**Platinic fluoride,  $\text{PtF}_4$** 

Deliquescent. Sol in  $\text{H}_2\text{O}$  with immediate decomp. into  $\text{PtO}_4\text{H}_2$  and  $\text{HF}$  (Moissan, C R 109. 807.)

**Platinous hydroxide,  $\text{PtO}_2\text{H}_2$** 

Sol in  $\text{HCl}$ ,  $\text{HBr}$ , and  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but not in other oxygen acids. Decomp. by boiling  $\text{KOH} + \text{Aq}$ . (Thomsen, J pr. (2) 16. 344.)

When freshly pptd, is insol in dil.  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ , and in  $\text{HC}_2\text{H}_3\text{O}_2$ ; sol. in conc.  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . Very sol. in  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$ . After drying, is insol. in conc.  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Wöhler, Z. anorg. 1904, 40. 424.)

**Platinic hydroxide,  $\text{Pt}(\text{OH})_4$** 

Easily sol in dil acids and in  $\text{NaOH} + \text{Aq}$ . (Topsoe, J. B. 1870. 386.)

Nearly insol. in acetic acid (Döbereiner) Insol. in all acids except conc.  $\text{HCl}$  and aqua regia. (Wöhler, Z. anorg. 1904, 40. 438.)

+  $\text{H}_2\text{O}$ . Ppt. (Prost, Bull Soc. (2) 44. 256.) Insol in  $2\text{N}-\text{H}_2\text{SO}_4$  and dil.  $\text{HNO}_3 + \text{Aq}$ , mod. sol. in conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $2\text{N}-\text{HCl}$  and  $\text{NaOH} + \text{Aq}$ . (Wöhler.)

+  $2\text{H}_2\text{O}$ . Easily sol in dil. acids, even acetic acid, and in  $\text{NaOH} + \text{Aq}$ . (Topsoe.)

Insol. in acetic acid; sl. sol. in  $2\text{N}-\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ ; easily sol. in  $\text{HCl}$ , and  $\text{NaOH} + \text{Aq}$ . (Wöhler.)

**Platinoplatinic hydroxide,  $\text{Pt}_2\text{O}_4 \cdot 9\text{H}_2\text{O}$** 

Ppt (Prost, Bull Soc. (2) 46. 156.)

$\text{Pt}_2\text{O}_{11}$ ,  $11\text{H}_2\text{O}$ . Ppt. (Prost.)

**Platinum hydroxylamine comps.**

See—

Platodioxamine comps.,  $\text{Pt}(\text{NH}_2\text{O})_2\text{R}_2$

Platosoxamine comps.,  $\text{Pt}(\text{NH}_3\text{O})_2\text{R}_2$ .

Platosoxamine-amine comps.,

$\text{Pt}(\text{NH}_3\text{O})_2\text{NH}_3\text{R}_2$

**Platinous iodide,  $\text{PtI}_2$** 

Insol in  $\text{H}_2\text{O}$ , acids, or alcohol (Lassaigne, A ch (2) 51. 113.)

Difficultly sol. in  $\text{Na}_2\text{SO}_3 + \text{Aq}$  (Topsoe.) Gradually decomp. by hot  $\text{HI} + \text{Aq}$  of 1.038 sp gr, also by hot  $\text{KI} + \text{Aq}$ ,  $\text{PtI}_4$  being dissolved out and  $\text{Pt}$  left behind. Not attacked by conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ , but gradually decomp. by  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ . (Lassaigne.)

Insol. in acetone. (Eidmann, C. C. 1889, II. 1014.)

**Platinic iodide,  $\text{PtI}_4$** 

Insol in  $\text{H}_2\text{O}$ . Sol. in  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_3 + \text{Aq}$ . Sol. in  $\text{HI} + \text{Aq}$  or alkali iodides +  $\text{Aq}$ . Sol. in alcohol, with partial decomp. Not attacked by acids. (Lassaigne, A. ch. (2) 51. 122.)

Very sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

Sol in alcohol. (Bellus, C. C. 1902, I. 625.)

**Platinic iodide with  $\text{ML}$** 

See Iodoplatinate, M.

**Platinum nitride chloride,  $\text{PtNCl}$** 

See Platinum chloronitride.

**Platinous oxide,  $\text{PtO}$** 

Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in other acids. (Döbereiner, Pogg 28. 183.)

Sol in conc.  $\text{H}_2\text{SO}_4$ ; easily in conc  $\text{HCl} + \text{Aq}$ . (Stoer's Dict.)

Very sl. sol. in  $\text{HCl} + \text{Aq}$ . Sl. sol. in aqua regia. (Wöhler, B. 1903, 36. 3482.)

**Platinic oxide,  $\text{PtO}_2$** 

Insol. in acids, even aqua regia. (Wöhler, Dissert, 1901.)

**Platinum trioxide,  $\text{PtO}_3$** 

Unattacked by dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  or acetic acid. Sol. with decomp. in dil and conc.  $\text{HCl}$ , conc.  $\text{H}_2\text{SO}_4$  or conc.  $\text{HNO}_3$ . (Wöhler, B. 1909, 42. 3329.)

**Platinum sesquioxide,  $\text{Pt}_2\text{O}_3 + x\text{H}_2\text{O}$** 

Insol. in dil sol in conc  $\text{H}_2\text{SO}_4$ . Sl. sol. in hot dil  $\text{HNO}_3$ . Sol in  $\text{HCl}$ . Sol. in conc. alkali hydroxides +  $\text{Aq}$ . (Wöhler, B. 1909, 42. 3964.)

+2H<sub>2</sub>O. Insol. in HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>. Insol. in alkalis + Aq, also cold dil. HCl + Aq. Sol. in aqua regia. (Dudloy, Am. Ch. J. 1902, 28, 66)  
+5H<sub>2</sub>O. (Delépine, Bull. Soc. 1910, (4) 7, 103.)

#### Platinoplatinic oxide, Pt<sub>2</sub>O<sub>4</sub>.

Not attacked by long boiling with HCl, HNO<sub>3</sub>, or aqua regia (Jørgensen, J. pr. (2) 18, 344)

Does not exist. (Wöhler, Z. anorg. 1904, 40, 450.)

#### Platinum oxychloride, 3PtO, PtCl<sub>2</sub> (?)

Sol in HCl, and in KOH + Aq (Kane, Phil. Trans. 1842, 298)

PtCl<sub>2</sub>(OH)<sub>2</sub> = H<sub>2</sub>PtCl<sub>2</sub>O<sub>2</sub> (Jørgensen, J. pr. (2) 18, 345)

5PtO<sub>2</sub>, 2HCl + 9H<sub>2</sub>O. Insol in cold H<sub>2</sub>O; decomp. on boiling. Slowly sol. in HCl. (Blondel, A. ch. 1905, (8) 6, 100.)

#### Platinum oxysulphide, PtOS

See Platinum sulphhydroxide.

#### Platinum phosphide, PtP<sub>2</sub>

Insol in HCl + Aq. Sol in aqua regia (Schrotter, W. A. B. 1849, 303.)

PtP<sub>2</sub>H<sub>4</sub>. Insol in H<sub>2</sub>O, and HCl + Aq. (Cavazzi, Gazz. ch. it. 13, 324)

PtP. Insol in aqua regia (Clark and Joslin)

Pt<sub>2</sub>P. Sol in aqua regia (Clark and Joslin)

Pt<sub>2</sub>P<sub>2</sub>. Partially sol in aqua regia (Clark and Joslin, C. N. 48, 385)

Attacked very slowly by aqua regia. Rapidly sol. in molten alkalis. (Granger, C. N. 1898, 77, 229)

Completely sol in aqua regia if the action sufficiently prolonged, though with difficulty. (Granger, C. R. 1895, 123, 1285)

#### Platinum diselenide, PtSe<sub>2</sub>

As PtS<sub>2</sub> (Minozzi, Chem. Soc. 1909, 96, (2) 899.)

#### Platinum triselenide, PtSe<sub>3</sub>

Sl. attacked by hot conc. HNO<sub>3</sub>; not attacked by cold conc. HCl + Aq; slowly sol. in aqua regia and Cl<sub>2</sub> + Aq; insol. in CS<sub>2</sub>.

#### Platinum silicide, Pt<sub>2</sub>Si

Sol in hot aqua regia (Vigouroux, C. R. 1896, 123, 117)

Pt<sub>2</sub>Si<sub>2</sub>. (Colson, C. R. 94, 27.)

Pt<sub>2</sub>Si<sub>2</sub>. Slowly decomp. by aqua regia. (Guyard, Bull. Soc. (2) 25, 511.)

PtSi. Insol. in HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, HF, and HCl. Completely sol. in aqua regia. (Lebeau and Novitzky, C. R. 1907, 145, 241.)

#### Platinum sulphhydroxide, PtOS + H<sub>2</sub>O = PtS(OH)<sub>2</sub>.

Decomp. easily into—

Pt<sub>2</sub>S<sub>2</sub>O<sub>2</sub>H<sub>2</sub> =  $\frac{\text{PtS}}{\text{PtS}} \frac{\text{OH}}{\text{OH}} = \text{PtOS} + \frac{1}{2}\text{H}_2\text{O}$ . H<sub>2</sub>O cannot be removed without decomposing the compound. (v. Meyer, J. pr. (2) 15, 1.)

#### Platinous sulphide, PtS.

Not attacked by boiling acids, aqua regia, or KOH + Aq. (Böttger, J. pr. 2, 274)

Sol in large excess of (NH<sub>4</sub>)<sub>2</sub>S + Aq.

#### Platinoplatinic sulphide, Pt<sub>2</sub>S<sub>3</sub>.

Not attacked by HCl or HNO<sub>3</sub> + Aq, and only slowly by aqua regia. (Schneider, Pogg. 138, 607)

#### Platinic sulphide, PtS<sub>2</sub>

*Anhydrous* Aqua regia attacks sl, other acids not at all (Davy.)

*Hydrated* Insol in HCl + Aq; sl sol. in boiling HNO<sub>3</sub> + Aq. Sol. in aqua regia (Fresenius) Sol in alkali sulphides, hydrides and carbonates + Aq. (Berzelius.) Very sl. sol in (NH<sub>4</sub>)<sub>2</sub>S + Aq. (Claus)

Insol in NH<sub>4</sub>Cl, or NH<sub>4</sub>NO<sub>3</sub> + Aq. 1 pt. PtCl<sub>4</sub> in 100 pts. H<sub>2</sub>O + 25 pts. HCl is not pptd. by H<sub>2</sub>S (Rensch)

Difficultly sol. in alkali sulphhydroxides + Aq, but more easily in presence of SnS, Sb<sub>2</sub>S<sub>3</sub>, As<sub>2</sub>S<sub>3</sub>, or SnS<sub>2</sub> (Ribau, C. R. 85, 283)

#### Platinum sulphide, Pt<sub>2</sub>S<sub>3</sub>, or Tetraplatinum sulphoplatinate, 4PtS, PtS<sub>2</sub>.

Decomp. on moist air, but not attacked by acids (Schneider, J. pr. (2) 7, 214)

#### Platinum sulphides with M<sub>2</sub>S.

See Sulphoplatinate, M.

#### Platinum sulphocarbide, PtC<sub>2</sub>S<sub>2</sub>.

Not attacked by hot HCl, HNO<sub>3</sub> + Aq, slightly by aqua regia. (Schutzenberger, C. R. 111, 391.)

#### Platinum telluride, PtTe.

Decomp. by fused oxidizing agents, slowly sol. in conc. HNO<sub>3</sub>. (Roessler, Z. anorg. 1897, 15, 407)

#### Platinum ditelluride, PtTe<sub>2</sub>.

Insol in boiling conc. KOH + Aq; slowly sol. in boiling conc. HNO<sub>3</sub>; decomp. by fused oxidizing agents. (Roessler)

#### Plato-.

See also Platino-.

**Platoamidosulphonic acid.****Potassium platoamidosulphonate,**  
 $K_2Pt(NH_2SO_3)_4 + 2H_2O$ .

Very sl. sol. in cold  $H_2O$ ; sol. in 10 pts. boiling  $H_2O$ . (Ramberg and St. Kahlenberg, B. 1912, 45, 1514.)

**Sodium —,  $Na_2Pt(NH_2SO_3)_4 + 4H_2O$ .**

Very sol. in  $H_2O$ . (Ramberg and St. Kahlenberg.)

**Platodiamine bromide,  $Pt[(NH_3)_2Br]_2 + 3H_2O$ .**

Easily sol. in  $H_2O$ . (Cleve.)

**— carbonate,  $Pt(N_2H_5)_2CO_3 + H_2O$ .**

Sol. in  $H_2O$ . (Peyrone, A. 51. 14.)

$Pt(N_2H_5CO_2H)_2$ . Sl. sol. in, but decomp by boiling with  $H_2O$  into—

**— sesquicarbonate.**

More sol. than preceding salt. (Reiset, C. R. 11. 711.)

**— chloride,  $Pt[(NH_3)_2Cl]_2 + H_2O$ .**

"Reiset's first chloride." Sol. in 4 pts.  $H_2O$  at 16.5°, and in less hot  $H_2O$ . Insol. in alcohol or ether. (Reiset, A. ch. (3) 11. 419.)

As sol. in  $NH_4Cl + Aq$  as in  $H_2O$ ; insol. in absolute alcohol; sl. sol. in dil. alcohol, very sol. in dil.  $HCl + Aq$  (Peyrone, A. ch. (3) 12. 196)

**— cuprous chloride,  $Pt(NH_3)_4Cl_2, Cu_2Cl_2$ .**

Sol. in  $H_2O$ , and pptd. from  $H_2O$  solution by alcohol. (Buckton.)

**— cupric chloride,  $Pt(NH_3)_4Cl_2, CuCl_2$ .**

Sl. sol. in cold, decomp. by hot  $H_2O$  into  $Pt(NH_3)_2Cl_2, Cu_2Cl_2$ . (Buckton, Chem. Soc. 5. 218.)

Nearly insol. in  $H_2O$ ; easily sol. in warm  $HCl + Aq$ ; insol. in alcohol. (Millon and Commaille, C. R. 57. 822.)

Millon and Commaille's salt is  $Cu(NH_3)_4Cl_2, PtCl_2$ , cuprammonium oblorplatinate

**— lead chloride,  $Pt(NH_3)_4Cl_2, PbCl_2$ .**

Sol. in hot, much less in cold  $H_2O$ . Insol. in  $HCl + Aq$  or alcohol. (Buckton, Chem. Soc. 5. 213.)

**— mercuric chloride,  $Pt(NH_3)_4Cl_2, HgCl_2$ .**

Easily sol. in hot  $H_2O$ , much less in cold. Insol. in  $HCl + Aq$ . (Buckton)

**— zinc chloride,  $Pt(NH_3)_4Cl_2, ZnCl_2$ .**

Easily sol. in hot  $H_2O$ . Insol. in alcohol (Buckton.)

**Platodiamine chloroplatinate,  $Pt(NH_3)_4Cl_2, PtCl_4$ .**

Ppt. Insol. in  $H_2O$ . (Cossa, Gazz. ch. it. 17. 1.)

**— chloroplatinate,  $Pt(NH_3)_4Cl_2, PtCl_2$ .**

(Magnus' green salt.) Insol. in, and not decomp. by  $H_2O, HCl + Aq$ , or alcohol. (Magnus.)

Slowly sol. in boiling  $NH_4OH + Aq$  and in conc.  $NH_3$  salts +  $Aq$ . (Reiset, A. ch. (3) 11. 427.)

Almost as sol. in  $(NH_4)_2CO_3 + Aq$  as in  $NH_4OH + Aq$ . Sol. in hot  $PtCl_4 + Aq$  (Reiset)

Not decomp. by boiling  $KOH$ , dil.  $HCl$ , or  $H_2SO_4 + Aq$ , but easily by  $HNO_3 + Aq$ . (Gros, A. 27. 245.)

**— chromate,  $Pt(NH_3)_4CrO_4$ .**

Scarcely sol. in  $H_2O$  (Cleve.)

**— dichromate,  $Pt(NH_3)_4Cr_2O_7$ .**

Sl. sol. in  $H_2O$ . Insol. in alcohol. Sol. in  $KOH + Aq$ . (Buckton, Chem. Soc. 5. 213.)

**— platinum cyanide,  $Pt(NH_3)_4(CN)_2, Pt(CN)_2$ .**

Sl. sol. in cold, easily in boiling  $H_2O$ ; sol. in  $KOH, HCl$ , and dil.  $H_2SO_4 + Aq$  without decomp., but conc.  $H_2SO_4$  decomposes.

**— potassium ferrocyanide,**

$Pt(NH_3)_4K_4[Fe(CN)_6]_2 + 8H_2O$ .

**— hydroxide,  $Pt(NH_3)_4OH_2$ .**

"Reiset's first base." Easily sol. in  $H_2O$ . Sl. sol. in alcohol.

**— iodide,  $Pt(NH_3)_4I_2$ .**

Sl. sol. in cold, more easily in hot  $H_2O$ , but slowly decomp. on boiling. (Reiset.)

**— nitrate,  $Pt[(NH_3)_2NO_2]_2$ .**

Sol. in about 10 pts. boiling  $H_2O$ . Insol. or but sl. sol. in alcohol (Peyrone, A. ch. (3) 12. 203.)

**— nitrate sulphate,  $[Pt(NH_3)_4NO_3]_2SO_4, Pt(NH_3)_4SO_4$ .**

Very easily sol. in  $H_2O$  (Carlgren, Sv. V. A. F. 47. 310)

**— nitrite,  $Pt[(NH_3)_2NO_2]_2 + 2H_2O$ .**

Efflorescent. Very sol. in hot or cold  $H_2O$ . Insol. in 90% alcohol (Lang.)

**— platinumous nitrite,  $Pt[(NH_3)_2NO_2]_2, Pt(NO_2)_2$ .**

Scarcely sol. in cold, somewhat more easily in hot  $H_2O$ . Not attacked by cold dil. acids. More sol. in  $NH_4OH + Aq$  than in  $H_2O$ . (Lang)

**Platodiamine phosphate**,  $\text{Pt}(\text{N}_2\text{H}_4)_2\text{HPO}_4 \cdot \text{H}_2\text{O}$

Rather difficultly sol. in cold, and very easily in hot  $\text{H}_2\text{O}$ . (Cleve.)

— **ammonium phosphate**,  $\text{Pt}(\text{N}_2\text{H}_4)_2\text{PO}_4(\text{NH}_4)_2$ ,  $4\text{NH}_4\text{H}_2\text{PO}_4 + \text{H}_2\text{O}$ .

Very easily sol. in  $\text{H}_2\text{O}$  with decomp. into—  
 $\text{Pt}(\text{N}_2\text{H}_4)_2\text{PO}_4$ ,  $2\text{NH}_4\text{H}_2\text{PO}_4 + 9\text{H}_2\text{O}$ .  
Much more sol. in  $\text{H}_2\text{O}$  than the preceding comp. (Cleve.)

— **sulphate**,  $\text{Pt}(\text{NH}_3)_4\text{SO}_4$

Sol. in 32 pts  $\text{H}_2\text{O}$  at  $16.5^\circ$ ; more easily when heated (Reiset)

Sol. in 50–60 pts boiling  $\text{H}_2\text{O}$ ; less in cold  $\text{H}_2\text{O}$ , insol. in alcohol. (Cleve.)

— **sulphate, acid**,  $\text{Pt}[(\text{NH}_3)_2\text{SO}_4\text{H}]_2 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  or alcohol into neutral salt.  
 $3\text{Pt}(\text{NH}_3)_4\text{SO}_4$ ,  $\text{H}_2\text{SO}_4 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **sulphite**,  $\text{Pt}(\text{NH}_3)_4\text{SO}_3$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . (Burnbaum, A. 152, 143)

$\text{Pt}[(\text{NH}_3)_2\text{SO}_3\text{H}]_2 + 2\text{H}_2\text{O}$ . Ppt. Sol. in  $\text{HCl} + \text{Aq}$  (Cleve.)

— **platinous sulphite**,  
 $3\text{Pt}(\text{NH}_3)_4\text{SO}_3$ ,  $\text{PtSO}_3 + 2\text{H}_2\text{O}$ .

Scarcely sol. in cold  $\text{H}_2\text{O}$ ; sol. in 190 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . Easily sol. in warm  $\text{HCl} + \text{Aq}$  with decomp. (Peyrone)

$+ 4\text{H}_2\text{O}$ . (Carlgren, Sv. V. A. F. 47, 308.)  
 $2\text{Pt}(\text{NH}_3)_4\text{SO}_3$ ,  $\text{PtSO}_3$ ,  $\text{H}_2\text{SO}_3$  Insol. in cold  $\text{H}_2\text{O}$  or alcohol. Scarcely sol. in hot  $\text{H}_2\text{O}$ . (Peyrone)

— **sulphocyanide**,  $\text{Pt}(\text{NH}_3)_4(\text{CNS})_2 + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Solution is decomp. on boiling. (Cleve, Sv. V. A. H. 10, 9, 7.)

— **platinous sulphocyanide**,  
 $\text{Pt}(\text{NH}_3)_4(\text{CNS})_2$ ,  $\text{Pt}(\text{CNS})_2$ .

Insol. in  $\text{H}_2\text{O}$  and alcohol; sol. in dil.  $\text{HCl} + \text{Aq}$  (Buckton, Chem. Soc. 13, 122.)

**Platomonodiamine chloride**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{Cl} \\ \text{NH}_3\text{Cl} \end{smallmatrix}$

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Platomonodiamine chloroplatinate**

$2\text{Pt}(\text{NH}_3)_2\text{Cl}$ ,  $\text{PtCl}_2$ .

Moderately sol. in cold, but more easily in hot  $\text{H}_2\text{O}$ . (Cleve.)

— **nitrate**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{NO}_3 \\ \text{NH}_3\text{NO}_3 \end{smallmatrix} + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Platomonodiamine sulphate**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{SO}_4 \\ \text{NH}_3 \end{smallmatrix}$

Easily sol. in cold, but much more in hot  $\text{H}_2\text{O}$ .

**Platosemidiamine bromide**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{Br} \\ \text{Br} \end{smallmatrix}$

Sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Cleve.)

— **chloride**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{Cl} \\ \text{Cl} \end{smallmatrix}$

(Peyrone's chloride) Sol. in 387 pts  $\text{H}_2\text{O}$  at  $0^\circ$ , and 26 pts at  $100^\circ$  (Cleve), in 33 pts. at  $100^\circ$ . (Peyrone)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; very sl. sol. in  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; more easily in  $\text{HNO}_3 + \text{Aq}$ , sol. in alkali carbonates +  $\text{Aq}$ . (Peyrone, A. ch (3) 12, 193)

**Platosemidiamine chlorosulphurous acid**,  
 $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{SO}_2\text{H} \\ \text{Cl} \end{smallmatrix}$

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium platosemidiamine chlorosulphite platosemidiamine sulphite**,

$\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{SO}_2\text{NH}_4 \\ \text{Cl} \end{smallmatrix}$ ,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{SO}_2\text{NH}_4 \\ \text{SO}_2\text{NH}_4 \end{smallmatrix} + 2\text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$  Insol. in alcohol. (Cleve.)

**Platosemidiamine cyanide**,

$\text{Pt}(\text{CN})(\text{NH}_3)_2\text{CN}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **platinous cyanide**,  $\text{Pt}(\text{CN})(\text{NH}_3)_2\text{CN}$ ,  
 $\text{Pt}(\text{CN})_2(?)$ .

Ppt.

— **hydroxide**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{OH} \\ \text{OH} \end{smallmatrix}$

Not known.

— **iodide**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{I} \\ \text{I} \end{smallmatrix}$

Sl. sol. in boiling  $\text{H}_2\text{O}$ . (Cleve.)

— **nitrate**  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{NO}_3 \\ \text{NO}_3 \end{smallmatrix}$

Moderately sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **nitrite**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{NO}_2 \\ \text{NO}_2 \end{smallmatrix}$

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

— **oxalate**,  $\text{Pt}(\text{NH}_3)_2\text{C}_2\text{O}_4$ .

(Cleve.)  
 $+ 2\text{H}_2\text{O}$ . (Cleve.)

— **sulphate**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2 \\ \text{SO}_4 \end{smallmatrix}$

Very sl. sol. even in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Platosemidiamine sulphocyanide,**  
 $\text{Pt}(\text{SCN})(\text{NH}_4)_2\text{SCN}.$ Easily sol. in warm  $\text{H}_2\text{O}$ , but solution soon decomposes.**Platosemidiamine sulphurous acid.****Ammonium platosemidiamine sulphite,**  
 $\text{Pt} < (\text{NH}_4)_2\text{SO}_3(\text{NH}_4), (\text{NH}_4)_2\text{SO}_3.$ Very sol. in  $\text{H}_2\text{O}$  (Cleve.)**Barium —,**  $\text{Pt}(\text{SO}_3)[(\text{NH}_4)_2\text{SO}_3]\text{Ba}, \text{BaSO}_4.$   
Ppt (Cleve.)**Silver —.**  $\text{Pt}(\text{SO}_3\text{Ag})[(\text{NH}_4)_2\text{SO}_3\text{Ag}],$   
 $\text{Ag}_2\text{SO}_4.$ 

Ppt. (Cleve.)

**Diplatodiamine chloride,**  $\text{Pt}_2(\text{NH}_4)_4\text{Cl}_2.$ Insol. in  $\text{H}_2\text{O}$ .— hydroxide,  $\text{Pt}_2(\text{NH}_4)_4(\text{OH})_2 + \text{H}_2\text{O}$ Insol. in  $\text{H}_2\text{O}$ .— nitrate,  $\text{Pt}_2(\text{NH}_4)_4(\text{NO}_3)_2$ Insol. in  $\text{H}_2\text{O}$ . (Cleve.)— sulphate,  $\text{Pt}_2(\text{NH}_4)_4\text{SO}_4$ Insol. in  $\text{H}_2\text{O}$ . (Cleve.)**Platobromonitrous acid.****Potassium platobromonitrite,**  $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Br} + 2\text{H}_2\text{O}$ Sol. in about 3 pts. cold, and 2 pts. boiling  $\text{H}_2\text{O}$ . (Vèzes, A. ch. (6) 29. 194.) $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Br}_2 + \text{H}_2\text{O}$ . Sol. in 1 pt. cold, and still less hot  $\text{H}_2\text{O}$ . Insol. in alcohol (Vèzes.)**Platochloronitrous acid.****Potassium chloronitrite,**  $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Cl} + 2\text{H}_2\text{O}$ .Sol. in about 3 pts. cold, and 2 pts. boiling  $\text{H}_2\text{O}$ . (Vèzes, A. ch. (6) 29. 178.) $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Cl}_2$ . Sol. in about 3 pts. cold, and 2 pts. boiling  $\text{H}_2\text{O}$ . (Vèzes.)**Platochlorosulphurous acid.**

See Chloroplatosulphurous acid.

**Platoiodonitrous acid,**  $\text{H}_2\text{Pt}(\text{NO}_2)_2\text{I}_2.$ 

Known only in solution (Nilson, J. pr. (2) 21. 172.)

**Aluminium platoiodonitrite,**  $\text{Al}_3[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 27\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ . (Nilson.)**Ammonium —,**  $(\text{NH}_4)_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ ; decomp on heating.**Barium platoiodonitrite,**  $\text{BaPt}(\text{NO}_2)_2\text{I}_2 + 4\text{H}_2\text{O}$ .Very sol. in  $\text{H}_2\text{O}$ **Cadmium —,**  $\text{CdPt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$ Easily sol. in  $\text{H}_2\text{O}$ .**Cæsium —,**  $\text{Cs}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$ Easily sol. in  $\text{H}_2\text{O}$ .**Calcium —,**  $\text{CaPt}(\text{NO}_2)_2\text{I}_2 + 6\text{H}_2\text{O}$ .Very easily sol. in  $\text{H}_2\text{O}$ **Cerium —,**  $\text{Ce}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 18\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ .**Cobalt —,**  $\text{CoPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ Sol. in  $\text{H}_2\text{O}$ .**Didymium —,**  $\text{Dy}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 24\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Erbium —,**  $\text{Er}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 18\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ **Ferrous —,**  $\text{FePt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ Sol. in  $\text{H}_2\text{O}$ .**Ferric —,**  $\text{Fe}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 6\text{H}_2\text{O}$ Sol. in  $\text{H}_2\text{O}$ **Lanthanum —,**  $\text{La}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 24\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Lead —, basic,**  $\text{PbPt}(\text{NO}_2)_2\text{I}_2, \text{Pb}(\text{OH})_2.$ Insol. in  $\text{H}_2\text{O}$ **Lithium —,**  $\text{Li}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 6\text{H}_2\text{O}$ .Very sol. in  $\text{H}_2\text{O}$ **Magnesium —,**  $\text{MgPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Manganese —,**  $\text{MnPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Mercurous —, basic,**  $2\text{Hg}_2\text{Pt}(\text{NO}_2)_2\text{I}_2,$   
 $\text{Hg}_2\text{O} + 9\text{H}_2\text{O}.$ Insol. in  $\text{H}_2\text{O}$ .**Nickel —,**  $\text{NiPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ Sol. in  $\text{H}_2\text{O}$ .**Potassium —,**  $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$  in all proportions.

Very sol. in alcohol.

**Rubidium —,**  $\text{Rb}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .

Silver platiodonitrite,  $\text{Ag}_2\text{Pt}(\text{NO}_2)_2\text{I}_2$ .  
Insol. in  $\text{H}_2\text{O}$

Sodium —,  $\text{Na}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 4\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$

Strontium —,  $\text{SrPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ .  
Sol in  $\text{H}_2\text{O}$

Thallium —,  $\text{Tl}_2\text{Pt}(\text{NO}_2)_2\text{I}_2$   
Insol in  $\text{H}_2\text{O}$

Yttrium —,  $\text{Y}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 27\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$

Zinc —,  $\text{ZnPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$   
Sol. in  $\text{H}_2\text{O}$ .

Triplatoctonitrosylic acid,  $\text{H}_4\text{Pt}_6\text{O}(\text{NO}_2)_8$ .  
(Nilson, J. pr. (2) 18. 241)

Potassium triplatoctonitrosylate.  
See under Platonitrite, potassium.

Platinitrous acid,  $\text{H}_2\text{Pt}(\text{NO}_2)_4$ .  
Sol. in  $\text{H}_2\text{O}$  or alcohol. (Lang J. pr 83. 419.)  
Is called "Platotetranitrosylic acid" by Nilson

Aluminum platonitrite,  $\text{Al}_2[\text{Pt}(\text{NO}_2)_4]_3 + 14\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$   
 $\text{Al}_2(\text{OH})_4[\text{Pt}(\text{NO}_2)_4]_3\text{O}_2 + 10\text{H}_2\text{O}$  Sl sol. in cold, easily in hot  $\text{H}_2\text{O}$  and alcohol (Nilson, B. 9. 1727.)

Ammonium platonitrite,  $(\text{NH}_4)_2\text{Pt}(\text{NO}_2)_4 + 2\text{H}_2\text{O}$   
Moderately sol. in cold  $\text{H}_2\text{O}$  (Nilson, B. 9. 1724.)

Barium platonitrite,  $\text{BaPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ .  
Sl. sol. in cold, very sol. in hot  $\text{H}_2\text{O}$  (Lang.)

Cadmium platonitrite,  $\text{CdPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Nilson.)

Cesium platonitrite,  $\text{Cs}_2\text{Pt}(\text{NO}_2)_4$ .  
Resembles K salt.

Calcium platonitrite,  $\text{CaPt}(\text{NO}_2)_4 + 5\text{H}_2\text{O}$ .  
Very sol in  $\text{H}_2\text{O}$ . (Nilson)

Cerium platonitrite,  $\text{Ce}_2[\text{Pt}(\text{NO}_2)_4]_3 + 18\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Nilson)

Chromium diplatonitrite,  
 $\text{Cr}_2(\text{OH})_2[\text{Pt}(\text{NO}_2)_4]_2\text{O}_2 + 24\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Nilson.)

Cobalt platonitrite,  $\text{CoPt}(\text{NO}_2)_4 + 8\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$  (Nilson)

Copper platonitrite,  $\text{CuPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$  (Nilson)  
 $3\text{CuPt}(\text{NO}_2)_4, \text{CuO} + 12\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$  (Nilson)

Didymium platonitrite,  $\text{Dy}_2[\text{Pt}(\text{NO}_2)_4]_3 + 18\text{H}_2\text{O}$ .  
Deliquescent; sol. in  $\text{H}_2\text{O}$ .

Erbium platonitrite,  $\text{Er}_2[\text{Pt}(\text{NO}_2)_4]_3 + 9, \text{ and } 21\text{H}_2\text{O}$   
Deliquescent, sol in  $\text{H}_2\text{O}$ .

Glucinum diplatonitrite,  $\text{GlPt}(\text{NO}_2)_2\text{O} + 9\text{H}_2\text{O}$ .  
Sl sol. in cold  $\text{H}_2\text{O}$ .

Indium diplatonitrite,  $\text{In}(\text{OH})_2[\text{Pt}(\text{NO}_2)_4]_2\text{O}_2 + 10\text{H}_2\text{O}$ .  
Sl sol in  $\text{H}_2\text{O}$

Ferric diplatonitrite,  $\text{Fe}_2[\text{Pt}(\text{NO}_2)_4]_2\text{O}_3 + 30\text{H}_2\text{O}$ .  
Sl sol in cold, easily in hot  $\text{H}_2\text{O}$ .

Lanthanum platonitrite,  $\text{La}_2[\text{Pt}(\text{NO}_2)_4]_3 + 18\text{H}_2\text{O}$   
Deliquescent, sol. in  $\text{H}_2\text{O}$ .

Lead platonitrite,  $\text{PbPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ . (Nilson)

Lithium platonitrite,  $\text{Li}_2\text{Pt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ .  
Sl. deliquescent, easily sol. in  $\text{H}_2\text{O}$ .

Magnesium platonitrite,  $\text{MgPt}(\text{NO}_2)_4 + 5\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ .

Manganese platonitrite,  $\text{MnPt}(\text{NO}_2)_4 + 8\text{H}_2\text{O}$   
Sol. in  $\text{H}_2\text{O}$

Mercurous platonitrite,  $\text{Hg}_2\text{Pt}(\text{NO}_2)_4, \text{Hg}_2\text{O}$ .  
Nearly insol. in  $\text{H}_2\text{O}$  (Lang, J pr 83. 415)  
 $+ \text{H}_2\text{O}$ . Nearly insol in  $\text{H}_2\text{O}$ . (Nilson.)

Nickel platonitrite,  $\text{NiPt}(\text{NO}_2)_4 + 8\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ . (Nilson.)

Potassium platonitrite,  $\text{K}_2\text{Pt}(\text{NO}_2)_4$ .  
Sol. in 27 pts  $\text{H}_2\text{O}$  at  $15^\circ$ ; more easily sol in warm  $\text{H}_2\text{O}$ . (Lang, J. pr. 83. 415)  
 $+ 2\text{H}_2\text{O}$  Efflorescent (Lang.)  
 $\text{K}_2\text{H}_2\text{Pt}_2\text{O}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ . Very sl. sol. in cold (0.01 mol. in 1 l. at  $16^\circ$ ), but very easily in hot  $\text{H}_2\text{O}$ . (Vézes, A. ch. (8) 29. 182.)  
 $\text{K}_4\text{Pt}_4\text{O}(\text{NO}_2)_8 + 2\text{H}_2\text{O}$ . Sl sol. in warm  $\text{H}_2\text{O}$ . (Nilson)

**Potassium platinitrite bromide.**

See Platibromonitrite and platobromonitrite, potassium.

**Potassium platinitrite chloride.**

See Plati- and platochloronitrite, potassium.

**Potassium platinitrite hydrogen chloride,**  
 $K_2Pt(NO_2)_4$ , HCl.

Sol. in  $H_2O$ . (Miolati, Att. Linc. Rend. 1896, (5) 5, II, 358.)

**Potassium platinitrite iodide.**

See Plati- and platiodonitrite, potassium.

**Potassium platinitrite nitrogen dioxide,**  
 $K_2Pt(NO_2)_4$ ,  $2NO_2$ .

Violently decomp. by  $H_2O$ . (Miolati, Atti Linc. Rend. 1896, (5) 5, II, 356.)

**Rubidium platinitrite,  $Rb_2(Pt)(NO_2)_4$ , and  $+2H_2O$ .**

Very slowly sol. in cold, more easily in warm  $H_2O$ . (Nilson.)

**Silver platinitrite,  $Ag_2Pt(NO_2)_4$ .**

Very sl sol. in cold, easily in hot  $H_2O$

**Silver diplatinitrite,  $Ag_2Pt_2(NO_2)_4O$** 

Insol in  $H_2O$ . (Nilson.)

**Sodium platinitrite,  $Na_2Pt(NO_2)_4$ .**

Easily sol in  $H_2O$ .

**Strontium platinitrite,  $SrPt(NO_2)_4+3H_2O$ .**

Somewhat sl. sol. in cold  $H_2O$ , but easily sol. in warm  $H_2O$ .

**Thallium platinitrite,  $Tl_2Pt(NO_2)_4$** 

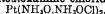
Very sl sol. in  $H_2O$ . (Nilson.)

**Yttrium platinitrite,  $Y_2[Pt(NO_2)_4]_3+9$ , or  $21H_2O$ .**

Sol. in  $H_2O$ .

**Zinc platinitrite,  $ZnPt(NO_2)_4+8H_2O$ .**

Sol. in  $H_2O$ .

**Platodioxamine chloride,**

Easily sol. in  $H_2O$ . (Alexander, A. 246. 239.)

**— chloroplatinite,  $Pt(NH_3O.NH_2OCl)_2$ ,  $PtCl_2$ .**

Sol. in warm HCl + Aq Insol. in cold  $H_2O$  or alcohol; very sl. sol. in hot  $H_2O$  (Alexander.)

**— hydroxide,  $Pt(NH_3O.NH_2O)_2(OH)_2$** 

Insol. in  $H_2O$  or alcohol Easily sol. in HCl or  $HNO_3$  + Aq. Difficultly sol. in hot dil.  $H_2SO_4$  + Aq. (Alexander.)

**Platodioxamine oxalate,**  
 $Pt(NH_3O.NH_2O)_2C_2O_4$ .

Insol in cold  $H_2O$ , alcohol, or organic acids. (Alexander)

**— phosphate,  $Pt_2(NH_3O.NH_2O)_{12}(PO_4)_2+3H_2O$** 

Ppt. (Alexander.)

**— sulphate,  $Pt(NH_3O.NH_2O)SO_4+H_2O$ .**

Sl. sol. in  $H_2O$  (Alexander.)

**Platosamine bromide,  $Pt(NH_4Br)_2$ .**

Sl. sol. even in hot  $H_2O$  (Cleve)

**— chloride,  $Pt(NH_4Cl)_2$** 

"Reiset's second chloride" Sol. in 140 pts.  $H_2O$  at  $106^\circ$  (Peyrone, A. 61. 180)

Sol in 130 pts.  $H_2O$  at  $100^\circ$ , and 4472 pts. at  $0^\circ$  (Cleve)

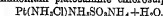
Easily sol. in  $NH_4OH$  + Aq,  $HNO_3$ , or aqua regia, with decomp. Sol. in KCN + Aq with evolution of  $NH_3$ . (Cleve)

**— ammonium chloride,  $Pt(NH_4Cl)_2$ ,  $2NH_4Cl$** 

Sl sol in cold, easily in hot  $H_2O$ ; insol. in alcohol; sol. in  $NH_4OH$  or  $(NH_4)_2CO_3$  + Aq. (Grimm, A. 99. 75)

**Platosamine chlorosulphurous acid,**

Easily sol. in  $H_2O$  without decomp (Cleve.)

**Ammonium platosamine chlorosulphite,**

Sol. in  $H_2O$ . (Peyrone, A. 61. 180.)

**Platosamine cyanide,  $Pt(NH_4CN)_2$ .**

Quite easily sol. in  $H_2O$  or  $NH_4OH$  + Aq. (Buckton)

**— hydroxide,  $Pt(NH_4OH)_2$** 

"Reiset's second base." Very sol. in  $H_2O$ . (Odling, B. 3. 685.)

**— iodide,  $Pt(NH_4I)_2$ .**

Very sl. sol. in  $H_2O$ . Sol in cold  $NH_4OH$  + Aq to form platodiamine iodide (Cleve)

**— nitrate,  $Pt(NH_4NO_3)_2$ .**

Moderately sol. in hot  $H_2O$ . Sol in  $NH_4OH$  + Aq with combination. (Reiset, A. ch. (3) 11. 26)

**— nitrite,  $Pt(NH_4NO_2)_2$** 

Very sl. sol. in cold, easily in hot  $H_2O$ . Insol in alcohol (Lang.)

**Platosamine platinous nitrite**,  $\text{Pt}(\text{NH}_2\text{NO}_2)_2$ ,  $\text{Pt}(\text{NO}_2)_2$ .

Slowly and sl. sol in cold, more easily sol in hot  $\text{H}_2\text{O}$ .

Extremely sl. sol. even in conc. acids; more sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Lang)

— oxide,  $\text{Pt}(\text{NH}_2)_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Reiset)

— oxalate,  $\text{Pt}(\text{NH}_2)_2\text{H}_2(\text{C}_2\text{O}_4)_2 + 2\text{H}_2\text{O}$   
Ppt. (Cleve.)

— sulphate,  $\text{Pt}(\text{NH}_2)_2\text{SO}_4 + \text{H}_2\text{O}$ .

Sl. sol in cold, more easily in hot  $\text{H}_2\text{O}$ .

— sulphite,  $\text{Pt}(\text{NH}_2)_2\text{SO}_3 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve)

— sulphocyanide,  $\text{Pt}(\text{NH}_2\text{SCN})_2$ .

Insol. in  $\text{H}_2\text{O}$ , can be cryst. from alcohol, not attacked by  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Buckton)

Very sol. in hot  $\text{H}_2\text{O}$  (Cleve.)

— silver sulphocyanide,

$\text{Pt}(\text{NH}_2)_2\text{Ag}_2(\text{SCN})_6$ .  
(Cleve.)

**Platosamine sulphurous acid**,

$\text{Pt}(\text{NH}_2\text{SO}_2\text{H})_2$ .

Exists only in its salts.

See **Platosamine sulphite**.

**Ammonium platosamine sulphite**,

$\text{Pt}(\text{NH}_2\text{SO}_2\text{NH}_4)_2$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol

**Barium platosamine sulphite**,

$\text{Pt}(\text{NH}_2)_2(\text{SO}_3)_2\text{Ba} + 3\text{H}_2\text{O}$ .

Ppt. (Cleve)

**Cobalt** — — —,  $\text{Pt}(\text{NH}_2)_2(\text{SO}_3)_2\text{Co} + 6\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . Sol in  $\text{HCl} + \text{Aq}$

**Copper** — — —,  $\text{Pt}(\text{NH}_2)_2(\text{SO}_3)_2\text{Cu} + 5\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$ .

**Lead** — — —,  $\text{Pt}(\text{NH}_2)_2(\text{SO}_3)_2\text{Pb} + \text{H}_2\text{O}$   
Ppt.

**Manganese** — — —,  $\text{Pt}(\text{NH}_2)_2(\text{SO}_3)_2\text{Mn} + 4\text{H}_2\text{O}$

Ppt. Sl. sol. in  $\text{H}_2\text{O}$ .

**Nickel** — — —,  $\text{Pt}(\text{NH}_2)_2(\text{SO}_3)_2\text{Ni} + 7\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ .

**Sodium platosamine sulphite**,

$\text{Pt}(\text{NH}_2\text{SO}_2\text{Na})_2 + 5\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  100 com. sat. solution at  $20^\circ$  contains 5.52 g. cryst. salt. (Haberland and Hanekop, A. 245. 235.)

**Silver** — — —,  $\text{Pt}(\text{NH}_2\text{SO}_2\text{Ag})_2 + \text{H}_2\text{O}$ .  
Ppt

**Uranyl** — — —,  $\text{Pt}(\text{NH}_2)_2(\text{SO}_3)_2\text{UO}_2 + \text{H}_2\text{O}$ .  
Ppt.

**Zinc** — — —,  $\text{Pt}(\text{NH}_2)_2(\text{SO}_3)_2\text{Zn} + 6\text{H}_2\text{O}$ .  
Ppt. Very sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Platosesemiamine potassium chloride**,

$\text{Pt}^{\text{NH}_4\text{Cl}}_{\text{Cl}}$ ,  $\text{KCl} + \text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Cossa, B. 23. 2507.)

**Platosoxamine chloride**,  $\text{Pt}^{\text{NH}_4\text{OCl}}_{\text{NH}_2\text{OCl}}$

Sol. in  $\text{H}_2\text{O}$ . Much less sol. in  $\text{H}_2\text{O}$  than platosoxamine chloride. (Alexander, A. 246. 239.)

**Platosoxamine amine chloride**,

$\text{Pt}^{\text{NH}_2\text{O.NH}_2\text{Cl}}_{\text{NH}_2\text{NH}_2\text{OCl}}$

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and conc  $\text{HCl} + \text{Aq}$ . (Alexander, A. 246. 239.)

— chloroplatinite,  $\text{Pt}^{\text{NH}_2\text{O.NH}_2\text{Cl}}_{\text{NH}_2\text{NH}_2\text{OCl}} \cdot \text{PtCl}_6$

Ppt

**Platosulphurous acid**.

**Ammonium platosulphite**,  $(\text{NH}_4)_2\text{Pt}(\text{SO}_3)_2 + 3\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  (Birnbbaum, A. 139. 170)  
 $(\text{NH}_4)_2\text{Pt}(\text{SO}_3)_2 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Liebig, Pogg. 17. 108.)

**Ammonium platosulphite chloride**,

$(\text{NH}_4)_2\text{Pt}(\text{SO}_3)_2 \cdot 2\text{NH}_4\text{Cl}$

Sol in  $\text{H}_2\text{O}$ . (Birnbbaum.)  
 $\text{PtClSO}_3\text{H} \cdot 2\text{NH}_4\text{Cl}$ . Deliquescent; sol. in  $\text{H}_2\text{O}$ . (Birnbbaum, A. 152. 143)  
See also Chloroplatosulphite, ammonium.

**Potassium platosulphite**,  $\text{K}_2\text{Pt}(\text{SO}_3)_2 + 4\text{H}_2\text{O}$

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Much more sol. than the Na salt. (Birnbbaum, A. 139. 168.)

$+ 3\text{H}_2\text{O}$  (Lang, J. pr. 83. 415.)  
 $6\text{K}_2\text{O} \cdot 2\text{PtO} \cdot 10\text{SO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Claus, J. B. 1847-48. 453)

Does not exist. (Lang)  
 $\text{K}_2\text{Pt}(\text{SO}_3)_2$ . Sol. in  $\text{H}_2\text{O}$ .

**Silver platosulphite,  $\text{Ag}_3\text{Pt}(\text{SO}_3)_4$ .**

Ppt Very sol. in cold  $\text{NH}_4\text{OH} + \text{Aq}$  (Lang J, pr. 83. 415)

**Sodium platosulphite,  $\text{Na}_4\text{Pt}(\text{SO}_3)_4$ .**

Very sl sol in cold, somewhat more easily in hot  $\text{H}_2\text{O}$ . Not decomp. by boiling  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ . Gradually sol in  $(\text{NH}_4)_2\text{S}$  or  $\text{K}_2\text{S} + \text{Aq}$ . Insol. in  $\text{NaCl} + \text{Aq}$  or alcohol (Litton and Schneidermann, A. 42. 316)

+  $1\frac{1}{2}\text{H}_2\text{O}$ .

+  $7\text{H}_2\text{O}$ .

$\text{Na}_4\text{Pt}(\text{SO}_3\text{H})_4$ . Moderately sol in  $\text{H}_2\text{O}$ . (Litton and Schneidermann)

**Platothiosulphuric acid.****Sodium platothiosulphate,  $\text{Na}_4\text{Pt}(\text{S}_2\text{O}_3)_4 + 10\text{H}_2\text{O}$ .**

Very sol in  $\text{H}_2\text{O}$  (Schottlander, A. 140. 200.)

$\text{PtS}_2\text{O}_3, 4\text{Na}_2\text{S}_2\text{O}_3 + 10\text{H}_2\text{O}$ .

$\text{PtS}_2\text{O}_3, 6\text{Na}_2\text{S}_2\text{O}_3 + 19\text{H}_2\text{O}$ .

$2\text{PtS}_2\text{O}_3, 7\text{Na}_2\text{S}_2\text{O}_3 + 18\text{H}_2\text{O}$ . (Jochem, C. C. 1886. 642.)

**Plumbic acid.****Barium plumbate,  $\text{Ba}_3\text{PbO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol in  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$ . Sol. in acids in presence of a reducing substance (Kassner, Arch Pharm 228. 109)

**Calcium plumbate.**

Insol in  $\text{H}_2\text{O}$ .  $\text{HNO}_3 + \text{Aq}$  dissolves out  $\text{CaO}$ . (Crum, A. 56. 218.)

$\text{Ca}_2\text{PbO}_4$ . Properties as  $\text{Ba}_3\text{PbO}_4$ . (Kassner, Arch Pharm. 228. 109.)

+  $4\text{H}_2\text{O}$ . Easily decomp by  $\text{HNO}_3$ . (Kassner, Arch. Pharm 1894, 232. 378)

**Calcium hydrogen plumbate,  $\text{H}_2\text{CaPb}_2\text{O}_6$ .**

Fairly stable, slowly sol. in  $\text{HNO}_3$  in the cold (Kassner.)

**Calcium lead orthoplumbate,  $\text{CaPbPbO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$   $\text{HNO}_3$ , acetic and other acids cause a separation of  $\text{PbO}_2$ . (Kassner, Arch. Pharm 1903, 241. 147)

**Copper metaplumbate,  $\text{CuPbO}_3$ .**

Decomp. by acids. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Acetic acid dissolves  $\text{Cu}$ . (Hoehnel, Arch. Pharm 1896, 234. 399.)

**Lead metaplumbate,  $\text{PbPbO}_3$ .**

Identical with lead sesquioxide. (Hoehnel, Arch. Pharm. 1896, 234. 399.)

**Manganese metaplumbate.**

Decomp. by acids. (Hoehnel, Arch. Pharm. 1896, 234. 399.)

**Potassium plumbate,  $\text{K}_2\text{PbO}_3 + 3\text{H}_2\text{O}$ .**

Very deliquescent. Decomp by pure  $\text{H}_2\text{O}$  into  $\text{PbO}_2$  and  $\text{KOH}$ . Sol in  $\text{KOH} + \text{Aq}$  without decomp. (Fremy, J Pharm (3) 3. 32.)

**Silver metaplumbate,  $\text{Ag}_3\text{PbO}_3$ .**

Ppt (Grütznar, Arch. Pharm 1895, 233. 518)

**Sodium plumbate.**

Sol in  $\text{H}_2\text{O}$  with decomposition. Sl. sol in alkalies +  $\text{Aq}$  (Fremy, A. ch (3) 12. 490)

**Sodium metaplumbate,  $\text{Na}_3\text{PbO}_3 + 4\text{H}_2\text{O}$ .**

Decomp by  $\text{H}_2\text{O}$ ; insol in alcohol. (Hoehnel, Arch Pharm 1894, 232. 224)

**Strontium plumbate,  $\text{Sr}_2\text{PbO}_4$ .**

Properties as  $\text{Ba}_3\text{PbO}_4$ . (Kassner, Arch Pharm. 228. 109.)

**Zinc metaplumbate,  $\text{ZnPbO}_3 + 2\text{H}_2\text{O}$ .**

Decomp. by dil acids; insol. in  $\text{H}_2\text{O}$ . (Hoehnel, Arch. Pharm. 1896, 234. 398.)

**Plumbous acid.****Calcium plumbite.**

Sl sol in  $\text{H}_2\text{O}$ . (Kausten, Seher J. 5. 575)

**Potassium plumbite,  $\text{PbO}, \text{K}_2\text{O}$ .**

Known only in solution.

**Silver plumbite,  $\text{Ag}_3\text{PbO}_3$ .**

Insol in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  and  $\text{KOH} + \text{Aq}$ ; sol. in  $\text{HNO}_3$  and acetic acid; and in conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HI}$ , and  $\text{HF}$ . (Bullnheimer, B 1898, 31. 1288.)

+  $2\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$ . Decomp. on air. (Kratwig, B 15. 264)

**Sodium plumbite.**

Known only in solution

**Potassium,  $\text{K}_2$ .**

Violently decomposes  $\text{H}_2\text{O}$  or alcohol. Insol in hydrocarbons. Sol. with violent action in acids.

**Solubility in fused  $\text{KOH}$  at  $t^\circ$ .**

$t^\circ$	G. K sol. in 100 g fused $\text{KOH}$
480	7.8-8.9
600	3-4
650	2-2.7
700	0.5-1.3

(Hevesy, Z. Elektrochem 1909, 15. 534.)

Sol. in liquid  $\text{NH}_3$ . (Seely, C N 23. 169); (Franklin, Am Ch J 1898, 20. 829.)  
1 gram atom of  $\text{K}$  dissolves in 4.74 mol.

liquid  $\text{NH}_3$  at  $0^\circ$ , in 4.79 mol. at  $-50^\circ$ ; in 4.82 mol at  $-100^\circ$  (Ruff, B 1903, 39. 839.)  
 Insol in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch 1906, 54. 874.)

Slowly sol in ethylene diamine Insol in ethyl amine and in secondary and tertiary amines (Kraus, J. Am Chem. Soc 1907, 29. 1561)

**Potassium acetylide,  $\text{K}_2\text{C}_2$**

(Moissan, C R 1898, 127. 917.)

**Potassium acetylide acetylene,  $\text{K}_2\text{C}_2$ ,  $\text{C}_2\text{H}_2$ .**

(Moissan, C. R. 1898, 127. 915.)

**Potassium amalgams.**

$\text{Hg}_2\text{K}$ ,  $\text{Hg}_3\text{K}$ ,  $\text{Hg}_4\text{K}$ ,  $\text{Hg}_{10}\text{K}$ ,  $\text{Hg}_{12}\text{K}$  and  $\text{Hg}_{16}\text{K}$  (Guntz, C R 1900, 131. 183)

$\text{Hg}_{12}\text{K}$  Stable up to  $0^\circ$ . Can be cryst from Hg without decomp. below  $0^\circ$

$\text{Hg}_{10}\text{K}$  Stable from  $0^\circ$  to  $71^\circ$  or  $73^\circ$  Can be cryst from Hg without decomp. at any temp. between these limits.

$\text{Hg}_3\text{K}$ . Stable from  $71^\circ$  or  $73-75^\circ$ . Can be cryst. from Hg without decomp at any temp between these limits. (Kerp, Z. anorg. 1900, 25. 68.)

**Potassium amide,  $\text{KH}_2\text{N}$ .**

Decomp by water or alcohol Insol in hydrocarbons.

**Potassium ammonickelate,  $\text{Ni}_3\text{N}_2\text{K}_4$ ,  $6\text{NH}_3$**

Decomp by  $\text{H}_2\text{O}$  Sol in liquid  $\text{NH}_3$ . (Bohart, J. phys. Chem. 1915, 19. 559)

**Potassium ammonoargentate,  $\text{AgNHK}$ ,  $\text{NH}_3$  or  $\text{AgNH}_3$ ,  $\text{KNH}_2$**

Ppt, decomp. in the air. Decomp by  $\text{H}_2\text{O}$  or by liquid  $\text{NH}_3$  solutions of acids. (Franklin, J. Am Chem. Soc. 1915, 37. 855)

**Potassium ammonobarate,  $\text{BaNHK}$ ,  $2\text{NH}_3$ .**

Hydrolyzed by  $\text{H}_2\text{O}$  Insol in liquid  $\text{NH}_3$ . Decomp. and dissolved in a solution of  $\text{NH}_4\text{NO}_3$  in liquid  $\text{NH}_3$ . (Franklin, J. Am. Chem Soc. 1915, 37. 2297.)

**Potassium ammonocadmiate,  $\text{Cd}(\text{NHK})_2$ ,  $2\text{NH}_3$**

Ppt. (Franklin, Am. Ch. J. 1912, 47. 310.)  
 $\text{Cd}(\text{NHK})_2$ ,  $2\text{NH}_3$  Decomp. by  $\text{H}_2\text{O}$ . Insol. in liquid  $\text{NH}_3$ . (Bohart, J. phys. Chem. 1915, 19. 542.)

**Potassium ammonocalciate,  $\text{CaNHK}$ ,  $2\text{NH}_3$ .**

Hydrolyzed by  $\text{H}_2\text{O}$  Readily sol. in a solution of  $\text{NH}_4\text{NO}_3$  in liquid  $\text{NH}_3$ . (Franklin, J. Am. Chem. Soc. 1915, 37. 2300.)

**Potassium ammonocuprite,  $\text{CuNHK}_2$ ,  $3\text{NH}_3$ .**

Very sol in liquid  $\text{NH}_3$ .

$\text{CuNHK}_2$ ,  $2\text{NH}_3$ .

$\text{CuNHK}_2$ ,  $\text{NH}_3$ . (Franklin, J. Am. Chem. Soc. 1912, 34. 1503)

$\text{CuNHK}_2$ ,  $2\frac{1}{2}\text{NH}_3$ . Ppt (Franklin, Am. Ch J. 1912, 47. 311.)

**Potassium ammonomagnesate,  $\text{Mg}(\text{NHK})_2$ ,  $2\text{NH}_3$**

Sl. sol in liquid  $\text{NH}_3$ . Rapidly hydrolyzed by  $\text{H}_2\text{O}$ . (Franklin, J. Am. Chem. Soc. 1913, 35. 1463)

**Potassium ammonoplumbite,  $\text{PbNHK}$ ,  $2\frac{1}{2}\text{NH}_3$ .**

Completely hydrolyzed by action of water vapor Violently decomp. by  $\text{H}_2\text{O}$  or dil. acids Sol. in liquid  $\text{NH}_3$ . (Franklin, J. phys Chem. 1911, 15. 519.)

**Potassium ammonostannate,  $\text{Sn}(\text{NHK})_2$ ,  $4\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  Readily sol. in  $\text{HCl} + \text{Aq}$  Sl. sol. in liquid  $\text{NH}_3$ . Readily sol. in a solution of  $\text{NH}_4\text{I}$  in liquid  $\text{NH}_3$ . (Fitzgerald, J. Am. Chem. Soc. 1907, 29. 1696.)

**Potassium ammonostrontiate,  $\text{SrNHK}$ ,  $2\text{NH}_3$ .**

Hydrolyzed vigorously by  $\text{H}_2\text{O}$ . Sol. in solutions of  $\text{NH}_4\text{NO}_3$  in liquid  $\text{NH}_3$  Insol. in liquid  $\text{NH}_3$ . (Franklin, J. Am Chem. Soc. 1915, 37. 2299.)

**Potassium ammonothallate,  $\text{TlNHK}$ ,  $4\text{NH}_3$**

Sensitive to action of air or moisture. Violently decomp by  $\text{H}_2\text{O}$  or dil. acids. Moderately sol. in liquid  $\text{NH}_3$  at  $20^\circ$ , more sol. at higher temp. and much less sol at lower temp. Decomp. by liquid  $\text{NH}_3$  solutions of acids. (Franklin, J. phys. Chem. 1912, 16. 689.)

**Potassium ammonotitanate,  $(\text{N}) \text{TiNHK}$ .**

Vigorously hydrolyzed by  $\text{H}_2\text{O}$ . Insol. in liquid  $\text{NH}_3$  solutions of either potassium amide or  $\text{NH}_4\text{Br}$  (Franklin, J. Am. Chem. Soc 1912, 34. 1500)

**Potassium ammonozincate,  $\text{Zn}(\text{NHK})_2$ ,  $2\text{NH}_3$ .**

Decomp. by water. Sl. sol. in liquid  $\text{NH}_3$ . (Fitzgerald, J. Am Chem. Soc. 1907, 29. 663.)  
 Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids. Sl. sol. in liquid  $\text{NH}_3$ . Sol. in solutions of ammonium salts in liquid  $\text{NH}_3$ . (Franklin, Z. anorg. 1907, 55. 195.)

**Potassium arsenide,  $\text{K}_3\text{As}$ .**

(Hugot, C. R. 1899, 129. 604.)

$\text{K}_2\text{As}_4$ . (Hugot.)

**Potassium arsenide, ammonia,  $\text{AsK}_3$ ,  $\text{NH}_3$ .**

Nearly insol. in liquid  $\text{NH}_3$ . (Hugot.)

$\text{K}_2\text{As}_4$ ,  $\text{NH}_3$ . (Hugot.)

Potassium azoimide,  $\text{KN}_3$ .

Stable in aq. solution.

48.5 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $10.5^\circ$ .48.9 " " " " 100 "  $\text{H}_2\text{O}$  " 15.5.49.6 " " " " 100 "  $\text{H}_2\text{O}$  " 17.0.1375 " " " " 100 " abs. alcohol at  $16^\circ$ .

Insol. in pure ether. (Curtius, J pr 1898, (2) 68, 280.)

## Potassium bromide, KBr.

Solubility of KBr in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. KBr	$t^\circ$	Pts. KBr
0	53.48	60	85.35
20	64.52	80	93.46
40	74.63	100	102.0

(Kremers, Pogg. 97, 151.)

Solubility of KBr in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. KBr	$t^\circ$	Pts. KBr
-13.4	46.17	43.15	77.0
-6.2	49.57	45.45	77.73
0	53.32	50.5	80.33
+3.4	55.60	54.8	82.78
5.2	56.63	60.15	85.37
12.65	61.03	66.75	88.22
13.0	61.17	71.45	90.69
13.3	61.45	74.85	92.25
18.3	64.11	86.5	97.28
26.05	68.31	97.9	102.9
30.0	70.35	110.0	110.3
37.9	74.46		..

Solubility is represented by a straight line of the formula  $54.43 + 0.5128t$ . (Coppet, A. ch. (5) 30, 416.)100 pts.  $\text{KBr} + \text{Aq}$  sat. at  $15-16^\circ$  contain 39.08 pts. KBr (v. Hauer, J pr. 98, 137.)Solubility of KBr in 100 pts.  $\text{H}_2\text{O}$  at high temp.

$t^\circ$	Pts. KBr
140	120.9
181	145.6

(Tilden and Shenstone, Phil. Trans. 1884, 23.)

Sat. solution boils at  $112^\circ$ . (Kremers)Sat.  $\text{KBr} + \text{Aq}$  contains at:

$-12^\circ$	$-10^\circ$	$+3^\circ$	$32^\circ$	$39^\circ$
31.0	31.5	35.7	41.6	47.7% KBr,
55°	77°	140°	173°	220°
45.5	48.7	54.1	58.5	61.6% KBr.

(Etard, A. ch. 1894, (7) 2, 539.)

If solubility  $S = \text{pts. KBr in 100 pts. solution}$ ,  $S = 34.5 + 0.2420t$  from  $0^\circ$  to  $40^\circ$ ,  $S =$  $41.5 + 0.1378t$  from  $30^\circ$  to  $120^\circ$ . (Etard, C R 98, 1432.)Solubility of KBr in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. KBr	$t^\circ$	G. KBr.
10.5	62.1	-11	44.9
10	60.7	-10.5	41.8
3.5	55.5	-10	39.7
0	52.6	-8.5	35.7
-5	50.1	-8	31.2
-8	47.5	-6.5	25.0
-11.5	45.3		..

(Meusser, Z. anorg. 1905, 44, 80.)

68.74 g. KBr are sol in 100 g.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Amadori and Pampanini, Rend. Ac. Linc. 1911, V, 20, 473.)Sp. gr. of  $\text{KBr} + \text{Aq}$  at  $19^\circ$ .

% KBr	Sp. gr.	% KBr	Sp. gr.
5	1.037	30	1.256
10	1.075	35	1.309
15	1.116	40	1.366
20	1.159	45	1.432
25	1.207		

(Gerlach, Z. anal. 8, 285.)

Sp. gr. of  $\text{KBr} + \text{Aq}$  at  $15^\circ$  containing:

5	10	20	30	36% KBr
1.0357	1.074	1.1533	1.2553	1.3198

(Kohlrausch, W. Ann. 1879, 1.)

Sp. gr. of  $\text{KBr} + \text{Aq}$  at  $t^\circ$ .

G. KBr dissolved in 100 g. $\text{H}_2\text{O}$	G. KBr in 100 g of the solution	$t^\circ$	Sp. gr.
4.106	4	14.5	1.0291
11.111	10	15.7	1.0753
25.000	20	16.5	1.1625
42.867	30	16.0	1.2580

(de Lannoy, Z. phys. Ch. 1895, 18, 460.)

 $\text{KBr} + \text{Aq}$  containing 6.99% KBr has sp. gr.  $20^\circ/20^\circ = 1.0521$ . (Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 278.)Sp. gr. of  $\text{KBr} + \text{Aq}$  at  $20.5^\circ$ .

Normality of $\text{KBr} + \text{Aq}$ .	G. KBr in 100 g of solution	Sp. gr. $t^\circ/4^\circ$
4.29	37.97	1.3449
3.01	28.83	1.2407
2.00	20.49	1.1629
1.00	11.03	1.0815

(Oppenheimer, Z. phys. Ch. 1898, 27, 452.)

Solubility of  $\text{KBr} + \text{NH}_4\text{Br}$  at  $25^\circ$ .

% KBr	% $\text{NH}_4\text{Br}$	Sp gr
55.81	0.0	1.3750
55.42	0.64	1.3745
53.65	2.46	1.3733
51.68	5.13	1.3721
44.12	15.29	1.3711
34.73	26.22	1.3715
26.23	34.76	1.3753
26.03	38.14	1.3753
23.22	41.78	1.3766
22.23	43.25	1.3777
17.99	48.08	1.3766
0.0	57.73	1.3763

(Fock, Z. Kryst. Min. 1897, 28. 357.)

Solubility in  $\text{KNO}_3 + \text{Aq.}$ 

1 litre of the solution contains

at $14.5^\circ$		at $25.2^\circ$	
Mol. $\text{KNO}_3$	Mol. KBr	Mol. $\text{KNO}_3$	Mol. KBr
0.0	4.332	0.0	4.761
0.362	4.156	0.131	4.72
0.706	4.093	0.527	4.61
1.235	3.939	0.721	4.54
		1.090	4.475
		1.170	4.44
		1.504	4.375

(Touren, C. R. 1900, 130. 911.)

See also under  $\text{KNO}_3$ .

100 pts.  $\text{KBr} + \text{KCl} + \text{Aq}$  sat at  $15-16^\circ$  contain 37.55 pts. of the two salts; 10.0 pts.  $\text{KBr} + \text{KI} + \text{Aq}$  sat. at  $15-16^\circ$  contain 57.96 pts. of the two salts; 100 pts.  $\text{KBr} + \text{KCl} + \text{KI} + \text{Aq}$  sat. at  $15-18^\circ$  contain 67.88 pts. of the three salts. (v. Hauer, J. pr. 98. 137.)

Solubility of  $\text{KBr} + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

% KBr	% KCl	Sp gr.
55.81	0.00	1.3756
53.15	2.34	1.3700
50.36	4.66	1.3648
45.46	8.26	1.3544
37.96	13.66	1.3320
32.48	16.69	1.3119
21.80	21.39	1.2689
14.07	25.09	1.2455
4.75	29.17	1.1977
0.00	31.13	1.1756

(Fock, Z. Kryst. Min. 1897, 28. 357.)

Solubility of  $\text{KBr} + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Sat. solution contains		
	% KCl	% KBr	% total salt
-14	10.7	18.8	29.5
-13.7			29.4
-13.5			29.5
-7	10.7	19.8	30.5
+5.2			34.4
+6	11.3	22.6	33.9
10	11.0	23.7	34.7
21	10.8		35.3
26	11.2	25.5	36.7
30			39.4
32	11.9	26.6	38.5
39			39.8
47	11.0	30.8	41.8
52	11.0	31.2	42.2
55	11.9	29.9	41.8
71	12.0	31.7	43.7
73	11.8	32.9	44.7
102	12.8	35.8	48.6
152	13.2	40.6	53.8
160	12.5	42.3	54.8
168			55.0
225	14.7	45.0	59.7

(Étard, A. ch. 1894, (7) 3. 281.)

Solubility of  $\text{KBr} + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .G per 100 g  $\text{H}_2\text{O}$ 

KBr	KCl
68.47	0.0
62.26	5.43
58.50	8.46
52.45	12.48
45.42	17.17
38.70	21.23
26.62	25.88
12.94	31.02
0.0	36.12

(Amadori and Pampanini, Att. Acc. Line. 1911, 20, II. 475.)

Solubility in  $\text{KCl} + \text{Aq}$  at  $25^\circ$ .

1 litre of the solution contains

Mol. KCl	Mol. KBr
0.0	4.761
0.67	4.22
0.81	4.15
1.35	3.70
1.48	3.54
1.61	3.42
1.70	3.34
2.46	2.60
3.775	0.525

(Touren, C. R. 1900, 130. 1252.)

See also under KCl.

By repeatedly heating KBr+Aq sat. at 15-16° with KI and cooling to 15°, nearly all the KBr can be separated (v. Hauer)

100 pts H<sub>2</sub>O sat. with KBr at 16° dissolve 13.15 pts KI, but on addition of more KI, KBr is pptd. (van Melekebeke, C. C. 1872. 580)

### Solubility in KI+Aq at t°.

t°	Sat. solution contains		
	% KBr	% KI	% total salt
-22	8.3	42.6	50.9
-19	9.5	42.8	52.3
-6	9.3	44.7	54.0
-1.5	.	.	55.3
+3	10.3	45.9	56.2
13.6	10.1	46.2	55.9
25	10.8	48.0	58.8
44.2	11.1	50.1	61.2
51	12.1	50.0	62.1
66	10.8	53.1	63.9
70	11.6	51.9	63.5
80	12.3	52.5	64.8
93	13.0	53.7	66.7
116	13.2	54.6	67.8
125	13.7	54.8	68.5
150	15.1	55.1	70.2
175	16.0	57.2	73.2
175	.	.	72.7
195	16.7	56.5	73.2
220	17.6	57.0	74.6

(Etard, A. ch 1894, (7) 3 279.)

### Solubility of KBr+KI in H<sub>2</sub>O at 25°.

G per 100 g. H <sub>2</sub> O	
KBr	KI
53.21	35.92
42.32	66.63
34.14	95.36
30.08	119.59
29.62	119
22.15	127.10
21.88	127.31
18.54	130.61
0.0	149.26

(Amadori and Pampanini, Att. Acc. Linc. 1911, 20, II. 475.)

### Solubility of KBr in KOH+Aq.

G. per 1000 g H <sub>2</sub> O		G per 1000 g H <sub>2</sub> O	
KOH	KBr	KOH	KBr
36.4	558.4	277.6	248.1
113.5	433.6	434.7	137.1
177.2	358.1	579.6	64.8
231.1	251.2	806.9	33.4

(Ditte, C. R. 1897, 124. 30.)

Sol in Br<sub>2</sub> at 15°. (Walden, Z. anorg. 1900, 25. 220)

Moderately sol. in liquid NH<sub>3</sub>. (Franklin, Am Ch J 1898, 20. 829)

Sol. in liquid NH<sub>3</sub>. 45 pts are sol. in 100 pts. liquid NH<sub>3</sub> at -50°. (Joannis, C. R. 1905, 140. 1244.)

Attacked by liquid NO<sub>2</sub> with liberation of Br<sub>2</sub>. (Frankland, Chem Soc. 1901, 79. 1361.)

Insol in liquid CO<sub>2</sub>. (Büchner, Z. phys. Ch 1906, 54. 674.)

Sol in SO<sub>2</sub>. (Walden, Z. anorg 1900, 25. 217)

Sol. in SO<sub>2</sub>Cl(OH). (Walden, Z. anorg. 1902, 29. 382)

Difficultly sol. in AsBr<sub>3</sub>. (Walden, Z anorg 1902, 29. 374.)

Sol in SbCl<sub>3</sub>. (Walden, Z anorg. 1900, 25. 220.)

Sol. in liquid SO<sub>2</sub>. (Walden, Z. anorg 1902, 30. 160)

Hydrazine dissolves 56.4 pts KBr at 12.5-13°. (de Bruyn, R. t. c 1899, 18. 297)

Sl. sol. in alcohol (Ballard.)

Sol. in 200 pts cold, and 16 pts boiling 80% alcohol

Sol in 180 pts 90% alcohol. (Hager)

Sol. in 750 pts abs. alcohol at 15°. (Eder, Dingl. 221. 89)

100 pts absolute methyl alcohol dissolve 1.51 pts. at 25°, 100 pts absolute ethyl alcohol dissolve 0.13 pt. at 25° (de Bruyn, Z. phys. Ch. 10. 783.)

### Solubility of KBr in methyl alcohol+Aq at 25°.

P = % by wt. of alcohol in alcohol+Aq.  
S = Sp. gr. of alcohol+Aq sat. with KBr  
L = millimols KBr in 100 cc. of the solution.

P	S 25°/4°	L
0	1.3797	471
10.6	1.300	389
30.8	1.159	252
47.1	1.058	162
64.0	0.9801	87
78.1	0.8906	44
98.9	0.8411	23
100	0.8047	14.2

(Herz and Anders, Z. anorg. 1907, 55. 273.)

100 g. KBr+CH<sub>3</sub>OH contain 0.2 g. KBr at the critical temp. (Centnerszwer, Z. phys. Ch 1910, 72. 437.)

## Solubility of KBr in ethyl alcohol + Aq

Wt % alcohol	Temp = 30°		Temp = 40°	
	G KBr per 100 g		G KBr per 100 g.	
	Solution	Solvent	Solution	Solvent
0	41.62	71.30	43.40	76.65
5	38.98	67.25	40.85	72.70
10	36.33	63.40	38.37	69.00
20	31.09	56.40	33.27	62.30
30	25.98	50.15	28.32	56.45
40	21.24	44.95	23.22	50.46
50	16.27	38.85	18.11	44.25
60	11.50	32.50	13.02	37.40
70	6.90	24.70	7.98	28.90
80	3.09	15.95	3.65	18.95
90	0.87	8.80	1.03	10.45

(Taylor, J. phys. Ch. 1896, 1. 724.)

At room temp., 1 pt. KBr by weight is sol. in:

 52 pts. methyl alcohol, D<sup>15</sup> 0.7990  
 350 " ethyl " D<sup>15</sup> 0.8100.  
 1818 " propyl " D<sup>15</sup> 0.8160

(Rohland, Z. anorg. 1898, 18. 325.)

## Solubility of KBr in ethyl alcohol at 0°

Cons. of alcohol in mol. g. per l H <sub>2</sub> O	G KBr in 1 l H <sub>2</sub> O	Mol. solubility
—	536.75	4.51
1/4	529.25	4.45
1/2	502.85	4.22
1	491.75	4.13
2	455.25	3.82

 (Armstrong and Eyre, Proc. R. Soc. 1910,  
 [A] 84. 127.)

 100 g. methyl alcohol dissolve 2.17 g KBr  
 at 25°.

 100 g. ethyl alcohol dissolve 0.142 g. KBr  
 at 25°.

 100 g. propyl alcohol dissolve 0.035 g KBr  
 at 25°.

 100 g. isoamyl alcohol dissolve 0.003 g KBr  
 at 25°.

 (Turner and Bissett, Chem. Soc. 1913, 103,  
 1909.)

 0.055 g. is sol. in 100 g propyl alcohol  
 (Schlamp, Z. phys. Ch. 1894, 14. 276.)

 Sol. in 5000 pts. ether (sp. gr. 0.729 at 15°).  
 (Eder, l. c.)

 Sol. in 1700 pts. alcohol-ether (1:1) at 15°  
 (Eder, l. c.)

 100 pts. acetone dissolve 0.023 pt. KBr at  
 25°. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

## Solubility of KBr in acetone + Aq at 25°

 A = cc. acetone in 100 cc. acetone + Aq.  
 KBr = millimols KBr in 100 cc. of the  
 solution.

A	KBr	Sp. gr
0	481.3	1.3793
20	366.7	1.2688
30	310.5	1.2118
40	259.0	1.1558
50	202.9	1.0918
60	144.9	1.0275
70	95.3	0.9591
80	46.5	0.89415
90	10.1	0.8340

(Herz and Knoch, Z. anorg. 1905, 45. 282.)

## Solubility of KBr in glycerine + Aq at 25°

 G = g. glycerine in 100 g glycerine + Aq  
 KBr = millimols KBr in 100 cc. of the solution.

G	KBr	Sp. gr
0	481.3	1.3793
13.28	444.3	1.3704
25.98	404.0	1.3655
45.36	340.5	1.3594
54.23	310.4	1.3580
83.84	219.25	1.3603
100	172.65	1.3691

(Herz and Knoch, Z. anorg. 1905, 45. 287.)

 100 g. 95% formic acid dissolve 23.2 g.  
 KBr at 18.5°. (Aschan, Chem. Ztg. 1913, 37.  
 1117.)

 Insol. in methyl acetate. (Naumann, B.  
 1909, 42. 3790), ethyl acetate (Naumann,  
 B. 1904, 37. 3801.)

 Insol. in benzonitrile (Naumann, B.  
 1914, 47. 1370.)

 100 ccm. of a sat. solution of KBr in fur-  
 fural at 25° contain 0.139 pts by wt KBr.  
 (Walden, Z. phys. Ch. 1906, 55. 713.)

 Insol. in CS<sub>2</sub>. (Arcowski, Z. anorg. 1894,  
 6. 257.)

Potassium rhodium bromide.

See Bromorhodite, potassium.

Potassium ruthenium tribromide.

See Bromoruthenite, potassium.

Potassium ruthenium tetrabromide.

See Bromoruthenate, potassium.

Potassium selenium bromide.

See Bromoselenate, potassium.

**Potassium tellurium bromide.**

See Bromotellurate, potassium.

**Potassium thallic bromide,  $\text{KBr}$ ,  $\text{TlBr}_3 + 2\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ .  
 $3\text{KBr}$ ,  $2\text{TlBr}_3 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ram-  
melsberg)**Potassium thorium bromide.**Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)**Potassium tin (stannous) bromide,  $\text{KBr}$ ,  $\text{SnBr}_2 + \text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Benas, C. C. 1884. 958.)  
Can be recryst. from  $\text{HBr}$  or  $\text{KBr} + \text{Aq}$ .  
(Richardson, Am. Ch. J. 14. 95.)  
 $2\text{KBr}$ ,  $\text{SnBr}_2 + 2\text{H}_2\text{O}$ . Cannot be recryst.  
from  $\text{HBr} + \text{Aq}$  (Richardson.)**Potassium tin (stannic) bromide,  $2\text{KBr}$ ,  $\text{SnBr}_4$ .**

See Bromostannate, potassium.

**Potassium uranous bromide,  $\text{KUBr}_2$ .**Very sol. in  $\text{H}_2\text{O}$ . (Aloy, Bull. Soc. 1899,  
(3) 21. 264.)**Potassium uranyl bromide,  $2\text{KBr}$ ,  $\text{UO}_2\text{Br}_2 + 2\text{H}_2\text{O}$ .**Very easily sol. in  $\text{H}_2\text{O}$  (Sendtner)**Potassium zinc bromide,  $\text{KBr}$ ,  $\text{ZnBr}_2 + 2\text{H}_2\text{O}$ .**Not hygroscopic (Ephraim, Z anorg  
1903, 59. 60.) $2\text{KBr}$ ,  $\text{ZnBr}_2 + 2\text{H}_2\text{O}$ . Not hygroscopic.  
(Ephraim)**Potassium bromide ammonia,  $\text{KBr}$ ,  $4\text{NH}_3$ .**

(Joannis, C. R. 1905, 140. 1244.)

**Potassium bromide ruthenium dihydronitro-  
sochloride,  $(\text{NO})\text{Ru}_2\text{H}_2\text{Cl}_2$ ,  $2\text{HCl}$ ,  $3\text{KBr}$ .**Ppt Sl. sol. in  $\text{H}_2\text{O}$  (Brizard, A. ch  
1900, (7) 21. 359)**Potassium bromide,  $\text{KBr}_2\text{I}$ .**Decomp. rapidly on air. (Wells and  
Wheeler, Sill Am J. 143. 475)**Potassium carbonyl,  $\text{K}_2\text{C}_2\text{O}_2$ .**Decomp. by  $\text{H}_2\text{O}$  with explosion. (Joannis,  
C. R. 116. 158.)**Potassium chloride,  $\text{KCl}$ .**Sol. in  $\text{H}_2\text{O}$  with absorption of heat  
30 pts.  $\text{KCl} + 100$  pts.  $\text{H}_2\text{O}$  at  $13.2^\circ$  lower  
the temp.  $12.6^\circ$  (Rüdorff, B. 2. 68.)100 pts.  $\text{H}_2\text{O}$  dissolve 29.31 pts.  $\text{KCl}$  at  $0^\circ$ .  
(Gay-Lussac); 28.5 pts.  $\text{KCl}$  at  $0^\circ$  (Mulder;  
Gerardin.)The saturated solution contains 58.5%, and  
boils at  $107.6^\circ$  (Mulder), contains 59.40%, and  
boils at  $108.3^\circ$  (Legrand), contains 59.26%,  
and boils at  $109.6^\circ$  (Gay-Lussac); boils at  
 $110^\circ$ . (Kremers.)Sol. in 3.016 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach); in  
3.03 pts. at  $17.5^\circ$  or 100 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  dis-  
solve 33 pts  $\text{KCl}$ . (Schiff.)100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts  $\text{KCl}$ :

$t^\circ$	Pts $\text{KCl}$	$t^\circ$	Pts $\text{KCl}$	$t^\circ$	Pts $\text{KCl}$
0	29.21	52.39	43.89	109.60	59.26
10.35	34.53	79.58	50.93	...	...

(Gay-Lussac, A. ch. (2) 11. 308.)

100 pts  $\text{H}_2\text{O}$  dissolve 34.8 pts  $\text{KCl}$  at  $11.8^\circ$ , 34.9  
pts at  $13.8^\circ$ ; 35 pts at  $15.6^\circ$ . (Kopp)100 pts  $\text{H}_2\text{O}$  at  $17.5^\circ$  dissolve 33.24 pts  $\text{KCl}$ , and  
sp gr. of solution is 1.635. (Karsten.)100 pts  $\text{H}_2\text{O}$  at  $12^\circ$  dissolve 32 pts., and at  $100^\circ$ , 59.4  
pts. (Otto Graham)Sol. in 3 pts.  $\text{H}_2\text{O}$  at ord. temp., and 3 pts. boiling  
 $\text{H}_2\text{O}$  (Bergmann), in 3.33 pts. hot or cold  $\text{H}_2\text{O}$  (Four-  
croy), in 3 pts. at  $15^\circ$ , and 1.68 pts. at  $110^\circ$  (M. R. and  
P.)Sol. in 3.5 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , and in less than 1 pt. hot  
 $\text{H}_2\text{O}$  (Schubarth), 109 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  dissolve 30.7-  
33.0 pts.  $\text{KCl}$  (Ore's Dist.).100 pts.  $\text{H}_2\text{O}$  dissolve 35.405 pts.  $\text{KCl}$  at  $15^\circ$ , and  
solution has sp gr. = 1.1803 (Michel and Kraft, A.  
ch. (3) 41. 478)100 pts  $\text{H}_2\text{O}$  dissolve at:

18° 30° 40° 57°

33.6 37.8 40.1 45.0 pts.  $\text{KCl}$ .

(Gerardin, A. ch. (4) 5. 139.)

100 pts.  $\text{H}_2\text{O}$  dissolve 33.06-32.08 pts  $\text{KCl}$   
at  $15.6^\circ$  and sp gr. of solution = 1.171. (Page  
and Keightley, Chem. Soc. (2) 10. 566.)Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{KCl}$	$t^\circ$	Pts $\text{KCl}$	$t^\circ$	Pts $\text{KCl}$
0	28.5	17	33.9	34	38.5
1	28.7	18	34.2	35	38.7
2	29.0	19	34.4	36	39.0
3	29.3	20	34.7	37	39.3
4	29.5	21	35.0	38	39.6
5	30.0	22	35.3	39	39.9
6	30.5	23	35.5	40	40.1
7	31.0	24	35.8	41	40.3
8	31.5	25	36.1	42	40.6
9	31.7	26	36.4	43	40.9
10	32.0	27	36.6	44	41.2
11	32.3	28	36.9	45	41.5
12	32.5	29	37.2	46	41.7
13	32.8	30	37.4	47	42.0
14	33.1	31	37.7	48	42.3
15	33.4	32	38.0	49	42.5
16	33.6	33	38.2	50	42.8

## Solubility in 100 pts., etc.—Continued.

t°	Pts KCl	t°	Pts KCl	t°	Pts KCl
51	43.1	71	48.5	91	54.1
52	43.4	72	48.8	92	54.4
53	43.6	73	49.1	93	54.6
54	43.9	74	49.4	94	54.9
55	44.2	75	49.6	95	55.2
56	44.4	76	49.9	96	55.5
57	44.7	77	50.2	97	55.7
58	44.9	78	50.5	98	56.0
59	45.2	79	50.8	99	56.3
60	45.5	80	51.0	100	56.6
61	45.8	81	51.3	101	56.9
62	46.1	82	51.5	102	57.2
63	46.3	83	51.8	103	57.4
64	46.6	84	52.1	104	57.7
65	46.9	85	52.4	105	58.0
66	47.2	86	52.6	106	58.2
67	47.5	87	52.9	107	58.5
68	47.7	88	53.2	107.65	58.5
69	48.0	89	53.5		
70	48.3	90	53.8		

(Mulder, calculated from his own and other observations, Scheik Verhand. 1864. 41.)

Solubility in 100 pts H<sub>2</sub>O at t°.

t°	Pts KCl	t°	Pts KCl	t°	Pts KCl
-11°	24.46	25.7	36.10	64.95	47.17
-6.4	25.78	29.25	37.31	71.65	48.76
0	27.9	33.0	39.71	74.25	49.27
+3.9	29.37	41.45	40.67	80.75	51.24
9.4	30.84	46.15	42.34	86.6	52.53
14.4	32.19	48.8	42.86	91.4	53.49
14.95	32.66	55.1	44.51		
19.0	34.32	60.55	45.90		

(Coppet, A. ch (5) 30. 414.)

Solubility is represented by a straight line, of which the formula is  $28.51 + 0.2837t$  (Coppet.)

100 pts H<sub>2</sub>O dissolve 29.33 pts KCl at 4°, 45.5 pts. at 60° (Andree, J. pr. (2) 29. 456.)

100 pts H<sub>2</sub>O dissolve at.

0° 100° 130° 180°

29.2 56.5 66 78 pts KCl

(Tilden and Shenstone, Lond. R. Soc. Proc. 35. 345.)

Solubility of KCl in 100 pts H<sub>2</sub>O at high temp

t°	Pts KCl	t°	Pts KCl	t°	Pts KCl
125	59.6	147	70.8	180	77.5
133	69.3	175	75.2		

(Tilden and Shenstone, Phil. Trans. 1884. 23.)

If solubility S = pts. KCl in 100 pts. solution,  $S = 20.5 + 0.1445t$  from -90° to 110°. (Étard, C. R. 98. 1432.)

Sat. KCl + Aq contains at:

142° 150° 175° 180°  
38.6 38.8 41.2 41.8% KCl.

190° 200° 242° 732° (mpt.)  
43.2 42.9 47.6 100% KCl

(Étard, A. ch 1894, (7) 2. 256.)

100 g H<sub>2</sub>O dissolve 0.488 gram-equivalent KCl at 25°. (van't Hoff and Meyerhoffer, Z. phys. Ch. 1904, 49. 315.)

Solubility of KCl in H<sub>2</sub>O at t°.

G KCl per 100 G H <sub>2</sub> O		
t°	KCl	Sp. gr.
0 70	28.29	1.1540
19.55	34.37	1.1738
32.80	38.32	1.1839
59.85	45.84	1.1980
74.80	49.58	1.2032
89.45	53.38	1.2069
108.0°	58.11	1.2118

\* Bpt. of sat. solution.

(Berkeley, Phil. Trans. Roy. Soc. 1904, 203, A. 189.)

Solubility of KCl in 100 g. H<sub>2</sub>O at t°.

t°	g. KCl	t°	g. KCl
+18.5	33.3	-4.5	25.9
11.5	31.2	-9	23.9
10	30.8	-8.5	21.5
7.5	29.8	-8	20.0
2.5	28.4	-7	17.5
0	27.5	-6	15.7
-1	27.2	-5.5	14.3

(Meusser, Z. anorg. 1905, 44. 80.)

Sat. KCl + Aq at 25° contains 26.46% KCl (Foote, Am. Ch. J. 1906, 35. 238.)

28.01 g KCl are contained in 100 g. solution sat. at 30°. (de Waal, Dissert. 1910.)

36.12 g KCl are sol in 100 g. H<sub>2</sub>O at 25°. (Amadori and Pampaloni, Rend. Acc. Linc. 1911, V. 20. 473.)

4.272 g. mol. are contained in 1 l. solution sat. at 25°. (Herz Z. anorg. 1911, 73. 274.)

Solubility of KBr at 6° = 23.06%; 28.4° = 26.91%; 62.6° = 31.57° (Süss, Z. Krist. 1912, 51. 262.)

Solubility at 22° = 25.68%. (Brönstedt, Z. phys. Ch. 1912, 80. 208.)

100 mol. H<sub>2</sub>O dissolve at:

19.3° 29.7° 40.1° 54.5°  
8.2 8.99 9.75 10.39 mol. KCl.

(Sudhaus, Minn. Jahrb. Beil.-Bd. 1914, 37. 18.)

KCl+Aq sat at 16° has sp. gr.=1.077.  
(Stolba, J pr 97. 503.)

Sp. gr. of KCl+Aq at 17 5°.

% KCl	Sp gr.	% KCl	Sp gr.	% KCl	Sp gr.
1	1 0062	9	1 0586	17	1.1152
2	1 0125	10	1.0655	18	1 1225
3	1 0189	11	1 0725	19	1.1298
4	1 0254	12	1 0795	20	1 1372
5	1 0319	13	1 0866	21	1 1446
6	1 0385	14	1 0937	22	1 1521
7	1 0451	15	1.1008	23	1 1596
8	1 0518	16	1 1080	24	1.1673

(Schiff, A. 110. 76)

Sp gr of KCl+Aq at 19 5°

% KCl	Sp. gr	% KCl	Sp gr
5 98	1 0382	21 31	1 1436
11 27	1 0733	25 133	1 1720
16 27	1 1075		

(Kremers, Pogg 95. 119.)

Sp. gr. of KCl+Aq at 15°.

% KCl	Sp gr	% KCl	Sp gr	% KCl	Sp gr
1	1 00650	10	1 06580	19	1.12894
2	1 01300	11	1.07271	20	1.13608
3	1 01950	12	1 07962	21	1.14348
4	1 02600	13	1 08654	22	1.15088
5	1 03250	14	1 09345	23	1 15828
6	1.03916	15	1 10036	24	1.16568
7	1 04582	16	1 10750	24 9*	1.17234
8	1 05248	17	1 11465		..
9	1 05914	18	1 12179		

\* Mother liquor.

(Gerlach, Z. anal. 8 281.)

Sp. gr. of KCl+Aq at 20°, containing mols  
KCl to 100 mols. H<sub>2</sub>O

Mols KCl	Sp gr	Mols. KCl	Sp. gr
0.5	1 01310	4.0	1 09415
1.0	1 02568	5.0	1 11445
2 0	1 04959	..	..

(Nicol, Phil. Mag. (5) 16. 122.)

Sp gr. of KCl+Aq at 18°.

% KCl	Sp gr	% KCl	Sp. gr.	% KCl	Sp gr
5	1.0308	15	1.0978	25	1.1408
10	1 0638	20	1.1355		..

(Kohlrausch, W. Ann. 1879. 1.)

Sp gr. of KCl+Aq at 0°. S=pts. salt in 100  
pts. of solution; S<sub>1</sub>=mols. salt in 100  
mols. solution.

S	S <sub>1</sub>	Sp gr.
20.7840	5 954	1 1489
17 7214	4.940	1 1258
14 4707	3.922	1 1018
11.0757	2 918	1 0769
7 5440	1 931	1.0521
4.4968	1 123	1 0308

(Charpy, A. ch. (6) 29. 23.)

Sp gr. of KCl+Aq at 25°

Concentration of KCl+Aq	Sp gr.
1-normal	1 0466
1/2 " "	1 0235
1/3 " "	1 0117
1/4 " "	1 0059

(Wagner, Z. phys. Ch 1890, 5. 36.)

KCl+Aq containing 5.05% KCl has sp. gr.  
20°/20°=1 0327

KCl+Aq containing 20.55% KCl has sp.  
gr 20°/20°=1.1393.

(Le Blanc and Rohland, Z phys. Ch. 1896,  
19. 272)

Sp. gr of KCl+Aq

g KCl in 1000 g of solution	Sp gr 10°/16°
0	1.000000
0 7140	1.000464
1 5042	1 000975
3 0724	1.001991
8 3165	1.005391

(Dijken, Z. phys. Ch 1897, 24. 109.)

Sp. gr. of KCl+Aq at 20 1°, when p=per  
cent strength of solution; d=observed  
density, and w=volume conc. in g per  
cc.  $\left(\frac{pd}{100}\right)=w$

p	d	w
36 43	1 853	0 43171
31.12	1 1554	0 35954
24.79	1.1215	0 27887
18.06	1 0866	0.19610
13 17	1 0617	0.13980
8 412	1 0386	0 08736
6.610	1 0297	0.06806
4 419	1 0193	0.4505
3.456	1.0148	0.03507
1 197	1 0040	0.01202

(Barnes, J. phys. Ch. 1898, 2. 544.)

Sp. gr. of KCl+ $\text{Aq}$  at  $t^\circ$ .

$t^\circ$	Normality of KCl+ $\text{Aq}$ .	g KCl in 100 g of solution	Sp gr $t^\circ/4^\circ$
20 5	3 74	23 93	1 1617
"	2 65	17 06	1 1166
"	1 87	12 82	1 0829
"	0 93	6 64	1 0424

(Oppenheimer, Z. phys. Ch. 1898, 27, 450.)

Sp. gr. of KCl+ $\text{Aq}$  at  $18^\circ/4^\circ$ 

g KCl in 100 g. of solution	Sp gr
0 24963	1 0003
0 12459	0 9995
0 08342	0 99920
0 062343	0 99912

(Jahn, Z. phys. Ch. 1900, 33, 559)

KCl+ $\text{Aq}$  containing 1 pt. KCl in 58 923 pts.  $\text{H}_2\text{O}$  at  $17^\circ$  has sp. gr.=1.0096. (Hittorf, Z. phys. Ch. 1902, 39, 628.)

Sp. gr.  $20^\circ/4^\circ$  of a normal solution of KCl = 1.0443. (Haigh, J Am Chem. Soc. 1912, 34, 1151)

Sp. gr. of sat. KCl+ $\text{Aq}$  at  $t^\circ$ .

$t^\circ$	g KCl sol. in 100 g. $\text{H}_2\text{O}$	Sp gr.
$-10^\circ$	24 98	1 139
0	28.50	1 156
10	31 23	1 168
20	34 11	1 177
30	37 28	1 183
40	40 12	1 190
50	42 86	1.195
60	45 48	1 199
70	48 30	1.203

(Tschernaj, J. Russ. phys. Chem. Soc. 1912, 44, 1565)

Sp. gr. of dil. KCl+ $\text{Aq}$  at  $20.004^\circ$ .Conc.=g. equiv. KCl per l at  $20.004^\circ$ .Sp. gr. compared with  $\text{H}_2\text{O}$  at  $20.004^\circ=1$ .

Conc	Sp. gr
0 0000	1 000,000,0
0.0001	1 000,004,8
0 0002	1.000,009,7
0 0005	1.000,024,2
0.0010	1.000,048,5
0.0026	1.000,097,1
0.0050	1.000,242,6
0.0100	1 000,483,6

(Lamb and Lee, J. Am. Chem. Soc., 1913, 35, 1687.)

KCl+ $\text{Aq}$  containing 10% KCl boils at  $101.1^\circ$ ; containing 20% at  $103.4^\circ$ . (Gerlach.)  
Sat KCl+ $\text{Aq}$  containing 52.7 pts. KCl to 100 pts.  $\text{H}_2\text{O}$  forms a crust at  $107.7^\circ$ ; highest temp. observed,  $108.5^\circ$ . (Gerlach, Z. anal. 26, 426)

B.-pt. of KCl+ $\text{Aq}$  containing pts. KCl to 100 pts.  $\text{H}_2\text{O}$ . G=according to Gerlach (Z. anal. 26, 438); L=according to Legrand (A. ch. (2) 59, 426).

B.-pt.	G	L	B.-pt.	G	L
100 5°	4 9	4 7	105°	36 2	37 8
101 0	9 2	9 0	105 5	39.3	41 0
101 5	13 1	13 2	106	42.4	44 2
102	16 7	17 1	106 5	45 5	47 4
102.5	20 1	20 9	107	48.4	50 5
103	23 4	24 5	107 5	51.5	53 7
103 5	26 7	28 0	108	54 5	56 9
104	29 9	31.4	108 3	.	59 4
104 5	33.1	34.6	108 5	57.4	.

Precipitated from aqueous solution by HCl + $\text{Aq}$ . Much less sol in very dil. HCl+ $\text{Aq}$  than in  $\text{H}_2\text{O}$  (Fresenius)

Nearly insol. in conc. HCl+ $\text{Aq}$ .

100 cc. sat. HCl+ $\text{Aq}$  dissolve 1.9 g. KCl at  $17^\circ$ . (Ditte, A. ch. 1881, (5) 24, 226.)

Solubility of KCl in HCl+ $\text{Aq}$  at  $0^\circ$ .

G per 100 cc of solution

HCl	KCl
0.0	25.73
1.42	22.69
2.41	20.84
2.59	20.51
4.05	17.71
8.39	11 93
12.40	7 46
14.95	5.60
23.88	1.49
34.20	1.52

(Engel, A. ch. 1888, (6) 33, 377.)

Solubility of KCl in HCl+ $\text{Aq}$ .

$t^\circ$	Concentration of HCl g. mol per 1000 g. $\text{H}_2\text{O}$	Wt. KCl per 1000 g. $\text{H}_2\text{O}$	Mol solubility
0	0	283.55	3 81
"	$\frac{1}{4}$	267.25	3 59
"	$\frac{1}{2}$	250.00	3 36
"	1	214 25	2 88
25	0	359 25	4.82
"	$\frac{1}{4}$	341 55	4.59
"	$\frac{1}{2}$	324 30	4.35
"	1	289.60	3.89

(Armstrong and Eyre, Proc. R. Soc. 1910 (A) 84, 127.)

100 g. sat. HCl+Aq dissolve 1.9 g. KCl at 20°. (Stoltzenberg, B. 1912, 45. 2248.)

Solubility in HCl+Aq at 25°.

Millimoles HCl in 10 ccm.	Millimoles KCl in 10 ccm
	42.72
5.66	37.49
10.20	33.79
15.90	28.68
20.94	24.74
32.52	17.39

(Herz, Z. anorg. 1912, 73. 275.)

Solubility of KCl in HBr+Aq at 25°.

Millimoles HBr in 10 ccm	Millimoles KCl in 10 ccm
	42.72
6.61	37.80
34.15	19.57

(Herz, Z. anorg. 1912, 73. 275.)

Sol. in sat.  $\text{NH}_4\text{Cl}$ +Aq with pptn. of  $\text{NH}_4\text{Cl}$ . When action has ceased, the solution at 18.75° contains 31.6% of the mixed salt; or 100 pts.  $\text{H}_2\text{O}$  dissolve 46.1 pts. of the mixed salt, viz. 16.27 pts. KCl and 29.83 pts.  $\text{NH}_4\text{Cl}$ . (Karsten.)

Solubility of KCl in  $\text{NH}_4\text{Cl}$ +Aq at 25°.

Dissolved in 1000 mols $\text{H}_2\text{O}$	
Mols KCl	Mols $\text{NH}_4\text{Cl}$
74.2	23.8
67.9	32.5
61.4	52.2
55.5	65.9
50.2	74.4
43.0	96.3
37.6	110.0
37.0	107.5
37.5	109.4
22.6	118.2

(Biltz, Z. anorg. 1911, 71. 174.)

See also  $\text{NH}_4\text{Cl}$ .

Sol. in sat.  $\text{BaCl}_2$ +Aq with pptn. of  $\text{BaCl}_2$  until a state of equilibrium is reached, when 100 pts.  $\text{H}_2\text{O}$  at 16.8° dissolve 45.9 pts. mixed salts, viz. 18.2 pts.  $\text{BaCl}_2$  and 27.7 pts. KCl.

See also  $\text{BaCl}_2$ .

Solubility of KCl in  $\text{MgCl}_2$ +Aq of given percentage composition.

t°	30%	21.2%	15%	11%
10	1.9%	5.3%	9.9%	14.3%
20	2.6	6.5	11.3	15.9
30	3.4	7.6	12.7	17.5
40	4.2	8.8	14.2	19.0
50	5.0	10.0	15.6	20.5
60	5.8	11.2	17.0	21.9
70	6.5	12.4	18.3	23.2
80	7.3	13.6	19.5	24.5
90	8.1	14.7	20.8	25.8
100	8.9	15.9	22.1	27.1

(Precht and Wittgen, B. 14. 1667.)

Solubility of KCl+NaCl in 20%  $\text{MgCl}_2$ +Aq.

t°	% KCl	% NaCl	t°	% KCl	% NaCl
10	4.2	5.7	60	8.9	6.3
20	5.1	5.8	70	9.9	6.4
30	6.0	5.9	80	10.9	6.6
40	6.9	6.0	90	11.9	6.7
50	7.9	6.1	100	13.0	6.9

(P and W.)

Sol. in sat.  $\text{KNO}_3$ +Aq with pptn. of  $\text{KNO}_3$

1 litre of the solution contains			
at 14.5°		at 25.2°	
Mol. KCl	Mol. $\text{KNO}_3$	Mol. KCl	Mol. $\text{KNO}_3$
3.865	0.0	4.18	0.0
3.810	0.204	4.11	0.136
3.782	0.318	4.07	0.318
3.710	0.615	3.93	0.902
3.667	0.818	3.85	1.212
3.629	0.910	3.81	1.367
3.597	1.176	3.70	1.805
3.582	1.220		

(Touren, C. R. 1900, 130. 909.)

Solubility of KCl in  $\text{KNO}_3$ +Aq.

t°	Concentration of $\text{KNO}_3$ in g. mol. per 1000 g. $\text{H}_2\text{O}$	Wt. KCl in 1000 g. $\text{H}_2\text{O}$	Mol. solubility
0	0	283.55	3.81
"	$\frac{1}{4}$	284.25	3.81
"	$\frac{1}{2}$	283.60	3.81
"	1	287.60	3.86
25	0	364.15	4.89
"	$\frac{1}{4}$	355.00	4.90
"	$\frac{1}{2}$	361.65	4.86
"	1	358.80	4.81
"	$1\frac{1}{2}$	355.20	4.77

(Armstrong and Eyre, Proc. R. Soc. 1910 [A], 84. 127.)

See also  $\text{KNO}_3$ .

Sol. in sat.  $\text{NaNO}_3 + \text{Aq}$  without causing pptn. (See  $\text{NaNO}_3$ .)

Sol. in sat.  $\text{Ba(NO}_3)_2 + \text{Aq}$  without causing pptn.

Solubility in  $\text{KBr} + \text{Aq}$  at 25°.

1 litre of the solution contains			
Mol. KBr		Mol. KCl	
0 0		4 18	
0 49		3 85	
0 85		3 58	
1 31		3 19	
1 78		2 91	
2 25		2 58	
2 69		2 33	

(Touren, C. R. 1900, 130. 1252.)

See also KBr.

100 pts.  $\text{H}_2\text{O}$  dissolve 133.2 pts. KI and 10.4 pts. KCl at 21.5°, no matter how prepared. (Rüdorff, B. 6. 484.)

100 pts.  $\text{KCl} + \text{Aq}$  sat. at 15–16° contain 25.26–25.37 pts. KCl. 100 pts.  $\text{KCl} + \text{KI} + \text{Aq}$  sat. at 15–16° contain 57.80 pts. of the two salts. KCl is pptd. by KI (v. Hauer, J. pr. 98. 137.)

Solubility in  $\text{KI} + \text{Aq}$  at t°.

t°	Sat. solution contains		
	% KCl	% KI	% total salt
0	4.8	50.8	56.6
8	5.1	51.1	56.2
18	..	..	57.9
30	4.2	54.6	58.8
41	4.7	55.0	59.7
49	5.7	56.0	61.7
60	..	..	62.5
75	4.4	59.5	63.9
82	5.0	59.6	64.6
96	..	..	65.2
102	..	..	66.8
140	..	63.3	..
155	7.6	64.8	72.4
182	8.7	65.4	74.1
190	8.6	66.0	74.6
245	10.0	66.5	76.5

(Étard, A. ch. 1894, (7) 3. 281.)

Solubility of  $\text{KCl} + \text{KI}$  in  $\text{H}_2\text{O}$  at 25°.

G per 100 g. $\text{H}_2\text{O}$			
KCl	KI	KCl	KI
0	149.26	19.64	68.22
4.06	144.03	23.75	43.89
7.63	137.79	29.56	23.83
11.36	132.60	31.38	14.83
11.74	133.90	33.68	7.00
15.10	105.91	36.12	0.00

(Amadori and Pampanini, Att. Acc. Linc. 1911, 20, II. 475.)

Solubility of KCl in  $\text{KOH} + \text{Aq}$  at 0°.

G per 100 cc. solution	
KCl	KOH
26.83	0.0
23.44	1.33
21.30	2.64
17.39	5.56
13.80	8.46
10.91	11.23
8.64	13.53
6.73	16.43
4.74	19.72

(Engel, Bull. Soc. 1891, (3) 6. 16.)

Solubility in  $\text{KOH} + \text{Aq}$  at 20°.

G KOH in 1 litre	G KCl in 1 litre	Sp. gr.	Degrees Baumé
10	293	1.185	22.5
20	285	1.185	22.5
30	276	1.190	23.0
40	265	1.192	23.0
50	255	1.195	23.5
60	245	1.200	24.0
70	236	1.200	24.0
80	226	1.205	24.5
90	219	1.205	24.5
100	211	1.210	25.0
110	205	1.210	25.0
120	199	1.215	25.5
130	192	1.215	25.5
140	185	1.220	26.0
150	178	1.225	26.5
160	171	1.225	26.5
170	165	1.230	27.0
180	159	1.235	27.5
190	153	1.240	28.0
200	148	1.245	28.5
210	142	1.250	29.0
220	137	1.255	29.5
230	133	1.260	30.0
240	128	1.265	30.5
250	124	1.270	30.8
260	120	1.275	31.3
270	115	1.280	31.7
280	112	1.285	32.0
290	108	1.290	32.5
300	104	1.295	33.0
310	100	1.300	33.5
320	96	1.305	34.0
330	93	1.310	34.2
340	89	1.315	34.6
350	85	1.320	35.0
360	81	1.325	35.5
370	78	1.330	36.0
380	74	1.335	36.3
390	71	1.340	36.7
400	68	1.345	37.1
410	64	1.350	37.5

## Solubility in KOH+Aq at 20°.—Continued

G KOH in 1 litre	G KCl in 1 litre	Sp gr	Degrees Baumé
420	61	1.355	38.0
430	58	1.360	38.5
440	55	1.365	38.9
450	53	1.370	39.2
460	50	1.375	39.5
470	47	1.380	40.0
480	44	1.385	40.2
490	42	1.390	40.6
500	40	1.397	41.0
510	38	1.405	41.5
520	35	1.410	42.0
530	33	1.415	42.3
540	31	1.420	42.6
550	29	1.425	43.0
560	27	1.430	43.5
570	25	1.435	43.7
580	24	1.440	44.0
590	23	1.445	44.3
600	22	1.450	44.6
610	21	1.455	45.0
620	20	1.460	45.5
630	18	1.465	45.9
640	17	1.470	46.2
650	16	1.475	46.5
660	15	1.480	46.8
670	15	1.485	47.0
680	15	1.490	47.5
690	15	1.495	47.9
700	14	1.500	48.2
710	14	1.505	48.5
720	13	1.510	48.8
730	13	1.515	49.1
740	13	1.520	49.5
750	13	1.525	49.7
760	12	1.530	50.0
770	12	1.535	50.3
780	12	1.540	50.6
790	11	1.545	51.0
800	11	1.550	51.3
810	10	1.550	51.5
820	10	1.565	51.8
830	9	1.570	52.2
840	9	1.575	52.6
850	9	1.580	53.0

(Winteler, Z. Elektrochem, 1900, 7, 360.)

## KCl+NaCl.

100 pts. KCl+NaCl+Aq sat. at 13–16° contain 30.18 pts. of the two salts. (v. Hauer.)

100 pts. H<sub>2</sub>O dissolve 13.92 pts. KCl and 30.85 pts. NaCl at 15.6°, and solution has sp. gr.=1.233. (Page and Keighley)

100 pts. H<sub>2</sub>O dissolve 10.11 pts. KCl, 32.15 pts. NaCl, and 4.69 pts. K<sub>2</sub>SO<sub>4</sub>, and solution has sp. gr.=1.250. (P and K.)

100 pts. H<sub>2</sub>O dissolve 29.9 pts. NaCl and 15.7 pts. KCl at 18.8° (Rüdorff.)

Solubility of KCl+NaCl in H<sub>2</sub>O at t°. 100 pts. H<sub>2</sub>O dissolve pts. KCl and pts. NaCl.

t°	Pts KCl	Pts NaCl	t°	Pts KCl	Pts NaCl
10	12.5	29.7	60	24.6	27.2
20	14.7	29.2	70	27.3	26.8
30	17.2	28.7	80	30.0	26.4
40	19.5	28.2	90	32.9	26.1
50	22.0	27.7	100	34.7	25.8

(Precht and Wittgen, B 14. 1687.)

100 pts. H<sub>2</sub>O dissolve 13.99 pts. KCl+30.54 pts. NaCl=44.53 pts. mixed salts at 20°. (Nicol, Phil. Mag. (5) 31. 385.)

## Solubility of KCl in NaCl+Aq at 20°

G. per 100 g. H <sub>2</sub> O	
NaCl	KCl
0.0	34.52
6.5	29.37
13.0	4.71
19.5	0.42

(Nicol, Phil. Mag. 1891, 31. 369.)

## Solubility of KCl+NaCl at t°.

t°	G per 100 g. H <sub>2</sub> O	
	KCl	NaCl
25	15.8	14.5
"	29.0	31.3
80	30.0	25.2
"	26.4	34.0

(Soeh, J. phys. Ch. 1898, 2. 46.)

## Solubility of KCl+NaCl at ?°

G salts in 100 g. H <sub>2</sub> O		
NaCl	KCl	Solid phase
9.89	28.34	KCl
18.35	22.75	"
29.88	16.28	KCl+NaCl
31.57	10.91	NaCl
33.17	5.65	"

(Uyeda, Mem. Col. Sc. Kyoto, 1910, 2. 245.)

100 g. H<sub>2</sub>O sat. with NaCl dissolve 0.216 gram-equivalent KCl at 25°

100 g. H<sub>2</sub>O sat. with K<sub>2</sub>SO<sub>4</sub> dissolve 0.466 gram-equivalent KCl at 25°. (Euler, Z. phys. Ch. 1904, 49. 315.)

Solubility in NaCl+Aq at 20°, 30°, 40° and 91°. Tables given in the original show that each salt diminishes the solubility of the other. (Leather, Chem. Soc. 1915, 108. (2) 13.)

Solubility of KCl+NaCl in HCl+Aq at 25°.

% HCl	% NaCl	% KCl
0	19.95	10.90
8 61	10.65	7 58
17 16	3.56	3 80
20.65	2.03	2.86
32 78	0 18	1 27

(Hucks, J. Am. Chem. Soc. 1915, 37. 846.)

See also under NaCl.

KCl+SrCl<sub>2</sub>.

100 pts H<sub>2</sub>O dissolve 11.2 pts KCl and 48.6 pts SrCl<sub>2</sub> at 14.5°. (v Hauer.)

If SrCl<sub>2</sub>+Aq sat. at 14.5 is sat. with KCl at same temp., 100 pts. H<sub>2</sub>O dissolve:

KCl	33.2	11 2	...
SrCl <sub>2</sub> . . .	..	48 6	50 7
		59 8	

(Mulder, Schenk. Verhandel. 1864.)

KCl+(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>.

Sat solution of KCl+(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> at b.pt when cooled to 14° has different composition from sat. solution of (NH<sub>4</sub>)Cl and K<sub>2</sub>SO<sub>4</sub>, and its composition is changed by warming it with either KCl or (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>. (Rüdorff)

KCl+K<sub>2</sub>SO<sub>4</sub>.

100 pts. H<sub>2</sub>O contain the following amounts salt at 18.75°: (1) sat. with KCl alone; (2) sat. first with KCl then with K<sub>2</sub>SO<sub>4</sub>; (3) sat. with K<sub>2</sub>SO<sub>4</sub> and KCl together; (4) sat. first with K<sub>2</sub>SO<sub>4</sub> then with KCl; (5) sat. with K<sub>2</sub>SO<sub>4</sub> alone.

	1	2	3	4	5
KCl . . .	34.5	32 96	33.12	33 12	..
K <sub>2</sub> SO <sub>4</sub> . . .		1.79	1 75	1.83	10.8

(Karsten.)

100 pts. H<sub>2</sub>O sat. with both K<sub>2</sub>SO<sub>4</sub> and KCl contain the following amounts.

	At 14.8°		
KCl . . .	33.5	28.2	..
K <sub>2</sub> SO <sub>4</sub> . . .	.	2 0	10.3

	At 15.8°		
KCl . . .	33.6	27.9	..
K <sub>2</sub> SO <sub>4</sub> . . .	.	2.3	10.4

	At 16.1°		
KCl . . .	33.6	27.1	..
K <sub>2</sub> SO <sub>4</sub> . . .	.	3.3	10.4

(Kopp, A. 34. 264.)

Sat. K<sub>2</sub>SO<sub>4</sub>+Aq dissolves KCl only with pptn. of K<sub>2</sub>SO<sub>4</sub>, but sat. KCl+Aq dissolves some K<sub>2</sub>SO<sub>4</sub> without any separation. (Karsten.)

Solubility of KCl+K<sub>2</sub>SO<sub>4</sub>: 100 pts. H<sub>2</sub>O dissolve at t°.

t°	Pts. KCl	Pts. K <sub>2</sub> SO <sub>4</sub>	t°	Pts. KCl	Pts. K <sub>2</sub> SO <sub>4</sub>
10	30 9	1.32	60	43 8	1 94
20	33.4	1.43	70	46.5	2 06
30	36.1	1 57	80	49.2	2 21
40	38.7	1.68	90	52 0	2 38
50	41.3	1.82	100	54 5	2.53

(Precht and Wittgen.)

100 g. H<sub>2</sub>O dissolve 34.76 g. KCl+2.93 g. K<sub>2</sub>SO<sub>4</sub> at 25°. (Van't Hoff and Meyerhoffer, Z. phys. Ch. 1898, 27. 75.)

Sol in 20% KC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (Stromeyer.) Quickly attacked by liquid NO<sub>2</sub> in the presence of traces of moisture, with evolution of Cl<sub>2</sub>. (Frankland, Chem. Soc. 1901, 79. 1361.)

Sl. sol in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J 1898, 20. 829)

Easily sol. in liquid HF (Franklin, Z. anorg. 1905, 46. 2.)

100 g. hydrazine dissolves 8.5 pts. KCl at 12.5-13°. (de Bruyn, R. t. c. 1899, 18. 297.)

100 g. anhyd. hydroxylamine dissolves 12.3 g. KCl at 17-18°. (de Bruyn, Z. phys. Ch. 1892, 10. 782.)

100 pts. alcohol of 0.900 sp. gr. dissolve 4.62 pts; 0.872, 1.60 pts; 0.834, 0.38 pt.; 0.817, 0.00 pt KCl (Karwan.)

Sol in 48 pts boiling alcohol (Wenzel) Insol in absolute alcohol containing LiCl (Mitscherlich)

At 15°, 100 pts alcohol of p percentage by volume (S=sp. gr.) dissolve pts. KCl as follows:

p	10	20	30	40
S	0.984	0.972	0.958	0.940
KCl	19 8	14 7	10 7	7 7

p	50	60	80
S	0.918	0.896	0.848
KCl	5.0	2 8	0.45

(Schiff, A. 118. 365)

100 pts. of a mixture of 40% alcohol with 60% H<sub>2</sub>O dissolve 9.2 pts. KCl at 15° (Schiff)

Insol. in absolute alcohol or in 96% alcohol at 15° or below. At 20°, 100 pts. of the latter dissolve 0.04 pt.; at 25°, 0.06 pt., at 30°, 0.20 pt KCl. Dilute alcohol dissolves less KCl than the contained H<sub>2</sub>O would dissolve by itself

Solubility in dil. alcohol. D = sp. gr. of alcohol; S = solubility in 100 pts. alcohol at t°.

D = 0.8004		D = 0.9848		D = 0.9793		D = 0.9726	
t°	S	t°	S	t°	S	t°	S
0	23.2	4	20.9	4	16.4	3	12.2
4	24.8	20	25.5	21	20.3	5	12.7
22	29.4	27	26.6	28	22.0	16	15.4
25	30.2	30	27.5	43	25.6	20	16.1
34	32.8	37	29.0			25	17.3
52	37.5	60	35.2			34	19.0

D = 0.9573		D = 0.9390		D = 0.8967		D = 0.8244	
t°	S	t°	S	t°	S	t°	S
10	8.8	2	4.2	12	2.87	4	0.00
11	9.0	7	5.1	31	4.35	15	0.00
17	10.3	16	6.4	47	4.88	20	0.04
30	12.5	30	8.5	65	5.65	25	0.06
40	13.9	38	9.6			32	0.20
60	16.7	57	11.3				

(Gerardin, A. ch. (4) 5 140)

Solubility of KCl in dil alcohol at 14.5°

Sp. gr.	100 ccm contain		
	Alcohol	Water	KCl
1.1720		88.10	29.10
1.1542	2.79	85.78	26.85
1.1365	4.98	84.00	24.67
1.1075	10.56	79.63	20.56
1.1085	15.57	75.24	17.24
1.0545	20.66	70.52	14.27
1.0455	24.25	67.05	13.25
0.9695	40.42	50.18	6.35
0.9315	48.73	40.60	3.82
0.8448	68.63	15.55	0.30

(Bodlander, Z. phys. Ch. 7. 316.)

Solubility of KCl in ethyl alcohol.

(G. KCl per 100 g. alcohol + Aq.)

Wt % alcohol	at 30°		Wt. % alcohol	at 40°	
	at 30°	at 40°		at 30°	at 40°
0	38.9	41.8	43.1	11.1	13.1
5.28	33.9	35.9	55.9	6.8	8.2
9.43	30.2	33.3	65.9	3.6	4.1
16.9	24.9	27.6	78.1	1.3	1.6
25.1	19.2	21.8	86.2	0.4	0.5
34.1	15.6	17.2			

(Bathrick, J. phys. Ch. 1896, 1. 160.)

Solubility of KCl in ethyl alcohol at 0°.

Concentration of alcohol Mol g alcohol per 1000 g. H <sub>2</sub> O	Solubility in 1000 g H <sub>2</sub> O	Molecular solubility
	285.15	3.80
0.25	277.95	3.73
0.50	271.10	3.64
1.00	265.50	3.45
3.00	208.80	2.81

(Armstrong and Eyre, Proc. Roy. Soc. 1910, (A) 84 127.)

Solubility of KCl in ethyl alcohol + Aq at 25°.

Wt % alcohol	G. KCl per 100 cc sat solution	Wt % alcohol	G. KCl per 100 cc sat solution
0	31.18	60	4.18
10	23.93	70	2.27
20	17.89	80	0.93
30	13.27	90	0.31
40	9.40	100	0.08
50	6.26		

(McIntosh, J. phys. Ch. 1903, 7. 350.)

100 pts. absolute methyl alcohol dissolve 0.5 pt at 18.5°; 100 pts. absolute ethyl alcohol dissolve 0.034 pt at 18.5°. (de Bruyn, Z. phys. Ch. 10. 783.)  
100 pts. 40% wood alcohol dissolve 9.2 pts. KCl. (Schiff.)

Solubility of KCl in methyl alcohol + Aq at 25°.

P = % by wt. of alcohol in alcohol + Aq.

S = Sp. gr. alcohol + Aq sat. with KCl

L = millimols KCl in 100 ccm of the solution.

P	S 25°/4°	L
0	1.1782	417.4
10.6	1.125	329
30.8	1.033	183
47.1	0.9679	102
64.0	0.9064	46.1
78.1	0.8607	20.6
98.9	0.8242	9.9
100	0.7937	5.7

(Herz and Anders, Z. anorg. 1907, 55. 273.)

## Solubility of KCl in methyl alcohol.

t°	Concentration of alcohol Mol g alcohol per 1000 g H <sub>2</sub> O	Solubility l in 1000 g H <sub>2</sub> O	Molecular solubility
0		283.55	3.81
"	0.25	280.00	3.76
"	0.50	276.35	3.71
"	1.00	267.85	3.60
"	3.00	238.10	3.18
25		364.15	4.89
"	0.25	361.90	4.86
"	0.50	357.10	4.79
"	1.00	348.70	4.67
"	3.00	324.15	4.35

(Armstrong and Eyre, Proc. Roy. Soc. 1910  
(A) 84. 127.)

At room temp 1 pt by weight is sol in.  
200 pts methyl alcohol, D<sub>18</sub> 0.7990  
750 " ethyl " D<sub>18</sub> 0.8035  
Insol in propyl alcohol. (Rohland, Z.  
anorg 1899, 18. 325.)  
100 g methyl alcohol dissolve 0.53 g. KCl  
at 25°.  
100 g. ethyl alcohol dissolve 0.022 g. KCl  
at 25°.  
100 g propyl alcohol dissolve 0.004 g KCl  
at 25°.  
100 g isomyl alcohol dissolve 0.0008 g.  
KCl at 25°.  
(Turner and Bissett, Chem. Soc. 1913, 103.  
1909.)

Insol. in propyl alcohol. (Sohlamp, Z.  
phys. Ch. 1894, 14. 276.)

## Solubility of KCl in propyl alcohol.

t°	Concentration of alcohol Mol g per 1000 g H <sub>2</sub> O	Solubility in 1000 g. H <sub>2</sub> O	Molecular solubility
0		283.55	3.81
"	0.25	274.10	3.68
"	0.50	265.45	3.56
"	1.00	248.0	3.33
25		365.10	4.90
"	0.25	355.40	4.77
"	0.50	347.70	4.67
"	1.00	331.50	4.45

(Armstrong and Eyre, Proc. Roy. Soc. 1910,  
(A) 84. 127.)

Insol. in fusel-oil. (Gooch, Am. Ch. J. 9.  
53.)

Very sl. sol. in mixture of equal pts. ab-  
solute alcohol and ether. (Berzelius.)

500 mg. KCl treated with 10 g. of above  
mixture yield only 0.3 mg. to the liquid.  
(Lawrence Smith, Am. J. Sci 16 56)  
Insol. in acetone (Klug and M'Elroy, J.  
Anal. Ch. 6. 184, Erdmann, C. C. 1899, II.  
1014.)

## Solubility of KCl in acetone+Aq at t°

t°	% acetone	100 g of the solution contain		
		G H <sub>2</sub> O	G acetone	G KCl
30	0	72.73	0.00	27.27
	5	71.15	3.74	25.11
	9.09	69.62	6.96	23.42
	20	64.88	16.22	18.90
	30	59.49	25.45	15.06
	40	53.17	35.52	11.31
	50	45.98	45.98	8.04
	60	37.97	56.91	5.12
	70	29.22	68.18	2.60
	80	19.82	79.43	0.76
	90	9.98	89.88	0.13
	100	0.00	100.00	0.00
40	0	71.31	0.00	28.69
	5	69.62	3.67	26.72
	9.09	67.88	6.79	25.33
	15	65.15	11.51	23.34
	20	62.97	15.75	21.28
	30	59.49	25.45	15.06
	40	53.17	35.52	11.31
	50	45.98	45.98	8.04
	60	37.97	56.91	5.12
	70	29.22	68.18	2.60
	80	19.82	79.43	0.76

Since there is but one liquid phase here,  
these figures represent the solubility of KCl in  
acetone+Aq at 30° and 40°.

(Snell, J. phys. Chem. 1898, 2. 484.)

The addition of KCl to mixtures of acetone  
and H<sub>2</sub>O will cause a division into  
two layers. The following table gives  
the temp at which sat solutions of KCl  
in acetone+Aq of varying concentra-  
tions separate into two layers and also  
the compositions of the sat solutions of  
KCl in acetone+Aq

% acetone	Temp of division	100 g of solution contain		
		G H <sub>2</sub> O	G acetone	G KCl
26	46.5°			
30	40.0	59.36	25.44	15.20
40	34.2	53.21	35.47	11.32
50	32.6	45.97	45.97	8.06
60	33.3	37.86	56.80	5.34
70	35.5	29.09	68.25	2.66
75	39.0			
80	45.6	19.80	79.20	1.00

(Snell)

The following table gives the compositions of the solutions of KCl in acetone+Aq at the points at which the solution just divides into two layers. Temp = 40°.

100 g. of the solution contain		
G. H <sub>2</sub> O	G. acetone	G. KCl
56.08	28.63	14.08
53.05	35.67	11.29
50.34	39.82	9.83
47.60	43.83	8.58
44.35	48.36	7.29
42.08	50.75	6.57
38.53	56.26	5.21
36.59	58.84	4.57
32.37	64.18	3.45
30.62	66.43	2.95
28.12	69.45	2.44

(Snell.)

The addition of KCl to aqueous acetone causes the separation of the liquid into two layers. The following table gives the composition of these layers at 40°

Upper layer contains per 100 g. of solution		
G. H <sub>2</sub> O	G. acetone	G. KCl
55.20	31.82	12.90
54.27	36.69	12.03
53.27	35.44	11.20
51.69	37.76	10.55
51.23	48.50	10.27
50.34	39.88	9.77
49.08	41.67	9.20
48.02	43.18	8.79
47.02	43.73	8.64
46.40	45.34	8.17
45.65	46.52	7.83
45.64	46.57	7.79
58.99	25.24	15.77

Lower layer contains per 100 g. of solution

G. H <sub>2</sub> O	G. acetone	G. KCl
28.14	69.42	2.44
29.46	67.83	2.72
30.96	65.97	3.07
31.83	64.83	3.33
32.64	63.79	3.56
34.07	62.01	3.92
35.27	60.49	4.24
37.44	57.67	4.89
38.00	56.96	5.04
38.68	56.17	5.25
39.98	54.36	5.66
40.41	53.78	5.81
23.66	74.91	1.43

(Snell.)

Solubility in acetone+Aq at 20°.

A = cem. acetone in 100 cem. acetone+Aq.  
KCl = millimols KCl in 100 cem. of the solution.

A	KCl
0	410.5
10	351.7
20	286.6
30	223.7
40	166.5
50	115.4
60	71.2
70	38.5
80	12.9
90	2.0
100	

(Herz and Knoch, Z. anorg. 1904, 41 317.)

Solubility of KCl in glycerine+Aq at 25°.

G = g. glycerine in 100 g. glycerine+Aq.  
KCl = millimols KCl in 100 cc. of the solution.

G	KCl	Sp. gr.
0	424.5	1.1800
13.28	383.4	1.1848
25.98	339.3	1.1935
45.36	271.4	1.2106
54.23	238.5	1.2189
83.84	149.0	1.2590
100	110.6	1.2860

(Herz and Knoch, Z. anorg. 1905, 45. 267.)

Insol. in CS<sub>2</sub>. (Bayer; Arcetowski, Z. anorg. 1894, 6. 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790), ethyl acetate. (Naumann, B. 1910, 43. 314.)

Solubility of KCl in organic compounds +Aq at 25°.

Compound	G. comp. per 1 H <sub>2</sub> O	G. KCl per 100 g. sat. solution
Water		26.89
Acetaldehyde	11.01	27.05
Paraldehyde	11.07	26.42
Glycerol	13.01	25.58
Glycol	15.51	26.43
"	62.05	25.26
Mannitol	45.53	24.86
"	130.59	24.46

(Armstrong and Eyre, Proc. Roy. Soc. 1913, A, 88. 234.)

## Solubility in pyridine+Aq at 10°.

Solvent		100 g of the solution contain g. KCl
H <sub>2</sub> O	Pyridine	
100	0	23.79
90	10	19.76
80	20	16.37
70	30	13.19
60	40	10.05
50	50	6.34
40	60	3.335
30	70	1.245
20	80	0.24
10	90	0.039
0	100	.

(Schroeder, J. pr. 1908, (2) 77. 268.)

Insol in anhydrous pyridine and in 97% pyridine+Aq.

Very al sol. in 95% pyridine+Aq.

Sl. sol in 93% pyridine+Aq. (Kahlenberg, J. Am Chem. Soc 1908, 30. 1107)

100 com. of a sat. solution of KCl in furfural at 25° contain 0.085 pts. by wt. KCl. (Walden, Z. phys. Ch. 1906, 55. 713.)

100 g. H<sub>2</sub>O dissolve 246.5 g. sugar+44.8 g. KCl at 31.25°, 100 g sat solution contain 62.28 g. sugar+11.33 g. KCl. (Köhler, Z. Ver. Zuckeind, 1897, 47. 447.)

## Solubility in glucose+Aq at 25°

Concentration of glucose in 0 mol per 1000 g H <sub>2</sub> O	Solubility in 1000 g H <sub>2</sub> O	Molecular solubility
0.25	362.70	4.86
0.50	366.10	4.91
1.0	369.85	4.96
3.0	376.25	5.04
	402.25	5.39

(Armstrong and Eyre, Proc. Roy. Soc. 1910, 84. 127)

Potassium manganic chloride, K<sub>2</sub>MnCl<sub>4</sub>.

Sol. in H<sub>2</sub>O; less sol. in NH<sub>4</sub>Cl+Aq, unstable. (Neuman, M 1894, 15. 492.)

Potassium rhodium chloride.

See Chlororhodite, potassium.

Potassium ruthenium sesquichloride.

See Chlororuthenite, potassium.

Potassium ruthenium tetrachloride.

See Chlororuthenate, potassium.

Potassium tellurium chloride.

See Chlorotellurate, potassium.

Potassium thallic chloride, 3KCl, TiCl<sub>3</sub>+2H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. Not decomp. by boiling H<sub>2</sub>O. (Rammelsberg.)

Potassium thorium chloride, KCl, 2ThCl<sub>4</sub>+18H<sub>2</sub>O.

Deliquescent; sol. in H<sub>2</sub>O and alcohol. (Berzelius.)

Potassium tin (stannous) chloride (Potassium chlorostannite), KCl, SnCl<sub>2</sub>+H<sub>2</sub>O.

Decomp by H<sub>2</sub>O; sol in hot HCl or KCl+Aq. (Remsen and Richardson, Am Ch. J. 14. 90.)

2KCl, SnCl<sub>2</sub>+H<sub>2</sub>O. Partially decomp. by dissolving in H<sub>2</sub>O. (Rammelsberg, Pogg. 94. 507.)

+2H<sub>2</sub>O. Very sol. in hot, and but slightly in cold HCl+Aq or KCl+Aq. (Remsen and Richardson)

4KCl, SnCl<sub>2</sub>+3H<sub>2</sub>O (Poggiale, C. R. 20. 1182)

Does not exist. (Remsen and Richardson.)

Potassium tin (stannic) chloride, 2KCl, SnCl<sub>4</sub>.

See Chlorostannate, potassium.

Potassium tungsten chloride, K<sub>2</sub>(OH)WCl<sub>5</sub>

Decomp. by moisture Insol in organic solvents. (Olsson, B. 1913, 46. 581.)

K<sub>2</sub>W<sub>2</sub>Cl<sub>7</sub>. Sol. in H<sub>2</sub>O. Nearly insol in most organic solvents. (Olsson.)

Potassium uranium chloride, UCl<sub>4</sub>, 2KCl.

Very hygroscopic, sol in H<sub>2</sub>O with decomp.; sol in acetic acid Decomp. by alcohol. Nearly insol in ether (Aloy, Bull. Soc. 1899, (3) 21. 264)

Potassium uranyl chloride, K<sub>2</sub>(UO<sub>2</sub>)Cl<sub>4</sub>.

Very sol. in H<sub>2</sub>O. Moderately sol in dil alcohol. (Aloy, Dissert. 1901.)

+2H<sub>2</sub>O. Very sol. in H<sub>2</sub>O and alcohol. (Arfvedson.)

Sol. in H<sub>2</sub>O, with decomp. and separation of KCl, unless H<sub>2</sub>O is acidulated with HCl. (Pelgrot, A ch (3) 5. 37)

Solubility in H<sub>2</sub>O at t°.

t°	100 pts. of the solution contain			Solid phase
	Pts. UO <sub>2</sub>	Pts. Cl	Pts. K	
0.8	38.57	13.59	3.86	UO <sub>2</sub> Cl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O +KCl
14.9	33.71	13.51	...	"
17.5	37.36	14.50	5.27	"
25.0	35.01	15.26	...	"
41.5	35.27	15.92	7.39	"
50.0	34.18	16.56	.	"
60.0	34.19	17.25	9.14	UO <sub>2</sub> Cl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O
71.5	33.55	17.44	9.28	"
78.5	35.26	18.24	9.95	"

(Rimbach, B. 1904, 37. 463)

Potassium uranyl chloride is decomp. by  $H_2O$  at temp. below  $60^\circ$ . Above  $60^\circ$ , it is sol. in  $H_2O$  without decomp.

Potassium vanadium chloride,  $VK_2Cl_5 \cdot H_2O$ .

Difficultly sol. in  $H_2O$  and alcohol. (Stahler, B. 1904, 37. 4412.)

Potassium yttrium chloride.

Sol. in  $H_2O$  with evolution of heat

Potassium zinc chloride,  $2KCl, ZnCl_2$ .

Very deliquescent. Sol. in 1 pt. cold, and in all proportions of hot  $H_2O$ . (Pierre, A. ch. (3) 16. 248.)

$\cdot H_2O$ . Not very deliquescent. Can be recryst. (Ephraim, Z. anorg. 1908, 59. 58.)

$KCl, ZnCl_2 \cdot 2H_2O$ . Not deliquescent. Cannot be recryst. without decomp. (Ephraim.)

Potassium chloriodide,  $KCl_2I$ .

Very unstable. (Wells and Wheeler, Sill. Am. J. 143. 475.)

$KCl_2I$ . Sol. in  $H_2O$  with decomp. Ether dissolves out  $ICl_2$ . (Filliol, J. Pharm. 25. 438.)

Potassium fluoride,  $KF$  or  $K_2F_6$ .

Very deliquescent. Very sol. in  $H_2O$ . Sl. sol. in  $HF + Aq$ . Easily sol. in conc.  $KC_2H_3O_2 + Aq$ . Insol. in alcohol. (Berzelius.) Sol. in dilute alcohol. (Stromeyer, A. 100. 83.)

Sp. gr. of aqueous solution of  $KF$  at  $18^\circ$  containing—

5	10	20	30	40%	$KF$ .
1.041	1.084	1.117	1.272	1.378	

(Kohlrausch, W. Ann. 1879. 1.)

Solubility in  $HF + Aq$  at  $21^\circ$ .

(G. per 100 g.  $H_2O$ .)

$HF$	$KF$	$HF$	$KF$
0.0	96.3	13.95	31.4
1.21	72.0	15.98	33.4
1.61	61.0	17.69	35.6
3.73	40.4	20.68	38.4
4.03	32.5	28.60	46.9
6.05	30.4	41.98	61.8
9.25	29.9	53.71	74.8
11.36	29.6	74.20	105.0
12.50	30.5	119.20	169.5

(Ditte, C. R. 1896, 123. 1282.)

Easily sol. in liquid  $HF$ . (Franklin, Z. anorg. 1905, 46. 2.)

Very sl. sol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 8790.)

$KF$  will "salt out" acetone from aqueous solution. The table shows the composition of the solutions at the points at which inhomogeneous solutions of  $KF$ , acetone and  $H_2O$  just become homogeneous at  $20^\circ$

100 g. of the solution contain:

G $KF$	G $H_2O$	G acetone	G $KF$	G $H_2O$	G acetone
5.75	58.91	35.34	0.61	31.95	67.44
5.00	56.28	38.72	0.50	29.92	69.58
3.84	52.25	43.91	28.42	69.76	1.62
3.06	49.05	47.89	25.74	71.24	3.02
2.61	46.84	50.55	22.35	72.99	4.66
2.22	44.79	52.99	20.28	73.80	5.90
14.95	73.66	11.39	18.71	74.10	7.19
11.46	70.77	17.77	16.31	73.97	9.72
9.17	67.30	23.53	12.40	72.01	15.59
7.72	64.01	28.27	33.86	65.73	0.397
7.07	62.03	30.90	29.97	68.54	1.50
6.43	60.50	33.07	22.06	73.41	4.54
1.38	40.55	58.06	17.82	74.01	8.16
0.979	36.42	62.60	14.34	73.29	12.37
0.693	32.69	66.61	44.24	55.52	0.240
0.57	31.50	67.93	33.34	65.66	1.00
0.89	35.74	63.36	29.86	68.54	1.60
0.75	33.84	65.41	24.38	72.16	3.45

At the first quadruple point where the hydrate, acetone, water and vapor are in equilibrium the upper layer contains 98% acetone, while the lower layer contains in 100 g, 46.3 g  $KF$ . A sat. solution of  $KF$  will thus dehydrate acetone to the extent of 98%.

(Frankforter and Cohen, J. Am. Chem. Soc. 1914, 36. 1115.)

Similar data are given for  $KF$  in ethyl and propyl alcohol by Frankforter and Frary. (J. phys. Ch. 1913, 17. 402.)

$+2H_2O$ . Very deliquescent. (Guntz, A. ch. (6) 3. 20.)

Sat. aq. solution at  $18^\circ$  contains 45.3%  $KF$ . (de Forcrand, C. R. 1911, 152. 1210.)

Sp. gr. of solution sat at  $18^\circ = 1.502$ , and contains 48%  $KF$ . (Mylus and Funk, B. 1897, 30. 1718.)

$+4H_2O$ . Not deliquescent. (de Forcrand, C. R. 1911, 152. 1075.)

Sat. aq. solution at  $18^\circ$  contains 35.96%  $KF$ . (de Forcrand, C. R. 1911, 152. 1210.)

Potassium hydrogen fluoride,  $KF$ ,  $HF = KHF_2$ .

Easily sol. in  $H_2O$ . Sl. sol. in  $H_2O$  containing  $HF$ . Easily sol. in conc.  $KC_2H_3O_2 + Aq$ . Sol. in dil. alcohol, but insol. in absolute alcohol.

$KF, 2HF$ . Deliquescent. Decomp. by  $H_2O$  with absorption of heat. (Moissan, C. R. 106. 547.)

$KF, 3HF$ . As above (Moissan.)

Potassium manganic fluoride.

See Fluomanganate, potassium.

Potassium scandium fluoride,  $K_3ScF_6$ .

Sol in  $H_2O$  Decomp. by acids. (R. J. Meyer, Z. anorg. 1914, 86. 275.)

Potassium silicon fluoride.

See Fluosilicate, potassium.

Potassium tantalum fluoride.

See Fluotantalate, potassium.

Potassium tellurium fluoride,  $KF$ ,  $TeF_4$ .

Decomp. by  $H_2O$ . (Högbom, Bull. Soc. (2) 35. 60)

Potassium thallic fluoride,  $2TlF_3$ ,  $KF$ .

Decomp. by moisture Insol. in  $HF$ . (Gewecke, A. 1909, 366. 226)

Potassium thorium fluoride,  $2KF$ ,  $ThF_4 + 4H_2O$ .

Nearly insol. in  $H_2O$  Sol. in  $HF + Ag$   
 $KF$ ,  $ThF_4$  Precipitate (Chydenius)

Potassium tin (stannous) fluoride,  $2KF$ ,  $3SnF_2 + H_2O$

Sol. in  $H_2O$ . (Wagner, B. 19. 896.)

Potassium tin (stannic) fluoride.

See Fluostannate, potassium.

Potassium titanium tetrafluoride.

See Fluotitanate, potassium.

Potassium titanium sesquifluoride,  $4KF$ ,  $Ti_2F_6$ .

Precipitate. Very sl. sol. in  $H_2O$ . Sol. in dil. acids (Pocini, C. R. 97. 1064.)

See also Fluosesquitanate, potassium.

Potassium titanyl fluoride.

See Fluoxypertitanate, potassium.

Potassium tungstyl fluoride.

See Fluoxytungstate, potassium.

Potassium uranium fluoride,  $KF$ ,  $UF_4$ .

Insol. in  $H_2O$  and dil. acids Difficulty sol. in conc.  $HCl + Ag$  Sol. in conc.  $H_2SO_4$ . (Bolton, J. B. 1866. 212.)

Potassium uranyl fluoride.

See Fluoxuyranate, potassium.

Potassium vanadium sesquifluoride.

See Fluovanadate, potassium.

Potassium vanadium tetrafluoride (?).

Easily sol. in  $H_2O$  Insol. in alcohol. (Berzelius.)

Potassium zinc fluoride,  $KF$ ,  $ZnF_2$

Sol. in  $H_2O$ . (R. Wagner.)

$2KF$ ,  $ZnF_2$  Sol. in  $H_2O$ . (Berzelius.)

Potassium zirconium fluoride.

See Fluozirconate, potassium.

Potassium fluoride hydrogen peroxide,  $KF$ ,  $H_2O_2$

Not deliquescent. Very sol. in  $H_2O$ . Is not decomp. at  $70^\circ$  and only partially so at  $110^\circ$  (Tanatar, Z. anorg. 1901, 28. 255)

Potassium fluoride vanadic acid.

See Fluoxivanadate, potassium.

Potassium hydride,  $KH$ .

Decomp. by  $H_2O$  Insol. in oil of turpentine, benzene, ether and  $CS_2$ . (Moissan, C. R. 1902, 134. 18)

Potassium hydrosulphide,  $KSH$ .

Very deliquescent and sol. in  $H_2O$  with gradual decomp. Crystallizes with  $\frac{1}{2}H_2O$ . Sol. in alcohol.

Potassium hydroxide,  $KOH$ .

Very deliquescent, and sol. in  $H_2O$  with evolution of much heat. 100 pts.  $KOH$ , exposed over  $H_2O$  at  $16-20^\circ$  takes up 460 pts.  $H_2O$  in 56 days. (Mulder.)

1 pt.  $KOH$  dissolves in 0.6 pt. cold  $H_2O$  (Lowitz), in 0.47 pt. cold  $H_2O$  (Bineau, C. R. 41. 559), in 1 pt.  $H_2O$  (Abt.)

Solubility of  $KOH$  in  $H_2O$  at  $t^\circ$

$t^\circ$	G. $KOH$ per 100 g		Solid phase
	$H_2O$	solution	
-22	3.7	3.6	Ice
-20.7	22.5	18.4	"
-45.2	44.5	30.8	"
-36.2	36.2	26.6	$KOH \cdot 4H_2O$
-32.7	77.94	43.8	"
-33	80	44.4	$KOH \cdot 4H_2O + KOH$ .
-23.2	85	45.9	$2H_2O$
0	97	49.2	$KOH \cdot 2H_2O$
10	103	50.7	"
15	107	51.7	"
20	112	52.8	"
30	126	55.76	"
32.5	135	57.44	$KOH \cdot 2H_2O + KOH$ .
			$H_2O$
50	140	58.33	$KOH \cdot H_2O$
100	178	64.03	"
125	213	68.06	"
143	311.7	75.73	"

(Pickering, Chem. Soc. 1893, 63. 908.)

100 pts.  $KOH$  are sol. in 93.4 pts.  $H_2O$  at  $15^\circ$  or 100 pts.  $H_2O$  dissolve 107 pts.  $KOH$  at  $15^\circ$ . Sp. gr. = 1.5365 at  $15^\circ$ .

All higher values found in solubility tables are incorrect. (Ferehland, Z. anorg. 1902, 30, 133.)

100 g. sat. aq. solution at 15° contain 50.48 g. KOH. (de Forcrand, C. R. 1909, 149, 719.)

Sat. KOH+Aq boils at 157.7° (Griffiths); 340°. (Gerlach).

B.-pt. of KOH+Aq containing pts. KOH to 100 pts. H<sub>2</sub>O.

B.-pt.	Pts. KOH	B.-pt.	Pts. KOH
105°	20.5	215°	210.5
110	34.5	220	219.8
115	46.25	225	230.0
120	57.5	230	240.9
125	67.5	235	251.9
130	76.8	240	263.1
135	85.0	245	274.4
140	92.5	250	285.7
145	99.8	255	298.5
150	108.5	260	312.5
155	114.05	265	328.0
160	121.7	270	343.5
165	129.35	275	359.0
170	137.0	280	375.0
175	144.8	285	391.0
180	152.6	290	408.2
185	160.4	295	425.5
190	168.2	300	444.4
195	176.5	310	484.0
200	185.0	320	526.3
205	193.5	330	571.5
210	202.0	340	623.6

(Gerlach, Z. anal. 26, 464.)

Sp. gr. and b.-pt. of KOH+Aq according to Dalton

% K <sub>2</sub> O	Sp. gr.	B.-pt.	% K <sub>2</sub> O	Sp. gr.	B.-pt.
4.7	1.08	100.56°	36.8	1.44	123.89°
9.5	1.11	101.11	39.6	1.47	120.44
13.0	1.15	101.65	42.9	1.52	135.56
16.2	1.19	103.33	46.7	1.60	144.43
19.5	1.23	104.44	51.2	1.68	160.00
23.4	1.28	106.66	56.8	1.78	188.22
26.3	1.33	109.44	63.0	1.88	215.50
29.4	1.36	112.22	72.4	2.00	315.56
32.4	1.36	115.56	84.0	2.2	red heat
34.4	1.42	118.89	100	2.4	

Sp. gr. of KOH+Aq at 15°.

% K <sub>2</sub> O	Sp. gr.	% K <sub>2</sub> O	Sp. gr.	% K <sub>2</sub> O	Sp. gr.
0.568	1.0050	10.750	1.050	20.935	1.2268
1.607	1.0153	11.882	1.182	21.500	1.2342
2.829	1.0560	13.013	1.308	22.632	1.2493
3.961	1.0300	14.145	1.437	23.764	1.2648
5.092	1.0478	15.277	1.568	24.895	1.2805
6.224	1.0589	16.408	1.702	26.027	1.2966
7.355	1.0703	17.540	1.830	27.158	1.3131
8.487	1.0819	18.671	1.979	28.290	1.3300
9.619	1.0938	19.803	2.122		

(Zimmerman, N. J. Pharm. 18, 2, 5.)

Sp. gr. of KOH+Aq

% K <sub>2</sub> O	Sp. gr.	% K <sub>2</sub> O	Sp. gr.	% K <sub>2</sub> O	Sp. gr.
2.44	1.02	24.14	1.22	37.97	1.42
4.77	1.04	21.77	1.24	40.17	1.44
7.02	1.06	26.34	1.26	42.31	1.46
9.20	1.08	27.89	1.28	44.40	1.48
11.28	1.10	29.34	1.30	46.45	1.50
13.30	1.12	30.74	1.32	48.40	1.52
15.38	1.11	32.14	1.34	50.09	1.54
17.40	1.16	33.46	1.36	51.68	1.56
19.44	1.18	34.74	1.38	53.06	1.58
21.25	1.20	35.99	1.40		

(Richter)

Sp. gr. of KOH+Aq at 15°. a = sp. gr. if % is K<sub>2</sub>O; b = sp. gr. if % is KOH.

%	a	b	%	a	b
1	1.010	1.009	31	1.370	1.300
2	1.020	1.017	32	1.385	1.311
3	1.030	1.025	33	1.403	1.324
4	1.039	1.033	34	1.418	1.336
5	1.048	1.041	35	1.431	1.349
6	1.058	1.049	36	1.445	1.361
7	1.068	1.058	37	1.460	1.374
8	1.078	1.065	38	1.475	1.387
9	1.089	1.074	39	1.490	1.400
10	1.099	1.083	40	1.504	1.411
11	1.110	1.092	41	1.522	1.425
12	1.121	1.110	42	1.539	1.438
13	1.132	1.111	43	1.564	1.450
14	1.143	1.119	44	1.570	1.462
15	1.154	1.128	45	1.584	1.472
16	1.166	1.137	46	1.600	1.488
17	1.178	1.146	47	1.615	1.499
18	1.190	1.155	48	1.630	1.511
19	1.202	1.166	49	1.645	1.527
20	1.215	1.177	50	1.660	1.539
21	1.230	1.188	51	1.676	1.552
22	1.242	1.198	52	1.690	1.565
23	1.256	1.209	53	1.705	1.578
24	1.270	1.220	54	1.720	1.590
25	1.285	1.230	55	1.733	1.604
26	1.300	1.241	56	1.746	1.618
27	1.312	1.252	57	1.762	1.630
28	1.326	1.264	58	1.780	1.641
29	1.340	1.278	59	1.795	1.655
30	1.355	1.288	60	1.810	1.667

(Calculated by Gerlach, Z. anal. 8, 279, after Zimmermann, N. J. Pharm. 18, 2, 5, and Schiff, A. 107, 300.)

Sp. gr. of KOH+Aq at 15°.

% KOH	Sp. gr.	% KOH	Sp. gr.
4.2	1.0382	21.0	1.2008
8.4	1.0776	25.2	1.2439
12.6	1.1177	29.4	1.2880
16.8	1.1588		

(Kohlrausch, W. Ann. 1879, 1.)

## Sp. gr. of KOH+Aq at 15°

% KOH	Sp. gr.	% KOH	Sp. gr.
10	1.077	50	1.539
20	1.175	60	1.667
30	1.288	70	1.790
40	1.411		

(Gerlach, Z. anal. 27. 275, calculated from Schuff, A. 107. 300)

Sp. gr. of K<sub>2</sub>O+Aq at 15°.

% K <sub>2</sub> O	Sp. gr.	% K <sub>2</sub> O	Sp. gr.
5	1.054	30	1.558
10	1.111	35	1.428
15	1.171	40	1.500
20	1.231	45	1.576
25	1.294		

(Hager, Adjumenta varia, Leipsae, 1876.)

Sp. gr. of KOH+Aq at 20° containing 2 mols. KOH to 100 mols. H<sub>2</sub>O = 1.05325. (Nicol, Phil. Mag. (5) 16 122.)

## Sp. gr. of KOH+Aq at 15°.

% KOH	Sp. gr.	% KOH	Sp. gr.	% KOH	Sp. gr.
52	1.53822	34	1.33313	16	1.14925
51	1.52622	33	1.32236	15	1.13955
50	1.51430	32	1.31166	14	1.12991
49	1.50245	31	1.30102	13	1.12031
48	1.49067	30	1.29046	12	1.11076
47	1.47896	29	1.27997	11	1.10127
46	1.46733	28	1.26954	10	1.09183
45	1.45577	27	1.25918	9	1.08240
44	1.44429	26	1.24888	8	1.07302
43	1.43289	25	1.23866	7	1.06371
42	1.42150	24	1.22849	6	1.05443
41	1.41025	23	1.21835	5	1.04517
40	1.39905	22	1.20834	4	1.03593
39	1.38793	21	1.19837	3	1.02671
38	1.37686	20	1.18839	2	1.01752
37	1.36586	19	1.17855	1	1.00834
36	1.35485	18	1.16875	0	0.99918
35	1.34396	17	1.15898		

(Pickering, Phil. Mag. 1894, (5) 37. 375.)

Sp. gr. of N solution at 18°/4° = 1.0481 (Loomis, W. Ann. 1896, 60. 550.)

## Sp. gr. of KOH+Aq.

% KOH	6.87	12.10
Sp. gr. 20°/20°	1.0601	1.1025

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 272.)

KOH+Aq containing equal pts of KOH and H<sub>2</sub>O freezes at -54°. (Guyton-Morveau, Gm.-K. 2, 1. 18.)

KOH is completely miscible with NaOH and with RbOH in both the liquid and the solid states. (Hevesy, Z. phys. Ch. 1910, 73. 667.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 828.)

Abundantly sol. in strong alcohol or wood-spirit.

See below under KOH+2H<sub>2</sub>O.

Readily sol in glycerine.

Sol. in not less than 25 pts. of ether. (Boullay.) Sol in much more than 25 pts of ether. (Connell.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Insol in acetone. Readily sol. in fusel oil.

Insol in acetone and in methylal. (Eidmann, C. C. 1899, II 1014.)

Sol. in aqueous solution of mannite. (Favre, A. ch. (3) 11. 76.)

The composition of the hydrates formed by KOH at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by KOH and of the conductivity and sp. gr. of KOH+Aq. (Jones, Am. Ch. J. 1905, 34. 337.)

+H<sub>2</sub>O.

+2H<sub>2</sub>O. Very deliquescent, and sol in H<sub>2</sub>O with absorption of much heat.

100 g. sat. solution in H<sub>2</sub>O at 30° contain 55.75 g. anhyd. KOH. (de Waal, Dissert. 1910.)

Solubility of KOH+2H<sub>2</sub>O in alcohol+Aq at 30°.

% KOH	% alcohol	% H <sub>2</sub> O
55.75	0	44.25
54.81	0.43	44.76
..	..	..*
31.0	57.50	11.50
28.99	65.07	5.94
27.67	69.92	2.41
27.20	73.01	negative
26.25	81.98	"

\*Separates into two layers

(de Waal, Dissert, 1910)

+4H<sub>2</sub>O.

Potassium hydrogen titanium diimide,  
Ti(NH)NK.

Decomp. by H<sub>2</sub>O and alcohol Insol. in all ord. indifferent organic solvents. (Ruff, B. 1912, 45. 1371.)

## Potassium iodide, KI.

Deliquescent only in very moist air Very sol. in H<sub>2</sub>O with absorption of heat

The temp. of H<sub>2</sub>O can be lowered 24° by dissolving KI (Baup.)

140 pts KI dissolved in 100 pts. H<sub>2</sub>O at 10.8° lower the temp. 22.5°. (Rudorff, Pogg 136. 276.)

100 pts. H<sub>2</sub>O dissolve 120.6 pts. KI at 0° (Kremers); 127.8 pts. KI at 0° (Mulder), 127.9 pts KI at 0°. (Gerardin.)

By boiling, 100 pts. H<sub>2</sub>O dissolve 221 pts. KI at 120° (Baup.); 222.2 pts. KI at 120° (Gay-Lussac); 222.6 pts. KI at 118.4° (Mulder), 223.58 pts. KI at 117° (Legrand); 223.6 pts. KI at 117°. (Gerardin.)

Between those temps the solubility increases proportional to temp.

Sol in 0.735 pt H<sub>2</sub>O at 12°, in 0.709 pt H<sub>2</sub>O at 10°; in 0.7 pt H<sub>2</sub>O at 18°, in 0.43 pt H<sub>2</sub>O at 120° (Graham-Otto)

100 pts KI + liq sat. at 15-16° contain 58.07 pts. KI. (v. Hauser, J. pr 98, 137.)

100 pts H<sub>2</sub>O at 12.5° dissolve 130 pts; at 10°, 141 pts KI (Baup.)

100 pts H<sub>2</sub>O at 18° dissolve 143 pts. KI, at 120°, 271 pts (Gay-Lussac)

Sol. in 0.79 pt H<sub>2</sub>O at 0°, in 0.70 pt H<sub>2</sub>O at 20°; in 0.63 pt H<sub>2</sub>O at 48°, in 0.57 pt H<sub>2</sub>O at 90°, in 0.53 pt H<sub>2</sub>O at 80°, in 0.51 pt. H<sub>2</sub>O at 100°. (Kremers, Pogg 97. 15)

Sol. in 0.71 pt. H<sub>2</sub>O at 15°. (Eder, Dingl. 221. 89.)

Solubility of KI in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. KI	t°	Pts KI	t°	Pts KI
0	127.9	19	143.4	38	159
1	128.7	20	144.2	39	160
2	129.6	21	145.1	40	160
3	130.4	22	145.9	41	161
4	131.2	23	146.7	42	162
5	132.1	24	147.5	43	163
6	132.9	25	148.3	44	164
7	133.7	26	149.1	45	164
8	134.5	27	149.9	46	165
9	135.3	28	150.7	47	166
10	136.1	29	151.5	48	167
11	137.0	30	152.3	49	168
12	137.8	31	153	50	168
13	138.6	32	154	51	169
14	139.4	33	155	52	170
15	140.2	34	156	53	171
16	141.0	35	156	54	172
17	141.8	36	157	55	172
18	142.6	37	158	56	173

## Solubility of KI in 100 pts., etc.—Continued.

t°	Pts KI	t°	Pts KI	t°	Pts KI
57	174	78	191	99	208
58	175	79	192	100	209
59	175	80	192	101	210
60	176	81	193	102	211
61	177	82	194	103	212
62	178	83	195	104	213
63	179	84	196	105	213
64	180	85	197	106	214
65	180	86	197	107	215
66	181	87	198	108	216
67	182	88	199	109	217
68	183	89	200	110	218
69	184	90	201	111	219
70	184	91	202	112	220
71	185	92	202	113	220
72	186	93	203	114	221
73	187	94	204	115	222
74	188	95	205	116	223
75	188	96	206	117	223.6
76	189	97	207		
77	190	98	208		

(Mulder, calculated from his own and other observations, Scheik. Verhandel. 1864. 63.)

Solubility of KI in 100 pts H<sub>2</sub>O at t°.

t°	Pts. KI	t°	Pts KI	t°	Pts KI
-22.65	107.2	21.05	143.3	71.1	188.5
-22.35	106.6	25.6	146.6	74.75	185.6
-16.8	111.1	29.1	149.6	81.6	192.0
-11.35	116.3	37.3	156.7	86.35	194.6
-5.9	120.4	42.3	160.3	93.5	200.3
0	126.1	45.75	163.6	100.7	205.6
+3.25	130.1	51.8	167.6	110.2	216.1
9.55	134.0	55.05	169.1	113.7	218.8
12.75	137.1	60.55	173.4		
12.9	137.9	65.0	178.3		

(Coppet, A. ch. (5) 30. 417)

Solubility is represented by a straight line of the formula  $126.23 + 0.8088t$ . (Coppet.)

Solubility of KI in 100 pts. H<sub>2</sub>O at high temp.

t°	Pts. KI	t°	Pts KI
124	233.9	144	264.6
133	249.3	175	310.4

(Tilden and Shenstone, Phil. Trans. 1884. 23.)

If solubility  $S$  = pts. KI in 100 pts solution,  $S = 55.8 + 0.122t$  from 0° to 165° (Etard, C. R. 98. 1432.)

Sat KI+Aq contains % KI at t°.

t°	% KI	t°	% KI
-21	50.7	78	64.8
-21	51.0	96	66.9
-21	51.2	150	70.6
-19	52.2	151	70.9
-15	53.2	175	71.6
-9	54.5	176	72.7
0	56.9	190	73.8
+21	59.3	193	74.5
44	60.8	213	75.7
72	64.3		

(Étard, A. ch. 1894, (7) 2, 542)

Solubility of KI in 100 g H<sub>2</sub>O at t°.

t°	g KI	t°	g KI
-1	122.2	-11.5	64.7
-5	119.8	-9.5	51.5
-4	117.4	-7	42.6
-10	115.1	-6	34.4
-14	75.8	-5	25.7

(Mettusser, Z. anorg. 1905, 44, 80)

102.70 pts by weight are contained in 100 cc KI+Aq sat. at 25°, or 59.54 pts. in 100 g. of solution; sp. gr = 1.7254

94.05 pts by weight are contained in 100 cc KI+Aq sat at 0°, or 58.34 pts. in 100 g. of solution; sp. gr = 1.6699. (Walden, Z. phys. Ch. 1906, 55, 715.)

Solubility of KI in H<sub>2</sub>O at low temperatures

t°	% KI Solid phase	t°	% KI Solid phase
-12.5	38 Ice	-22	52.1 KI
-15	41.2 "	-20	52.6 "
-17.5	44.6 "	-15	53.5 "
-20	48 "	-10	54.5 "
-22.5	51.2 "	-5	55.4 "
-23.2	51.9 " + KI	0	56.4 "

(Kreman and Kerschbaum, Z. anorg. 1907, 56, 218.)

149.26 g. KI dissolve in 100 g. H<sub>2</sub>O at 25°. (Amadori and Pampanini, Rend. Acc. Linc. 1911, V, 20, 473.)

60.39 g in 100 g. KI+Aq sat. at 25°. (Parsons and Whittemore, J. Am. Chem. Soc. 1911, 33, 1934.)

56.1 g in 100 g. KI+Aq sat. at 0°; 60.35 g in 100 g. KI+Aq sat. at 30° (Van Dam and Donk, Chem. Weekbl. 1911, 8, 848)

Sp. gr. of KI+Aq at 21°.

% KI	Sp. gr.	% KI	Sp. gr.	% KI	Sp. gr.
1	1.0075	21	1.1807	41	1.4224
2	1.0151	22	1.1911	42	1.4371
3	1.0227	23	1.2016	43	1.4520
4	1.0305	24	1.2122	44	1.4671
5	1.0384	25	1.2229	45	1.4825
6	1.0464	26	1.2336	46	1.4982
7	1.0545	27	1.2445	47	1.5142
8	1.0627	28	1.2556	48	1.5305
9	1.0710	29	1.2669	49	1.5471
10	1.0793	30	1.2784	50	1.5640
11	1.0877	31	1.2899	51	1.5810
12	1.0962	32	1.3017	52	1.5984
13	1.1048	33	1.3138	53	1.6162
14	1.1136	34	1.3262	54	1.6343
15	1.1226	35	1.3389	55	1.6528
16	1.1318	36	1.3519	56	1.6717
17	1.1412	37	1.3653	57	1.6911
18	1.1508	38	1.3791	58	1.7109
19	1.1605	39	1.3933	59	1.7311
20	1.1705	40	1.4079	60	1.7517

(Schiff, A. 110, 75.)

Sp. gr. of KI+Aq. S=according to Schiff (A. 108, 340) at 21°; K=according to Kremers (Pogg. 96, 62), interpolated by Gerlach (Z. anal. 3, 285)

5	10	15	20	25	30% KI,
S 1.038	1.079	1.123	1.171		1.279
K 1.038	1.078	1.120	1.166	1.218	1.271
35	40	45	50	55	60% KI
S 1.331	1.396	1.469	1.546	1.636	1.734
K 1.331	1.396	1.469	1.546	1.636	1.734

Sp. gr. of KI+Aq at 18°.

% KI	Sp. gr.	% KI	Sp. gr.	% KI	Sp. gr.
5	1.0363	30	1.273	55	1.630
10	1.0762	40	1.3966		
20	1.1679	50	1.545		

(Kohlrausch, W. Ann. 1879, 1.)

Sp. gr. of KI+Aq at 18°

% KI	Sp. gr.
1.044	1.0632
5.0	1.0363

(Göttrian, W. Ann. 1883, 18, 191.)

Sp. gr. at 16°/4° of KI+Aq containing 32.4875% KI = 1.30238. (Schonrock, Z. phys. Ch. 1893, 11, 781.)

KI+Aq containing 9.35% KI has sp. gr. 20°/20° = 1.0726

KI+Aq containing 11.35% KI has sp. gr. 20°/20° = 1.0892. (Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 278)

B-pt. of KI+Aq containing pts. KI to 100  
pts. H<sub>2</sub>O

B-pt.	Pts KI	B-pt	Pts KI	B-pt	Pts KI
101°	15	108°	111.5	115	185°
102	30	109	123	116	195
103	45	110	131	117	205
104	60	111	145	118	215
105	74	112	155	118.5	220
106	87	113	165		
107	99.5	114	175		

(Gerlach, Z. anal. 26. 439)

Sat. KI+Aq boils at 119° (Kremers)

Sat. KI+Aq forms a crust at 117.5°, and contains 210 pts. KI to 100 pts. H<sub>2</sub>O; highest temp observed, 118.5°. (Gerlach, Z. anal. 26. 426)

Solubility of KI in I<sub>2</sub>+Aq at 25°

KI mol/l	I g-atoms/l
6.15	0.00
6.23	3.64
6.40	11.11
6.36	13.16
6.33	13.2
6.24	17.03

(Abegg, Z. anorg. 1906, 50. 428.)

Solubility of KI+I<sub>2</sub> in H<sub>2</sub>O at 25°.

% KI	% I	Solnd phase	% KI	% I	Solnd phase
29.45	64.34	KI+KI <sub>2</sub>	25.88	68.79	KI <sub>2</sub> +I <sub>2</sub>
28.91	63.88	"	25.57	69.01	"
26.84	66.54	KI <sub>2</sub> +KI <sub>2</sub>	27.86	66.56	KI <sub>2</sub>
27.18	67.14	"	27.27	66.91	"
27.14	66.60	"	26.95	67.17	KI <sub>2</sub>
			25.71	67.91	"

(Foote and Chalker, Am. Ch. J. 1908, 39. 504)

See also under Iodine.

KI+Aq sat. at 14.5° containing 139.8 pts KI to 100 pts. H<sub>2</sub>O dissolves 1.0 pt. K<sub>2</sub>SO<sub>4</sub> with separation of 2.2 pts. KI, so that solution contains 137.6 pts KI and 1.0 pt. K<sub>2</sub>SO<sub>4</sub> to 100 pts H<sub>2</sub>O. (Mulder, Rotterdam, 1864.)

100 pts. H<sub>2</sub>O dissolve 86.3 pts. KI and 2.1 pts. Na<sub>2</sub>SO<sub>4</sub> at 14.5°. (Mulder, J. B. 1866. 67.)

Sol. in AsCl<sub>3</sub>, SnCl<sub>4</sub> and POCl<sub>3</sub>. (Walden, Z. anorg. 1906, 25. 214.)

Attacked by dry liquid NO<sub>2</sub> with liberation of I<sub>2</sub>. (Frankland, Chem. Soc 1901, 79. 1361)

Sol. in liquid SO<sub>2</sub> (Walden, B. 1899, 32. 2804.)

Solubility in SO<sub>2</sub> decreases with rise of temp (Walden, Z. phys. Ch. 1903, 42. 456.) Insol. in liquid CO<sub>2</sub>. (Buchner, Z. phys. Ch. 1906, 54. 674.)

Very easily sol. in liquid NH<sub>3</sub> (Franklin, Am. Ch. J. 1898, 20. 829.)

Hydrazine dissolves 135.7 pts. KI at 12.5-13°. (de Bruyn, R. t. c. 1899, 18. 297.)

100 pts alcohol of 0.85 sp. gr. dissolve 18 pts KI at 12.5° 100 pts. absolute alcohol dissolve 2.5 pts. KI at 13.5° Much more sol in hot alcohol (Baup.)

100 pts. alcohol of D sp gr. at 0° dissolve at 18°—

D 0.9904 0.9851 0.9726 0.9665 0.9528

130.5 119.4 100.1 89.9 76.9 pts. KI,

D 0.9390 0.9088 0.8464 0.8322

66.4 48.2 11.4 6.2 pts KI.

That is, aqueous alcohol dissolves approximately the same amount of KI that the water present in the alcohol would dissolve, and it is therefore probable that KI is insol. in strictly absolute alcohol (Gerardin.)

Solubility in 100 pts alcohol of 0.9496 sp. gr at

8° 13° 25° 46° 55° 62°  
67.4 69.2 75.1 84.7 87.5 90.2 pts. KI.

(Gerardin, A. ch. (4) 5. 155)

Sol in 68.3 pts. absolute alcohol (Eder, Dingl. 221. 89); in 370 pts ether (sp. gr. 0.729), (Eder, l. c.), in 120 pts alcohol-ether (1:1), (Eder, l. c.)

Sol in 10-12 pts. 90% alcohol, and 40 pts. absolute alcohol. (Hager, Comm 1883.)

100 pts. absolute methyl alcohol dissolve 16.5 pts. at 20.5°; 100 pts. absolute ethyl alcohol dissolve 1.75 pts at 20.5° (de Bruyn, Z. phys. Ch. 10. 783.)

Solubility of KI in methyl alcohol+Aq at 25°

P = % by wt. of alcohol in alcohol+Aq.

S = Sp. gr. of alcohol+Aq sat with KI.

L = millimols KI in 100 ccm of the solution.

P	S 25°/4°	L
0	1.7213	620
10.6	1.634	555
30.8	1.460	431
47.1	1.325	335
64.0	1.185	243
78.1	1.066	169
98.9	0.9700	113
100	0.9018	80

(Herz and Anders, Z. anorg. 1907, 55. 274.)

Solubility of KI in  $\text{CH}_3\text{OH}$ .

G = g. KI in 100 g. of the solution.

 $t_1$  = temp of complete solution $t_2$  = temp at which salt begins to separate out

G	$t_1$	$t_2$
8.64		266°
12 95.	0°	..
14 2	20	
14 6		262
14 97	25	
19 2	85	256
26 8	115	242
28.9	144	229
29.6	188	196
33 0		.

(Centnerszwer, Z phys Ch 1910, 72. 432.)

Solubility of KI in methyl alcohol at  $t^\circ$ .

$t^\circ$	g KI in 100 g alcohol	$t^\circ$	g KI in 100 g alcohol
15	14 50	180	30.7
30	16 20	200	29 1
50	18 9	220	27 5
80	22.5	240	24.8
100	25.0	245	22.6
120	27.2	247	21 0
140	29.2	250	18 8
160	30 6	252 5*	7 6

\*Critical temp. of solution

(Tyrer, Chem Soc 1910, 97. 626.)

At room temp. 1 pt. KI by weight is sol in 6 pts methyl alcohol  $D^{18}$  0.7990.16 " ethyl "  $D^{18}$  0.8322219 " propyl "  $D^{18}$  0.8160

(Rohland, Z anorg 1898, 18. 325)

## Solubility in mixtures of methyl and ethyl alcohol at 25°

P = % methyl alcohol in the solvent.

G = g KI in 10 ccm. of the solution.

S = Sp. gr of the sat. solution at 25°.

P	G	S 25°/4°
0 00	0 155	0 8015
4 37	0 191	0.8041
10.40	0 225	0 8071
41 02	0 494	0 8205
80 69	1.013	0.8794
84.77	1.072	0.8795
91.25	1 184	0 8908
100.00	1 316	0 9018

(Herz and Kuhn, Z. anorg. 1908, 60. 155.)

## Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent

G = g. KI in 10 ccm of the solution

S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	1.316	0 9018
11 11	1.096	0 8823
23 8	0.854	0 8629
65 2	0.262	0 8187
91.8	0 060	0 8045
93 75	0 058	0 8041
100	0 043	0 8041

(Herz and Kuhn.)

## Solubility in mixtures of propyl and ethyl alcohol at 25°

P = % propyl alcohol in the solvent.

G = g. KI in 10 ccm of the solution.

S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	0 155	0.8015
8 1	0 146	0 7983
17 85	0 137	0 7991
56 6	0 075	0 7988
88 6	0 062	0 8022
91 2	0 049	0 8027
95 2	0 044	0 8029
100	0 043	0 8041

(Herz and Kuhn.)

100 g methyl alcohol dissolve 18.04 g. KI at 25°

100 g. ethyl alcohol dissolve 2 16 g. KI at 25°.

100 g propyl alcohol dissolve 0.43 g. KI at 25°

100 g isoamyl alcohol dissolve 0.09 g. KI at 25°

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

0.455 g. is sol. in 100 g. propyl alcohol. (Schlamp, Z. phys Ch 1894, 14. 276.)

Alcoholic solution can be mixed with  $\frac{1}{2}$  vol. ether without pptn

100 g. 95% formic acid dissolve 38.2 g. KI at 18.5° (Aschan, Chem. Ztg. 1913, 37. 1113.)

## Solubility in organic solvents at t°.

C = pts. by wt. of KI in 100 cm. of the sat. solution.

L = no. of litres which at the saturation temp. hold in solution 1 mol. KI.

S = sp. gr. of the solution at t°, referred to H<sub>2</sub>O at t°.

p = pts. by wt of KI in 100 g of the solution.

Solvent	t°	C	L	S	p
Water	25°	102.70	0.162	1.7254	59.54
"	0°	94.05	0.177	1.6699	56.32
Methyl alcohol	25°	13.48	1.241	0.9003	14.97
"	25°	14.26			
"	0°	11.61	1.430	0.8964	12.95
Ethyl alcohol	25°	1.520	10.92	0.7908	1.922
"	0°	1.107	13.87	0.8053	1.479
Glycol	25°	45.85	0.362	1.3888	33.01
"	25°	47.23	0.351		
"	0°	43.28	0.353	1.3954	31.03
Acetonitrile	25°	1.531	10.70		
"	25°	1.590	10.44	0.7936	2.003
"	0°	1.852	0.00	0.8198	2.250
Propionitrile	25°	0.310	52.53	0.7821	0.464
"	25°	0.355	46.76		
"	0°	0.344	48.26	0.8000	0.420
"	0°	0.412	40.29		
Benzonitrile	25°	0.051	325.5	1.0070	0.050
Nitromethane	25°	0.349	47.56	1.1367	0.307
"	25°	0.289	57.44		
"	0°	0.360	45.36	1.1627	0.315
"	0°	0.314	52.87		
Nitrobenzene	25°	0.0019	67.10		
Acetone	25°	1.038	16.0	0.7968	1.302
"	0°	1.732	0.58	0.8227	2.105
Furfural	25°	5.93	2.80	1.2014	4.94
"	0°	15.10	1.10		
Benzaldehyde	25°	0.343	48.4	1.0446	0.328
Benzylaldehyde	25°	0.519	30.34	1.1373	0.483
"	0°	1.257	13.21	1.1501	1.093
Ammonia	25°	0.720	23.06	1.1180	0.644
"	0°	1.520	10.92	1.1223	1.355
Ethyl acetate	25°	0.0013	12.80		
Methyl ethyl acetate	25°	2.459	6.75	1.1358	2.165
"	0°	3.256	5.10	1.1521	2.827
Ethyl cyanacetate	25°	0.888	18.7	1.0579	0.839
"	25°	1.090	15.23	1.0678	1.021

(Walden, Z. phys. Ch. 1906, 55. 715.)

Insol. in CS<sub>2</sub>. (Aretowski, Z. anorg. 1894, 6. 257.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Difficultly sol. in methyl acetate (Naumann, B. 1909, 42. 3789.)

Sol. in ethyl acetate. (Casasucca, C. R. 30. 821.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in ethylamine. (Shinn, J. phys. Chem. 1907, 11. 538.)

100 pts. acetone dissolve 2.930 pts. KI at 25°. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Sol in acetone, insol. in methylal. (Edmann, C. C. 1899. II. 1014.)

3.08 pts. sol. in 100 pts. acetone at -2.5°.

2.38 " " " 100 " " " +22°.

1.21 " " " 100 " " " 56°.

0.26 " " " 100 " pyridine " 10°.

0.11 " " " 100 " " " 119°.

(Lazocynski, B. 1894, 27. 2287.)

Freely sol. in glycerine. Insol. in acetic acid (Berthelot.)

Sol. in 3 pts glycerine, insol. in olive oil. (Cap and Garot.)

100 g. glycerol dissolve 40 g. KI at 15.5°.

(Ossendowski, Pharm. J. 1907, 79. 575.)

Potassium triiodide, KI<sub>3</sub>.

Very deliquescent; very sol. in H<sub>2</sub>O and alcohol (Johnson, Chem. Soc. 1877, 1. 249.)

Solution of I in KI contains this salt (see KI). Decomp. by heat or shaking with CS<sub>2</sub>, ether, chloroform. Sol. in alcohol, from which CS<sub>2</sub> does not remove I. (Jørgensen, J. pr. (2) 2. 247.)

## Potassium periodide.

Solubility determinations show that the compds. KI<sub>2</sub> and KI<sub>3</sub> are the only periodides of potassium which form solids at 25°.

See under KI+I. (Foote and Chalicer, Am. Ch. J. 1908, 39. 566.)

KI<sub>7</sub>. See above.

Potassium mercuric iodide ammonia, K<sub>2</sub>HgI<sub>4</sub>, 2NH<sub>3</sub>.

(Peters, Z. anorg. 1912, 77. 188.)

## Potassium silver iodide, KI, AgI.

Sol. in KI+Aq. Sol. in hot alcohol. (Boullay, A. ch. 34. 377.)

2KI, AgI, Sol. in KI+Aq. Decomp. by H<sub>2</sub>O (Boullay.)

Hygroscopic (Hellwig, Z. anorg. 1900, 25. 180.)

3KI, AgI. Decomp. by H<sub>2</sub>O (Ditte, C. R. 93. 415.)

KI, 2AgI Sol. in methylethylketone. (Marsh, Chem. Soc. 1913, 103. 783.)

Potassium silver polyiodide, AgK<sub>2</sub>I<sub>3</sub>, 3KI+5H<sub>2</sub>O

Very deliquescent. (Johnson, Chem. Soc. 33. 183.)

## Potassium tellurium iodide.

See Iodotellurate, potassium.

Potassium thallic iodide, KI, TI<sub>3</sub>.

Decomp. by H<sub>2</sub>O. Can be crystallized from alcohol (Willm.)

3KI, 2TI<sub>3</sub>+3H<sub>2</sub>O. Partially decomp. by H<sub>2</sub>O (Rammelsberg.)

Potassium (tin) stannous iodide, KI, SnI<sub>2</sub>+1½H<sub>2</sub>O

When treated with a small quantity of H<sub>2</sub>O, KI dissolves out; but when more H<sub>2</sub>O is added, the substance is completely dissolved. More sol. in warm than cold alcohol. (Boullay.)

**Potassium zinc iodide,  $KI, ZnI_2$ .**

Very deliquescent (Rammelsberg, Pogg. 43. 665)

$K_2ZnI_4 + 2H_2O$  Hygroscopic. (Ephraim, Z. anorg. 1910, 67. 382.)

**Potassium iodide sulphur dioxide,  $KI, SO_2$ .**

(Péchar, C. R. 1900, 130. 1188.)

$KI, 4SO_2$ . (Walden, Z. phys. Ch. 1903, 42. 439.)

$KI, 14SO_2$  (Walden.)

**Potassium nitride,  $K_3N$ .**

Decomp. violently by  $H_2O$ . (H. Davy)

**Potassium ruthenium dihydronitrosobromide,  $Ru_3H_2NOBr_3, 2HBr, 3KBr$ .**

Ppt (Brizard, A. ch. 1900, (7) 21. 362)

**Potassium ruthenium nitrosobromide,  $Ru_3H_2NOCl_3, 3KCl, 2HCl$ .**

Sl sol in  $H_2O$ . (Brizard, C. R. 1899, 129. 216.)

**Potassium suboxide.**

Decomposes  $H_2O$ .

Does not exist. (Lupton, Chem Soc 1876, 2. 565.)

**Potassium oxide,  $K_2O$** 

Very sol in  $H_2O$  with much heat.

See Potassium hydroxide.

**Potassium dioxide,  $K_2O_2$ .**

Deliquescent. Sol in  $H_2O$ .

Forms compound  $K_2O_2, 2H_2O_2$ . (Schöne, A. 193. 241)

**Potassium peroxide,  $K_2O_4$ .**

Deliquescent Very sol. with decomp. in  $H_2O$ .

**Potassium silicon oxyfluoride,  $SiF_2(OK)_2$  and  $SiO(F)OK$ .**

(Schiff and Bechi, A. Suppl. 4. 33)

**Potassium tantalum oxyfluoride,  $K_4Ta_4O_4F_{14}$ .**

Insol. in boiling water. Easily sol. in  $HF + Aq$  (Marignac, A. ch. (4) 9. 208.)

**Potassium phosphide,  $KP_3$ .**

Decomp. by  $H_2O$ . (Joannis, C. C. 1894, II. 834.)

$KP_3$ . Easily decomp by  $H_2O$ . (Hugot, C. R. 1895, 121. 208.)

**Potassium hydrogen phosphide,  $PH_3K$ .**

Decomp. by  $H_2O$ . (Joannis, C. R. 1894, 119. 558)

**Potassium phosphoselenide,  $KSeP = K_2Se, P_2Se_3$ .**

Sol in cold  $H_2O$  with rapid decomp. Sol. in alcohol with slight decomp. (Hahn, J. pr. 93. 430.)

**Potassium phosphotriselenide,  $2K_2Se, P_2Se_3$ .**

Deliquescent. Decomp. violently with  $H_2O$ . Sol in alcohol or ether, or in a mixture of the two, with slight decomp., but decomp. gradually on the air. (Hahn, J. pr. 93. 436)

**Potassium phosphopentaseelenide,  $K_4P_2Se_7 = 2K_2Se, P_2Se_5$ .**

Deliquescent, immediately decomp. by  $H_2O$ , alcohol, or ether (Hahn)

**Potassium phosphosulphide,  $4K_2S_2, P_2S_5$ .**

Deliquescent Sol. in  $H_2O$  with decomp.

**Potassium selenide,  $K_2Se$ .**

Sol in  $H_2O$  with subsequent decomp. on the air.

Insol. in liquid  $NH_3$ ; sol. in air free  $H_2O$  to a colorless liquid. (Hugot, C. R. 1899, 129. 299)

+  $2H_2O$ . Sol. in  $H_2O$  with decomp. (Clever, Z. anorg. 1895, 10. 143)

+ 9, 14, or 19  $H_2O$ . (Fabre, C. R. 102. 613.)

**Potassium tetraseelenide,  $K_2Se_4$ .**

Easily sol in  $H_2O$ . Decomp on standing.

Sol. in liquid  $NH_3$ . (Hugot, C. R. 1899, 129. 299)

**Potassium monosulphide,  $K_2S$ .**

Deliquescent. Sol in  $H_2O$  and alcohol.  $H_2O$  solution decomp on air.

Sol in 10 pts. glycerine. (Cap and Garot, J. Pharm. (3) 26. 81.)

Moderately sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol in acetone and in methylal. (Eidmann, C. C. 1899, II 1014)

Insol in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+  $5H_2O$ . (Schöne, Pogg. 131. 380.)

All potassium sulphides are sol in glycerine; insol in ether and ethyl acetate.

**Potassium disulphide,  $K_2S_2$ .**

Sol. in  $H_2O$  and alcohol, with gradual decomp.

**Potassium trisulphide,  $K_2S_3$ .**

Sol. in  $H_2O$  and alcohol, with gradual decomp on the air.

**Potassium tetrasulphide,  $K_2S_4$ .**

Sol. in  $H_2O$  and alcohol.

+  $2H_2O$ . Sol in  $H_2O$ . Sl sol. in alcohol.

+  $8H_2O$ . Sol in  $H_2O$ . Alcohol takes out water (Schöne.)

**Potassium pentasulphide,  $K_2S_5$ .**

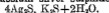
Sol. in  $H_2O$  and alcohol.

**Potassium palladium sulphide.**

See Sulphopalladate, potassium.

**Potassium platinum sulphide.**

See Sulphoplatinate, potassium.

**Potassium silver sulphide,**

Decomp. by  $\text{H}_2\text{O}$ . (Ditte, C R. 1895, 120 91)

**Potassium rhodium sulphide,  $3\text{K}_2\text{S}, \text{Rh}_2\text{S}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Leiché)

**Potassium tellurium sulphide.**

See Sulphotellurate, potassium.

**Potassium thallium sulphide,  $\text{K}_2\text{S}, \text{Tl}_2\text{S}_3$ .**

Not decomposed by  $\text{H}_2\text{O}$ , or hot  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . Decomp. by  $\text{HCl}$  or moderately conc.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Hot  $\text{HNO}_3 + \text{Aq}$  decomp. with separation of S. (Schneider, J. pr. 110. 168.)

**Potassium tin (stannic) sulphide.**

See Sulphostannate, potassium.

**Potassium zinc sulphide,  $\text{K}_2\text{S}, 3\text{ZnS}$** 

Not attacked by  $\text{H}_2\text{O}$ , but easily decomp. by the most dil. acids (Schneider, J. pr. (2) 8. 29.)

**Potassium telluride,  $\text{K}_2\text{Te}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Demarçay, Bull. Soc. (2) 40. 99.)

Sol. in  $\text{H}_2\text{O}$  and liquid  $\text{NH}_3$  (Hugot, C R. 1899, 129. 388.)

**Praseocobaltic chloride,**

Easily sol. in  $\text{H}_2\text{O}$

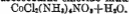
Dil.  $\text{HCl} + \text{Aq}$  dissolves traces; conc.  $\text{HCl} + \text{Aq}$  dissolves more. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp. Sol. in conc.  $\text{H}_2\text{SO}_4$  without decomp. Sl sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Rosc.)

— mercuric chloride,  $\text{Co}(\text{NH}_3)_4\text{Cl}_3, \text{HgCl}_2$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ ; insol. in  $\text{HgCl}_2 + \text{Aq}$ . (Vortmann, B. 15. 1892.)

— chloride dichromate,  
 $[\text{CoCl}_2(\text{NH}_3)_4]_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O}.$

Scarcely sol. in cold, easily sol. in warm  $\text{H}_2\text{O}$ . (Vortmann, B. 15. 1897.)

**Praseocobaltic chloride nitrate,**

Much less sol. in  $\text{H}_2\text{O}$  than the chloride. Precipitated from aqueous solution by dil.  $\text{HNO}_3 + \text{Aq}$ . (Vortmann, B. 16. 1896.)

**Praseodymicotungstic acid.****Ammonium praseodymicotungstate,**

Very sl sol. in  $\text{H}_2\text{O}$ . Decomp. by acids and alkalis. (E. F. Smith, J. Am. Chem. Soc. 1904, 26. 1478.)

**Barium praseodymicotungstate,  $4\text{BaO}, \text{Pr}_2\text{O}_3, 16\text{WO}_3 + 7\text{H}_2\text{O}$ .**

Ppt. Insol in  $\text{H}_2\text{O}$

$6\text{BaO}, \text{Pr}_2\text{O}_3, 16\text{WO}_3 + 9\text{H}_2\text{O}$  Ppt (E. F. Smith)

**Silver praseodymicotungstate,  $4\text{Ag}_2\text{O}, \text{Pr}_2\text{O}_3, 16\text{WO}_3 + 8\text{H}_2\text{O}$ .**

Insol in  $\text{H}_2\text{O}$  (E F Smith)

**Praseodymium, Pr****Praseodymium bromide,  $\text{PrBr}_3 + 6\text{H}_2\text{O}$** 

Very sol. in  $\text{H}_2\text{O}$ , sol. in  $\text{HBr}$ . (von Schule, Z. anorg. 1898, 18. 353.)

**Praseodymium carbide,  $\text{PrC}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ ; insol. in conc.  $\text{HNO}_3$ , decomp. by dil.  $\text{HNO}_3$  (Moissan, C R. 1900, 131. 597)

**Praseodymium chloride,  $\text{PrCl}_3$ .**

Very sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{PCl}_3$  or  $\text{SnCl}_4$ . Sol. in alcohol. Insol. in ether and most organic solvents. (Matignon, C. R. 1902, 134. 427.)

2.14 g.  $\text{PrCl}_3$  dissolve in 100 g. pyridine at  $15^\circ$ . (Matignon, Int. Cong. App. Chem. 1909, 2. 53.)

+  $\text{H}_2\text{O}$ .

+  $3\text{H}_2\text{O}$ .

+  $7\text{H}_2\text{O}$ . 100 g.  $\text{H}_2\text{O}$  dissolve 334.2 g.  $\text{PrCl}_3 + 7\text{H}_2\text{O}$  or 103.9 g. of the anhydrous salt at  $13^\circ$ . The aqueous solution sat. at  $14^\circ$  has a sp. gr.  $16^\circ/18^\circ = 1.687$ . At  $100^\circ$ , the solubility in  $\text{H}_2\text{O}$  is unlimited. (Matignon, A. ch. 1906, (8) 8. 388.)

Sol. in conc.  $\text{HCl}$ . (von Schule, Z. anorg. 1898, 18. 352.)

100 pts. of a solution of the salt in  $\text{HCl} + \text{Aq}$  contain at  $13^\circ$  41.05 pts. of anhydrous salt and 7.25 pts.  $\text{HCl}$ . Sp. gr. of this solution at  $16^\circ = 1.574$ . (Matignon, A. ch. 1906, (8) 8. 388.)

**Praseodymium hydride,  $\text{PrH}_3$  (?)**

(Muthmann, A. 1904, 331. 59.)

**Praseodymium hydroxide.**

Sol. in citric acid (Baskerville, J. Am. Chem. Soc. 1904, 26. 49.)

**Praseodymium nitride,  $\text{PrN}$ .**

Decomp. in moist air with evolution of  $\text{NH}_3$ . (Muthmann, A. 1904, 331. 59.)

**Praseodymium oxide,  $\text{Pr}_2\text{O}_3$ .**

Easily sol. in  $\text{H}_2\text{O}$  (v. Welsbach, M. 8. 477)

Decomp. by heating in the air. (Scheele, Z. anorg. 1898, 17. 322)

**Praseodymium monoperoxide,  $\text{Pr}(\text{OH})_2\text{H}_2\text{O}$**   
(Melikoff, Chem. Soc. 1902, 82. (2) 140.)

**Praseodymium superoxide,  $\text{Pr}(\text{OH})_2(\text{OOH})$ .**  
Ppt. (Melikoff, C. C. 1902, I. 172)

**Praseodymium bisulphoxide,  $\text{Pr}(\text{OOH})_2$ .**  
Ppt. (Melikoff)

**Praseodymium peroxide,  $\text{Pr}_2\text{O}_7$ .**  
Sol. in acids with evolution of O (v. Welsbach)

**Praseodymium oxysulphide,  $\text{Pr}_2\text{SO}_2$**   
(Biltz, Z. anorg. 1911, 71. 436)

**Praseodymium disulphide,  $\text{PrS}_2$**   
Decomp. by heat (Biltz, Z. anorg. 1911, 71. 437.)

**Purpureocobaltic salts.**

For other purpureocobaltic salts, see—

Chloropurpureocobaltic salts.

Bromopurpureocobaltic salts.

Nitratopurpureocobaltic salts.

Sulphatopurpureocobaltic salts.

**Purpureocobaltic cobaltcyanide,**  
 $\text{Co}(\text{NH}_3)_5\text{Co}(\text{CN})_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ .

— ferricyanide,  $\text{Co}(\text{NH}_3)_5\text{Fe}(\text{CN})_6$ .  
Insol. in cold  $\text{H}_2\text{O}$ . Probably belongs to roseo series.

— mercuric hydroxychloride,  
 $\text{CoN}_3\text{H}_{11}(\text{HgCl})_2(\text{HgOH})\text{Cl}_3$ .  
Ppt. (Vortmann and Morgulis, B. 22. 2045.)  
 $\text{CoN}_3\text{H}_{11}(\text{HgOH})\text{Cl}_3$ . Ppt. (V. and M.)

— mercuriodide, basic,  
 $\text{CoN}_3\text{H}_{11}(\text{HgI}_2)_2(\text{HgOH})\text{I}_3$ .  
Ppt. Sl. sol. in acids. Sol. in KI + Aq. (Vortmann and Borsbach, B. 23. 2804.)

— molybdate,  $\text{Co}_2\text{O}_3(\text{NH}_3)_{10}$ ,  $7\text{MoO}_3 + 3\text{H}_2\text{O}$  (?).  
Insol. in  $\text{H}_2\text{O}$  or dil.  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq.}$  (Carnot, C. R. 109. 109)

— sulphate.  
See Sulphatopurpureocobaltic salts.

— tungstate,  $\text{Co}(\text{NH}_3)_5\text{O}(\text{WO}_3)$ .  
Scarcely sol. in cold or hot  $\text{H}_2\text{O}$ . (Gibbs.)  
 $\text{Co}_2\text{O}_3(\text{NH}_3)_{10}$ ,  $10\text{WO}_3 + 9\text{H}_2\text{O}$  (?). Insol.

in  $\text{H}_2\text{O}$ , or dil.  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq.}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Carnot, C. R. 109. 147)

**Purpureocobaltic vanadate,  $\text{Co}_2\text{O}_3(\text{NH}_3)_{10}$ ,  $5\text{V}_2\text{O}_5 + 9\text{H}_2\text{O}$  (?).**

Ppt. Insol. in  $\text{H}_2\text{O}$  (Carnot, C. R. 109. 147)

**Purpureocobaltic octamine salts.**

See Octamine cobaltic purpureo salts.

**Pyrosulphuric acid,  $\text{H}_2\text{S}_2\text{O}_7$** 

See Disulphuric acid.

**Radium, Ra****Radium A.**

More sol. than Radium B and C in all solvents; sol. even in organic solvents, especially  $\text{CS}_2$  (Ramstedt, Le Radium, 1913, 10. 159)

**Radium B.**

More quickly sol. than Radium C in  $\text{H}_2\text{O}$  and acids, less quickly sol. in alkaline solutions, very sl. sol. in organic solvents (Ramstedt, Le Radium, 1913, 10. 159)

**Radium C.**

Sol. in common acids, less so in alkaline solutions and in  $\text{H}_2\text{O}$ , only very sl. sol. in organic solvents (Ramstedt, Le Radium, 1913, 10. 159; Chem. Soc. 1913, 104. (2) 659.)

**Radium bromide.**

Less sol. in  $\text{H}_2\text{O}$  than corresponding Ba comp. (Curie, Dissert. 1903.)

**Radium chloride.**

Less sol. in  $\text{H}_2\text{O}$  than corresponding Ba comp. (Curie, Dissert. 1903.)

**Radium emanation.**

Coefficient of absorption for  $\text{H}_2\text{O} = \text{C}$  245 at  $3^\circ$ ; 0.23 at  $20^\circ$ ; 0.17 at  $40^\circ$ ; 0.135 at  $60^\circ$ ; 0.12 at  $70^\circ$ ; 0.12 at  $80^\circ$ . (Hofmann, Phys. Zeit. 1905, 6. 339)

**Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$** 

Coefficient of solubility = conc. of the emanation in the liquid: conc. of the emanation in the gas

$t^\circ$	Coefficient of solubility
0	0.506
4.3	0.424
5.7	0.398
10.0	0.340
14.0	0.303
17.6	0.280
20.0	0.245
26.8	0.206
31.6	0.193
39.1	0.160

Coefficient of solubility in sea-water of sp. gr. at  $14^\circ = 1.022$  is 0.255.

(Boyle, Phil. Mag. 1911, (6) 22. 850.)

Solubility in  $H_2O$ .

Temp.	0.5°	17.5°	35°	41°	51°
Sol.	0.520	0.283	0.183	0.161	0.138
Temp.	60°	74°	79°	82°	91°
Sol.	0.127	0.112	0.111	0.111	0.108

(Kofler, M. 1913, 34. 389.)

Coefficient of solubility of radium emanation at 14° in various solvents.

Ethyl alcohol	7.34
Amyl alcohol	9.31
Toluene	13.7
Sea water	0.255
Mercury	0

(Boyle, Phil. Mag. 1911, (6) 22. 851.)

Coefficient of solubility emanation of radium in various solvents at t°.

Solvents	t = 18°	t = 0°	t = -18°
Ethyl acetate	7.35	9.41	13.6
Acetone	6.30	7.99	10.8
Absolute alcohol	6.17	8.28	11.4
Aniline	3.80	4.43	.
Benzene	12.82	16.54 at 3°	.
Chloroform	15.08	20.5	28.5
Cyclohexane	18.04 at 80°		
Water	0.285	0.52	
Ether	15.08	20.09	29.1
Glycerine	0.21		
Hexane	16.56	23.4	35.2
Paraffine oil	9.2	12.6	
Carbon-bisulphide	23.14	33.4	50.3
Toluene	13.24	18.4	27
Xylene	12.75		

(Ramstedt, Le Radium, 1911, 8. 255.)

## Solubility in various oils, etc., at t°.

Rape oil		Poppy seed oil		Oil of turpentine	
t°	Solubility	t°	Solubility	t°	Solubility
-3	51.2	-5	50.5	-21	42.5
10	35.3	16	30.2	0	23.1
20	26.1	40	19.1	18	16.6
100	6.2	65	12.4	50	7.5
200	3.3	90	8.4	6.5	4.08

Solubility in 10% dammar resin in oil of turpentine = 16.7 at 18°.

Solubility in 5% colophony in amyl alcohol = 11.2 at 20°.

Solubility in amyl alcohol = 10.6 at 18°.

Solubility in 20% colophony in amyl alcohol = 11.1 at 20°.

(Curie, Thesis. 1910.)

Coefficient of absorption for petroleum =

22.70 at -21°.

12.87 at +3°.

9.55 at 20°.

8.13 at 40°.

7.01 at 60°.

(Hofmann, Phys. Zeit. 1905, 6. 339.)

Rhodicyanhydric acid,  $H_2Rh(CN)_4$ .

Not known in the free state

Potassium rhodicyanide,  $K_2Rh(CN)_4$ .

Sol in  $H_2O$ . Easily decomp. by acids.

Very sol. in  $H_2O$ . (Leidie, C. R. 1900, 130. 89.)

## Rhodium, Rh.

Insol. in all acids, including aqua regia.

Rhodium "sponge" is sol. in  $HNO_3 + Aq$ , and somewhat in  $HCl + Aq$  when exposed to air

## Rhodium ammonia compounds.

See—

Bromopurpureorhodium comps.,  $BrRh(NH_3)_5X_2$ .

Chloropurpureorhodium comps.,  $ClRh(NH_3)_5X_2$ .

Iodopurpureorhodium comps.,  $IRh(NH_3)_5X_2$ .

$IRh(NH_3)_5X_2$ .

Luteorhodium comps.,  $Rh(NH_3)_5X_2$ .

Nitratopurpureorhodium comps.,  $(NO_3)Rh(NH_3)_5X_2$ .

Roseorhodium comps.,  $Rh(NH_3)_5(OH)_2X_2$ .

Xanthorhodium comps.,  $(NO_2)Rh(NH_3)_5X_2$ .

Rhodium tribromide,  $RhBr_3 \cdot 2H_2O$ .

Very sol. in  $H_2O$  (Goloubkine, Chem. Soc. 1911, 100. (2) 45.)

## Rhodium rubidium bromide.

See Bromorhodite, rubidium.

## Rhodium sodium bromide.

See Bromorhodite, sodium.

Rhodium dichloride,  $RhCl_2$  (?).

Insol. in  $H_2O$ ,  $HCl$ , or  $HNO_3 + Aq$ . Not attacked by boiling  $KOH$  or  $K_2CO_3 + Aq$ . (Fellenberg.)

Decomp. by boiling  $KOH + Aq$ . (Bezelius.) Does not exist. (Leidie, C. R. 106. 1076.)

Rhodium trichloride,  $RhCl_3$ .

Insol. in acids, even aqua regia. When boiled for a long time with  $KOH + Aq$ , it becomes sol. in  $HCl + Aq$ .

Insol. in  $H_2O$  and acids; sol. in alkalis +  $Aq$ . (Leidie, C. R. 1899, 129. 1251.)

+  $4H_2O$ . Very sl. deliquescent. Easily sol. in  $H_2O$ ,  $HCl + Aq$ , or alcohol. Insol. in ether. Decomp. by  $H_2SO_4$  only when boiling (Claus, J. pr. 80. 282.)

No definite amount of crystal  $H_2O$ . (Leidié A. ch. (6) 17. 271.)

**Rhodium chloride with MCl.**

See Chlororhodite, M.

**Rhodium dihydroxide,  $RhO_2 \cdot 2H_2O$ , or Rhodium rhodate,  $Rh_2O_3$ ,  $RhO_3 \cdot 6H_2O$**

Sol in  $HCl + Aq$

**Rhodium sesquihydroxide,  $Rh_2O_3 \cdot H_2O$ .**

Only sl. sol. in conc.  $HCl + Aq$ . (Claus.)  
 $+ 2H_2O$ . Easily sol in  $HCl$ ,  $H_2SO_4$ ,  $H_2SO_5$ ,  $HNO_3$ , or  $HSCN + Aq$ , also when moist, in  $H_2C_2O_4 + Aq$ . Sol. in conc.  $KOH + Aq$ ; very sl sol in  $H_2BO_3$ ,  $H_3PO_4$ ,  $H_2C_2H_4O_4$ , and  $H_2CN + Aq$ . Sol in acid alkali oxalates  $+ Aq$ . (Leidié, C R. 107. 234)

**Rhodium trioxide,  $RhI_3$ .**

Ppt (Goloubkine, Chem Soc. 1911, 100. (2) 45)

**Rhodium monoxide,  $RhO$ .**

Not attacked by acids. (Deville and Debray, A. ch (3) 61. 83.)

**Rhodium sesquioxide,  $Rh_2O_3$ .**

Insol in  $H_2O$ , boiling  $KOH + Aq$ , or any acid, even aqua regia (Claus.)

**Rhodium dioxide,  $RhO_2$ .**

Insol. in all acids or alkalis

**Rhodium trioxide,  $RhO_3$ .**

"Rhodic acid." Known only in solution of "Potassium rhodate," which is very easily decomp. (Claus)

**Rhodium oxybromide,  $Rh(OH)_2Br + 2H_2O$ .**

Sol. in  $H_2O$ . (Goloubkine, Chem Soc. 1911, 100. (2) 45)

**Rhodium monosulphide,  $RhS$ .**

Insol in aqua regia.

**Rhodium sesquisulphide,  $Rh_2S_3$ .**

Sol. in alkali sulphides  $+ Aq$ . (Debray, C. R. 97. 1332)

Insol in alkali sulphides  $+ Aq$ . Not attacked by  $HNO_3$ , aqua regia, or  $Br_2 + Aq$ . (Leidié, Bull. Soc. (2) 60. 664)

**Rhodium sodium sulphide,  $3Na_2S$ ,  $Rh_2S_3$ .**

Decomp. by  $H_2O$ . (Leidié)

**Rhodium sesquisulphydride,  $Rh_2S_3 \cdot H_2S$ .**

Easily sol. in aqua regia or  $Br_2 + Aq$ . Insol. in alkali sulphides  $+ Aq$  or acids. (Leidié, Bull. Soc. (2) 60. 664.)

**Rhodochromium bromide,**

$HO Cr_2(NH_4)_{10} Br_4 + H_2O$

Rather difficultly sol in  $H_2O$ . Decomp. by boiling or standing. Sol in  $NH_4OH + Aq$  or  $NaOH + Aq$ . Insol. in dil  $HBr + Aq$ ,  $KBr + Aq$ , or alcohol. (Jørgensen, J. pr (2) 26. 321.)

— bromide, basic,  $HO Cr_2(NH_4)_{10}(OH) Br_4 + H_2O$ .

Sl sol in  $H_2O$ . Sol in  $NH_4OH$  or  $NaOH + Aq$ . Insol in alcohol (Jørgensen.)

— bromoplatinate,  $HO Cr_2(NH_4)_{10} Br_4 Pt Br_2$ ,  $HO Cr_2(NH_4)_{10} Br_4 (Pt Br_2)_2 + 4H_2O$ .

Ppt (Jørgensen.)

— chloraurate,  $HO Cr_2(NH_4)_{10} Cl_2 (Au Cl_4)_2 + 2H_2O$ .

Difficultly sol. but not insol in  $H_2O$  (Jørgensen)

— chloride,  $HO Cr_2(NH_4)_{10} Cl_2 + H_2O$ .

Sol. in about 40 pts of cold  $H_2O$ . Insol in cold dil  $HCl + Aq$ ,  $NH_4Cl + Aq$ , or alcohol. Sol. in  $NH_4OH + Aq$ . (Jørgensen, J. pr. (2) 26. 321)

— chloriodide, basic,  $HO Cr_2(NH_4)_{10}(OH) Cl_2 I_2$ .

Sl sol in cold  $H_2O$ ; insol. in alcohol. (Jørgensen.)

— chloroplatinate,  $HO Cr_2(NH_4)_{10} Cl_2 Pt Cl_6$ ,  $HO Cr_2(NH_4)_{10} Cl_2 (Pt Cl_6)_2 + 4H_2O$ .

Precipitate. (Jørgensen.)

— dithionate,  $[HO Cr_2(NH_4)_{10}]_2 (S_2O_6)_2 + 2H_2O$

Nearly insol. in  $H_2O$ .

— dithionate, basic,  $HO Cr_2(NH_4)_{10}(OH) (S_2O_6)_2 + H_2O$ .

Insol. in  $H_2O$ , cold  $NH_4OH + Aq$ , or  $NaOH + Aq$

— iodide,  $HO Cr_2(NH_4)_{10} I_2 + H_2O$ .

Very difficultly sol in  $H_2O$ . Insol. in very dil  $HI + Aq$  or alcohol. Sl. sol. in  $NH_4OH$  or  $KOH + Aq$  (Jørgensen.)

— nitrate,  $HO Cr_2(NH_4)_{10} (NO_3)_2$ .

Rather difficultly sol. in  $H_2O$ , from which it is precipitated by a few drops of  $HNO_3 + Aq$ . Sol. in hot dil  $NH_4OH + Aq$ .

— nitrate chloroplatinate,  $HO Cr_2(NH_4)_{10} (NO_3)_2 (Pt Cl_6)_2 + 4H_2O$ .

Precipitate (Jørgensen.)

**Rhodochromium sulphate,**

$[HO Cr_2(NH_4)_{10}]_2 (SO_4)_4 + 2H_2O$

Very sl sol in cold  $H_2O$ . Easily sol. in cold dil.  $H_2SO_4 + Aq$ .

Almost insol. in a mixture of 3 vols.  $\text{H}_2\text{O}$ , 1 vol. alcohol, and  $\frac{1}{2}$  vol dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Jørgensen)

### Rhodonitrous acid.

**Ammonium rhodonitrite**,  $(\text{NH}_4)_2\text{Rh}_2(\text{NO}_2)_{12}$

Newly insol in cold, sl sol in hot  $\text{H}_2\text{O}$  Insol in conc.  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  Insol. in alcohol (Leidlé, C. R. 111. 108)

**Barium rhodonitrite**,  $\text{Ba}_2\text{Rh}_2(\text{NO}_2)_{12}$

Sl sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Lamy)

+  $12\text{H}_2\text{O}$ . Sol in 50 pts  $\text{H}_2\text{O}$  at  $16^\circ$ , and 6.5 pts. at  $100^\circ$  (Leidlé, C. R. 111. 108)

**Potassium rhodonitrite**,  $\text{K}_2\text{Rh}_2(\text{NO}_2)_{12}$

Nearly insol. in cold, very sl sol. in boiling  $\text{H}_2\text{O}$ . Completely insol in  $\text{KNO}_3 + \text{Aq}$ , and in  $\text{KCl} + \text{Aq}$  (30%  $\text{KCl}$ ), or  $\text{KC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (50%  $\text{KC}_2\text{H}_3\text{O}_2$ ) Insol. in alcohol (Leidlé, C. R. 111. 106.)

**Sodium rhodonitrite**,  $\text{Na}_2\text{Rh}_2(\text{NO}_2)_{12}$

Sol in  $2\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at  $17^\circ$ , and 1 pt at  $100^\circ$  Insol. in alcohol Decomp by  $\text{HCl} + \text{Aq}$ . (Leidlé, C. R. 111. 107)

### Rhodosochromium bromide.

Sol in  $\text{H}_2\text{O}$ ; insol in dil  $\text{HBr} + \text{Aq}$  (1). (Jørgensen, J. pr. (2) 45. 260)

— **chloraurate**,  $\text{Cr}_2(\text{NH}_3)_4(\text{HO})_2\text{Cl}_3$ ,  $2\text{AuCl}_3 + 2\text{H}_2\text{O}$

Not insol. in cold  $\text{H}_2\text{O}$ . (Jørgensen.)

— **chloride**,  $\text{Cr}_2(\text{NH}_3)_4(\text{HO})_2\text{Cl}_3 + 2\text{H}_2\text{O}$ .

Sol in 10.6 pts  $\text{H}_2\text{O}$  at  $18^\circ$ ; decomp by boiling. Pptd. by  $\frac{1}{2}$  to 1 vol. dil  $\text{HCl} + \text{Aq}$ . Sol in cold dil  $\text{NH}_4\text{OH} + \text{Aq}$ . (Jørgensen, J. pr. (2) 45. 260)

— **chloroplatinate**,  $2\text{Cr}_2(\text{NH}_3)_4(\text{OH})_2\text{Cl}_3$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  (Jørgensen.)

$\text{Cr}_2(\text{NH}_3)_4(\text{OH})_2\text{Cl}_3$ ,  $2\text{PtCl}_4 + 2\text{H}_2\text{O}$  Insol. in 95% alcohol. (Jørgensen.)

— **chromate**,  $(\text{Cr}_2(\text{NH}_3)_4(\text{OH})_2(\text{CrO}_4)_2 + 7\text{H}_2\text{O}$ . (Jørgensen.)

Very sl sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

— **iodide**,  $\text{Cr}_2(\text{NH}_3)_4(\text{OH})_2\text{I}_3 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  Insol. in dil.  $\text{HI} + \text{Aq}$ . (Jørgensen.)

— **nitrate**,  $\text{Cr}_2(\text{NH}_3)_4(\text{OH})_2(\text{NO}_3)_2 + \text{H}_2\text{O}$ .

Much less sol. in cold  $\text{H}_2\text{O}$  than the chloride Insol in dil.  $\text{HNO}_3 + \text{Aq}$ . (Jørgensen.)

— **oxalate**,  $(\text{Cr}_2(\text{NH}_3)_4(\text{OH})_2)_2(\text{C}_2\text{O}_4)(\text{HC}_2\text{O}_4)_4 + 2\text{H}_2\text{O}$

Sol. in cold  $\text{H}_2\text{O}$ , but not very easily. (Jørgensen.)

### Rhodosochromium sulphate,

$[\text{Cr}_2(\text{NH}_3)_4(\text{OH})_2]_2(\text{SO}_4)_3 + 5\text{H}_2\text{O}$

Very sl sol in cold  $\text{H}_2\text{O}$ . Easily sol in dil.  $\text{NH}_4\text{Cl} + \text{Aq}$  (Jørgensen)

$[\text{Cr}_2(\text{NH}_3)_4(\text{OH})_2]\text{SO}_4 \cdot \text{HSO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into  $\text{H}_2\text{SO}_4$  and above compound (Jørgensen.)

— **persulphide**,  $[\text{Cr}_2(\text{NH}_3)_4(\text{OH})_2]_2\text{S}_{11} + 4\text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$  (Jørgensen)

### Rhodosulphuric acid.

**Potassium rhodosulphate**,  $\text{K}_2\text{Rh}_2(\text{SO}_4)_4$ .

Two modifications

(a) Slowly sol in cold, easily in hot  $\text{H}_2\text{O}$

(b) Insol in  $\text{H}_2\text{O}$ .

Does not exist. (Leidlé, C. R. 107. 234.)

### Sodium rhodosulphate.

Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia. (Claus)

Does not exist (Leidlé)

$\text{Na}_2\text{Rh}_2(\text{SO}_4)_4$  Insol in  $\text{H}_2\text{O}$ . (Seubert and Kobbé, B. 23. 2560)

### Rhodosulphurous acid.

**Potassium rhodosulphite**,  $\text{K}_2\text{Rh}_2(\text{SO}_3)_2 + 6\text{H}_2\text{O}$

Nearly insol. in  $\text{H}_2\text{O}$ . Slowly sol. in acids. Not decomp. by boiling  $\text{KOH} + \text{Aq}$ . (Claus.)

### Sodium rhodosulphite,

$\text{Na}_2\text{Rh}_2(\text{SO}_3)_2 + 4\frac{1}{2}\text{H}_2\text{O} = 3\text{Na}_2\text{SO}_3$ ,  $2\text{RhSO}_3$

Insol in cold, very sl sol. in hot  $\text{H}_2\text{O}$ . Easily sol in  $\text{HNO}_3 + \text{Aq}$ . (Seubert and Kobbé, B. 23. 2558)

### Roseochromium bromide,

$\text{Cr}(\text{NH}_3)_5\text{Br}_2 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  Insol in  $\text{HBr} + \text{Aq}$ . (Christensen, J. pr. (2) 23. 26)

— **bromochromate**,  $\text{Cr}(\text{NH}_3)_5\text{Br}(\text{CrO}_4)$ .

Somewhat sol. in  $\text{H}_2\text{O}$ , but decomp. on standing. (Jørgensen, J. pr. (2) 25. 398.)

— **bromoplatinate**,  $\text{Cr}(\text{NH}_3)_5\text{Br}(\text{PtBr}_6) + 2\text{H}_2\text{O}$ .

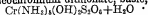
Preprecipitate Difficultly sol. in  $\text{H}_2\text{O}$ . (Christensen, l. c.)

— **chloride**,  $\text{Cr}(\text{NH}_3)_5\text{Cl}_2 + \text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$  with subsequent decomp. Insol. in alcohol (Christensen, J. pr. (2) 23. 26)

— **mercuric chloride**,  $\text{Cr}(\text{NH}_3)_5\text{Cl}_2$ ,  $3\text{HgCl}_2 + 2\text{H}_2\text{O}$ .

Sl sol. in  $\text{H}_2\text{O}$ . Sol in dil.  $\text{HCl} + \text{Aq}$  with decomposition (Christensen, l. c.)

**Roseochromium dithionate, basic,**

Easily sol in very dil.  $\text{HCl} + \text{Aq.}$  (Jørgensen, J pr (2) 25. 398.)

— **iodide,  $\text{Cr}(\text{NH}_4)_2\text{I}_2$** 

Easily sol in  $\text{H}_2\text{O}$ ; decomp by boiling (Christensen, l. c.)

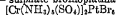
— **nitrate,  $\text{Cr}(\text{NH}_4)_2(\text{NO}_3)_2 + \text{H}_2\text{O}$** 

Rather easily sol in  $\text{H}_2\text{O}$ . (Christensen, l. c.)

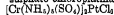
$\text{Cr}(\text{NH}_4)_2(\text{NO}_3)_2(\text{OH})_2$ ,  $\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$  or alcohol (Jørgensen, J pr (2) 44. 63)

— **sulphate,  $[\text{Cr}(\text{NH}_4)_2]_2(\text{SO}_4)_2 + 5\text{H}_2\text{O}$** 

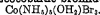
Easily sol in  $\text{H}_2\text{O}$ . Precipitated by alcohol (Christensen, l. c.)

— **sulphate bromoplatinate,**

Difficultly sol in  $\text{H}_2\text{O}$ . (Christensen, l. c.)

— **sulphate chloroplatinate,**

Difficultly sol in  $\text{H}_2\text{O}$ . (Christensen, l. c.)

**Roseocobaltic bromide,**

Sol in  $\text{H}_2\text{O}$ ; insol. in  $\text{HBr} + \text{Aq}$  (Jørgensen, J. pr. (2) 31. 49)

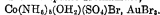
— **bromoplatinate,  $\text{Co}(\text{NH}_4)_2(\text{OH})_2\text{Br}_2$** 

Somewhat sol in  $\text{H}_2\text{O}$  or dil. alcohol. Insol in strong alcohol. (Jørgensen.)

$2\text{Co}(\text{NH}_4)_2(\text{OH})_2\text{Br}_2$ ,  $3\text{PtBr}_4 + 4\text{H}_2\text{O}$  Ppt (Jørgensen)

— **bromosulphate,**

Sol in  $\text{H}_2\text{O}$ . (Krok.)

— **bromosulphate bromaurate,**— **carbonate.**

Very sol in  $\text{H}_2\text{O}$ .

— **chloraurate,  $\text{Co}(\text{NH}_4)_2(\text{OH})_2\text{Cl}_2$ ,  $\text{AuCl}_3$** 

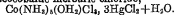
Moderately sol. in cold  $\text{H}_2\text{O}$ .

— **chloride,  $\text{Co}(\text{NH}_4)_2(\text{OH})_2\text{Cl}_2$** 

Sol. in 4.8 pts  $\text{H}_2\text{O}$  at  $10^\circ$ , but decomp. on heating.

100 pts.  $\text{H}_2\text{O}$  dissolve 16.12 pts at  $0^\circ$ , and 24.87 pts. at  $16^\circ$ . (Kurnakoff, J. russ Soc. 24. 269)

Sl. sol. in 1000 pts. fuming  $\text{HCl} + \text{Aq}$ , more easily in 20%  $\text{HCl} + \text{Aq}$  (Rose.)

**Roseocobaltic mercuric chloride,**

More easily sol in solvents than the anhydrous purpureo salt. (Carstanjen.)

$\text{Co}(\text{NH}_4)_2(\text{OH})_2\text{Cl}_2$ ,  $\text{HgCl}_2$ . Sol. in  $\text{HCl} + \text{Aq}$  with decomp. into above salt. (Jørgensen.)

— **chloroplatinate,**

Decomp by  $\text{H}_2\text{O}$ . (Jørgensen)

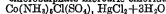
$2\text{Co}(\text{NH}_4)_2(\text{OH})_2\text{Cl}_2$ ,  $\text{PtCl}_4 + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ .

$2\text{Co}(\text{NH}_4)_2(\text{OH})_2\text{Cl}_2$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$ . Not difficultly sol. in warm  $\text{H}_2\text{O}$ . (Gibbs.)

$\text{Co}(\text{NH}_4)_2\text{Cl}_2$ ,  $\text{PtCl}_4 + \text{H}_2\text{O}$  (Gibbs.)

— **chlorosulphate,  $\text{Co}(\text{NH}_4)_2\text{Cl}(\text{SO}_4)$** 

Easily sol in  $\text{H}_2\text{O}$ .

— **chlorosulphate mercuric chloride,**

Sol. in bot  $\text{H}_2\text{O}$ , and can be recrystallized without decomp. (Krok)

— **dichromate,**

Can be recrystallized out of weak acetic acid

— **cobalticyanide,  $\text{Co}(\text{NH}_4)_2(\text{OH})_2\text{Co}(\text{CN})_6$** 

Nearly absolutely insol. in cold  $\text{H}_2\text{O}$ . (Jørgensen.)

$+ \text{H}_2\text{O}$ . (Gibbs and Gentile.)

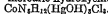
— **dithionate,  $\text{Co}(\text{NH}_4)_2(\text{S}_2\text{O}_6)(\text{OH})$** 

Decomp by  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 58. 296.)

$\text{Co}(\text{NH}_4)_2(\text{OH})_2(\text{S}_2\text{O}_6) + 2\text{H}_2\text{O}$ . Ppt. (Jørgensen.)

— **hydroxide,  $\text{Co}(\text{NH}_4)_2(\text{OH})_2$** 

Known only in aqueous solution.

— **mercuric hydroxychloride,**

Ppt Sol. in dil. acids. (Vortmann and Morgulis, B. 22. 2646.)

$\text{CoN}_4\text{H}_{12}(\text{HgOH})_2\text{Cl}_2(\text{OH})$ . Ppt Sol. in dil. acids. (Vortmann and Morgulis.)

— **iodide,  $\text{Co}(\text{NH}_4)_2(\text{OH})_2\text{I}_2$** 

Less sol. in  $\text{H}_2\text{O}$  than bromide Insol. in  $\text{HI} + \text{Aq}$  (Jørgensen)

— **iodosulphate,  $\text{Co}(\text{NH}_4)_2(\text{OH})_2\text{I}(\text{SO}_4)$** 

Easily sol in  $\text{H}_2\text{O}$ . (Krok)

— **mercuriodide,  $[\text{CoN}_4\text{H}_{12}]_2(\text{HgI})_2\text{I}_2$** 

Ppt. (Vortmann and Borsbach, B. 23. 2805.)

$\text{CoN}_4\text{H}_{12}(\text{HgI})_2\text{I}_2$ . Ppt. (Vortmann and Borsbach)

$\text{CoN}_4\text{H}_{12}(\text{HgI})_2\text{I}_2(\text{OH})$  Ppt.

**Roseocobaltic nitrate,**  
 $\text{Co}(\text{NH}_3)_4(\text{OH}_2)(\text{NO}_3)_2$

Three modifications:

$\alpha$ . Sol. in 20 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Jørgensen)  
 $\beta$  Known only in solution. Insol in cold  $\text{HNO}_3$  + Aq. (Gibbs.)

$\gamma$ . Easily sol. in hot  $\text{H}_2\text{O}$  (Gibbs) (Purpureo salt?)

$\text{Co}(\text{NH}_3)_4(\text{OH}_2)(\text{NO}_3)_2$ ,  $\text{HNO}_3$  Decomp by  $\text{H}_2\text{O}$  or alcohol. (Jørgensen, J. pr. (2) 44. 83.)

— **nitrate chloroplatinate,**  
 $\text{Co}(\text{NH}_3)_4(\text{OH}_2)(\text{NO}_3)\text{Cl}_2$ ,  $\text{PtCl}_4 + \text{H}_2\text{O}$   
 Ppt. (Jørgensen.)

— **nitatosulphate,**  
 $\text{Co}(\text{NH}_3)_4(\text{OH}_2)(\text{NO}_3)(\text{SO}_4)$   
 Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ .

— **oxalate,**  $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{C}_2\text{O}_4)_2 + 2\text{H}_2\text{O}$ .  
 Nearly insol in  $\text{H}_2\text{O}$ .  
 $[\text{Co}(\text{NH}_3)_4]_2(\text{C}_2\text{O}_4)_2$ ,  $4\text{H}_2\text{C}_2\text{O}_4$ .

— **oxalochloroplatinate,**  
 $[\text{Co}(\text{NH}_3)_4]_2(\text{C}_2\text{O}_4)\text{Cl}_2$ ,  $\text{PtCl}_4$ .  
 Sol. in hot  $\text{H}_2\text{O}$ .

— **oxalosulphate,**  $[\text{Co}(\text{NH}_3)_4]_2(\text{SO}_4)_2\text{C}_2\text{O}_4$ ,  
 $\text{H}_2\text{C}_2\text{O}_4 + 2\text{H}_2\text{O}$ .  
 Sol. in hot  $\text{H}_2\text{O}$ .  
 $[\text{Co}(\text{NH}_3)_4]_2(\text{SO}_4)_2(\text{C}_2\text{O}_4)(\text{OH})_2 + 6\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ .

— **orthophosphate,**  
 $\text{Co}(\text{NH}_3)_4(\text{OH}_2)(\text{PO}_4\text{H})(\text{OH}) + x\text{H}_2\text{O}$ .  
 Nearly insol. in  $\text{H}_2\text{O}$ .  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{PO}_4\text{H})_2 + 4\text{H}_2\text{O}$  Very sl. sol in cold  $\text{H}_2\text{O}$ ; easily in  $\text{H}_2\text{O}$  containing  $\text{HCl}$ . (Jørgensen.)

— **pyrophosphate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)]_4(\text{P}_2\text{O}_7)_2 + 12\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$ . (Jørgensen)  
 $\text{Co}(\text{NH}_3)_4(\text{OH}_2)(\text{P}_2\text{O}_7\text{Na}) + 12\text{H}_2\text{O}$  Nearly insol in cold, easily sol. in hot  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$ . (Jørgensen, J. pr. (2) 23. 252.)

— **sulphate,**  $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .  
 Three modifications:  
 $\alpha$  Sl. sol. in cold  $\text{H}_2\text{O}$ . Sol. in 58 pts. at  $27^\circ$  (Gibbs); 83.5 pts. at  $20.2^\circ$ , and 94.6 pts. at  $17.2^\circ$  (Jørgensen); more easily sol in hot  $\text{H}_2\text{O}$ , and still more easily in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
 $\beta$ . Sol. in 1–2 pts.  $\text{H}_2\text{O}$ . (Gibbs.)  
 $\gamma$ . Less sol. than lutesulphate. (Jørgensen.)  
 $+2\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Vortmann.)

**Roseocobaltic sulphate, acid,**  
 $[\text{Co}(\text{NH}_3)_4]_2(\text{SO}_4)_2 \cdot 2\text{H}_2\text{SO}_4 + 3\text{H}_2\text{O}$ .  
 (Fremy), or  $4[\text{Co}(\text{NH}_3)_4]_2(\text{SO}_4)_2 \cdot 9\text{H}_2\text{SO}_4 + 11\text{H}_2\text{O}$  (Jørgensen)  
 More easily sol. in  $\text{H}_2\text{O}$  than neutral sulphate, into which it is converted by recrystallization. Sol. in about 13 pts  $\text{H}_2\text{O}$ . (Jørgensen.)

— **cerium sulphate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{SO}_4)_2$ ,  $\text{Ce}_2(\text{SO}_4)_3 + 2\frac{1}{2}\text{H}_2\text{O}$ .  
 Sl. sol. in cold, practically insol. in boiling  $\text{H}_2\text{O}$ . Sol. in acids (Gibbs, Am. Ch. J. 15. 560)  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{SO}_4)_2$ ,  $\text{Ce}(\text{SO}_4)_2 + 2\frac{1}{2}\text{H}_2\text{O}$  As above. (Gibbs.)

— **sulphate chloraurate.**  
 Three modifications:  
 $\alpha$ .  $\text{Co}(\text{NH}_3)_4(\text{OH}_2)(\text{SO}_4)\text{Cl}$ ,  $\text{AuCl}_3$  Ppt. (Jørgensen)  
 $\beta$   $\text{Co}(\text{NH}_3)_4(\text{SO}_4)$ ,  $\text{AuCl}_3 + 2\text{H}_2\text{O}$  Sl. sol. in cold  $\text{H}_2\text{O}$ . (Gibbs.)  
 $\gamma$ . As above. Can be recrystallized from hot  $\text{H}_2\text{O}$

— **sulphate chloroplatinate,**  
 $2\text{Co}(\text{NH}_3)_4(\text{OH}_2)(\text{SO}_4)\text{Cl}_2$ ,  $\text{PtCl}_4$ .  
 Three modifications, all difficultly sol. in hot or cold  $\text{H}_2\text{O}$ . (Jørgensen.)

— **sulphite,**  $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{SO}_3)_2 + \text{H}_2\text{O}$ .  
 Sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Gibbs.)

— **cobaltic sulphite,**  
 $[\text{Co}(\text{NH}_3)_4]_2(\text{SO}_3)_2$ ,  $\text{Co}_2(\text{SO}_3)_3 + 9\text{H}_2\text{O}$ .  
 Insol in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Künzel.)

**Roseocobaltic octamine compounds.**

See Roseotetramine cobaltic compounds.

**Roseoiridium compounds.**

See Iridoquoquepentamine compounds.

**Roseorhodium bromide,**

$\text{Rh}(\text{NH}_3)_4(\text{OH}_2)\text{Br}_2$   
 Sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 34. 394.)

**Roseorhodium cobalticyanide,**

$\text{Rh}(\text{NH}_3)_4(\text{OH}_2)\text{Co}(\text{CN})_3$   
 Scarcely sol. in  $\text{H}_2\text{O}$ .

— **iodosulphate,**  $\text{Rh}(\text{NH}_3)_4(\text{OH}_2)\text{I}(\text{SO}_4)$ .  
 Very sl. sol. in  $\text{H}_2\text{O}$ , easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Jørgensen.)

— **nitrate,**  $\text{Rh}(\text{NH}_3)_4(\text{OH}_2)(\text{NO}_3)_2$ .  
 Moderately sol. in cold  $\text{H}_2\text{O}$  (Jørgensen)  
 $\text{Rh}(\text{NH}_3)_4(\text{OH}_2)(\text{NO}_3)_2$ ,  $\text{HNO}_3$ . Decomp.

by  $H_2O$  or alcohol. (Jørgensen, J. pr. (2) 44. 63.)

**Roseorhodium nitrate chloroplatinate,**  
 $[Rh(NH_3)_4(OH_2)_2(NO_3)_2]PtCl_6 + 2H_2O$ .  
 Ppt (Jørgensen)

— **orthophosphate,**  
 $[Rh(NH_3)_4(OH_2)_2(HPO_4)_2] + 4H_2O$ .  
 Very sl sol in  $H_2O$

— **sodium pyrophosphate,**  
 $[Rh(NH_3)_4(OH_2)_2Na_2P_2O_7] + 23H_2O$ .  
 Ppt Very sl sol in cold  $H_2O$ . Easily sol. in very dil. acids.

— **sulphate,**  
 $[Rh(NH_3)_4(OH_2)_2(SO_4)_2] + 3H_2O$ .  
 Very sl sol in cold, much more in hot  $H_2O$ .

— **sulphate chloroplatinate,**  
 $[Rh(NH_3)_4(OH_2)_2(SO_4)_2]PtCl_6$ .  
 Ppt. Nearly insol in  $H_2O$  or alcohol

**Roseotetramine cobaltic bromide,**  
 $Co(NH_3)_4(OH_2)_2Br_2$   
 Sol in  $H_2O$ ; insol in  $HBr + Aq$  Nearly insol in alcohol. (Jørgensen, Z anorg 2. 295.)

— **chloride,**  $Co(NH_3)_4(OH_2)_2Cl_2$   
 Easily sol in  $H_2O$ ; insol in conc  $HCl + Aq$ ; sol. in sat.  $HgCl_2 + Aq$  (Jørgensen)

— **cobaltcyanide,**  
 $Co(NH_3)_4(OH_2)_2Co(CN)_6$ .  
 (Jørgensen.)

— **oxalate sulphate,**  
 $[Co(NH_3)_4(OH_2)_2(SO_4)_2]C_2O_4$ .  
 Ppt (Jørgensen.)

— **pyrophosphate,**  
 $[Co(NH_3)_4(OH_2)_2(P_2O_7)_2] + 6H_2O$ .  
 Nearly insol in  $H_2O$ , but easily sol. in very dil. acids +  $Aq$  (Jørgensen.)

— **sulphate,**  
 $[Co(NH_3)_4(OH_2)_2(SO_4)_2] + 3H_2O$ .  
 Sol. in about 35 pts.  $H_2O$ , and more easily by addition of dil  $HCl$  or  $H_2SO_4 + Aq$ . (Jørgensen.)

— **sulphate bromaurate,**  
 $[Co(NH_3)_4(OH_2)_2(SO_4)_2]AuBr_4$ .  
 Sl. sol. in cold  $H_2O$ ; insol. in alcohol. (Jørgensen.)

— **sulphate chloroplatinate,**  
 $[Co(NH_3)_4(OH_2)_2(SO_4)_2]PtCl_6$ .  
 As the bromaurate. (Jørgensen.)

## Rubidium, Rb<sub>2</sub>

Decomp  $H_2O$  with violence Insol. in hydrocarbons. Sol. in liquid  $NH_3$  (Seely, C N 23. 169), (Franklin, Am Ch. J 1898, 20. 829)

## Rubidium acetylde acetylene $RbC_2, C_2H_2$

Very hygroscopic.  
 Insol in  $CCl_4$  and in ether. (Moissan, C R. 1903, 136. 1220.)

## Rubidium amalgam, $RbHg_{12}$

Stable in contact with  $Hg$  below  $0^\circ$   
 Above  $0^\circ$  the composition of the amalgam varies Can be cryst from  $Hg$  without decomp below  $0^\circ$ . (Kerp, Z. anorg. 1900, 25. 68.)

## Rubidium amide, $RbNH_2$

Very deliquescent Violently decomp. by  $H_2O$ ; less violently acted on by alcohol. (Titherley, Chem. Soc 1897, 71. 470.)

## Rubidium ammonia, $RbNH_3$

Decomp. by  $H_2O$ .  
 Very sol in liquid  $NH_3$  (Moissan, C. R. 1903, 136. 1178.)

## Rubidium azoimide, $RbN_3$

Sl. hygroscopic.  
 Stable in aq. solution  
 107 1 pts are sol in 100 pts  $H_2O$  at  $16^\circ$ .  
 114 1 " " " " 100 "  $H_2O$  "  $17^\circ$ .  
 0 182 " " " " 100 " abs alcohol at  $18^\circ$ .  
 Insol. in pure ether.  
 (Curtius, J pr. 1898, (2) 58. 281.)

## Rubidium bromide, $RbBr$

100 pts  $H_2O$  dissolve 98 pts at  $5^\circ$ , 104.8 pts. at  $16^\circ$ . (Reissig, A. 127. 33.)  
 Solubility in  $H_2O$   
 100 pts of the solution contain at  
 0.5° 5 0° 16 0°  
 47 26 49 50 51 17 pts.  $RbBr$ ,  
 39 7° 57 5° 113.5°  
 56 87 60 39 67 24 pts.  $RbBr$ .  
 (Rumbach, B. 1905, 38. 1557.)

Sp. gr. of  $RbBr$  containing g. equiv.  $RbBr$  per l.

G equiv $RbBr$	Sp. gr. $6^\circ/6^\circ$	Sp. gr. $18^\circ/18^\circ$	Sp. gr. $30^\circ/30^\circ$
0.508	1.06448	1.06389	1.06326
1 020	1.12931	1.12799	1.12626
2 031	1.25622	1.25366	1.25187
4.072	1.50574	1.50107	1.49870

(Clausen, W. Ann 1914, (4) 44. 1070)

RbBr + Aq. containing 6.60% RbBr has sp. gr.  $20^{\circ}/20^{\circ} = 1.0525$ .

RbBr + Aq. containing 14.36% RbBr has sp. gr.  $20^{\circ}/20^{\circ} = 1.1220$

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 279)

Sol. in acetone. (Fidmann, C. C. 1899, II 1014.)

Difficultly sol. in acetone (Naumann, B. 1904, 37, 4328.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790)

#### Rubidium tribromide, RbBr<sub>3</sub>.

Very sol. in H<sub>2</sub>O; decomp. by alcohol and ether (Wells and Wheeler, Sil. Am. J. 143, 475.)

#### Rubidium ruthenium bromide.

See Bromoruthenate and bromoruthenite, rubidium.

#### Rubidium selenium bromide.

See Bromoselenate, rubidium.

#### Rubidium tellurium bromide.

See Bromotellurate, rubidium.

#### Rubidium thallic bromide, RbBr, TlBr<sub>3</sub> + H<sub>2</sub>O

Recryst. from H<sub>2</sub>O unchanged (Pratt, Am. J. Sci. 1895, (3) 49, 403)

3RbBr, TlBr<sub>3</sub> + H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Pratt)

#### Rubidium stannic bromide.

See Bromostannate, rubidium.

#### Rubidium bromochloride, RbBrCl.

Easily decomp., even by H<sub>2</sub>O (Wells and Wheeler.)

RbBrCl<sub>2</sub>. Sol. in H<sub>2</sub>O; decomp. by alcohol and ether. (Wells and Wheeler)

#### Rubidium bromochloriodide, RbBrClI.

Sol. in H<sub>2</sub>O and alcohol. Decomp. by ether. (Wells and Wheeler)

#### Rubidium bromiodide, RbBrI.

Very sol. in H<sub>2</sub>O. Sat. solution contains about 44% RbBrI, and sp. gr. = 3.84. (Wells and Wheeler)

#### Rubidium carbide, Rb<sub>2</sub>C<sub>2</sub>

Decomp. violently by H<sub>2</sub>O. (Moissan, C. R. 1903, 136, 1221)

#### Rubidium chloride, RbCl.

100 pts H<sub>2</sub>O dissolve 76.38 pts. at 1°, 82.89 pts. at 7°. (Bunsen)

Solubility in H<sub>2</sub>O at t°  
100 pts of the solution contain pts. RbCl

t°	Pts RbCl
0 4	43 61
15 5	46 56
57 3	53 71
114 9	59 48

(Rimbach, B. 1902, 35, 1304.)

Solubility of RbCl in H<sub>2</sub>O at t°.

t°	G RbCl per 100 g.		t°	G RbCl per 100 g	
	H <sub>2</sub> O	Solution		H <sub>2</sub> O	Solution
0	77 0	43 5	60	115 5	53 6
10	84 4	45 8	70	121 4	54.8
20	91 1	47.7	80	127.2	56 0
30	97 6	49 4	90	133 1	57.1
40	103 5	50 9	100	138 9	58.9
50	109 3	52.2	112 9	146.6	59.5

(Berkeley, Phil. Trans. Roy. Soc. 1904, 203, A. 189.)

Sat. RbCl + Aq at 25° contains 48.57% RbCl. (Foote, Am. Ch. J. 1903, 35, 242.)

Sp. gr. of RbCl + Aq containing in 100 pts H<sub>2</sub>O

13 14 25 88 33 13 pts. RbCl

1 1056 1 2156 1 2675 sp. gr.

(Tammann, W. Ann. 24, 1885)

A normal solution of RbCl has sp. gr. at 25° = 1.0610. (Wagner, Z. phys. Ch. 1890, 5, 39)

RbCl + Aq containing 6.64% RbCl has sp. gr.  $20^{\circ}/20^{\circ} = 1.0502$ .

RbCl + Aq containing 10.59% RbCl has sp. gr.  $20^{\circ}/20^{\circ} = 1.0315$ . (Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 278.)

Sp. gr.  $20^{\circ}/4^{\circ}$  of a normal solution of RbCl = 1.085405. (Haigh, J. Am. Chem. Soc. 1912, 34, 1151.)

Sp. gr. of RbCl + Aq sat. at t°.

t°	Sp. gr.	t°	Sp. gr.
0.55	1.4409	60 25	1.5558
18.7	1.4865	75 15	1.5746
31.5	1.5118	89 35	1.5905
44.7	1.5348	114*	1.6148

\* Boiling point.

(Berkeley.)

Sp. gr. of RbCl containing g. equiv RbCl per l.

G. equiv. RbCl	Sp. gr. 0°/6°	Sp. gr. 18°/18°	Sp. gr. 30°/30°
0 5123	1.06410	1 04538	1.04503
1 001	1.08916	1 08810	1.08749
2 073	1.18200	1 17959	1 17828
3 984	1.34334	1 33967	1 33757

(Clausen, W. Ann. 1914, (4) 44, 1069.)

Very sl sol in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 829.)

Solubility in alcohols at 25°.

100 g methyl alcohol dissolve 1.41 g.

100 g ethyl alcohol dissolve 0.078 g.

100 g propyl alcohol dissolve 0.015 g.

100 g isoamyl alcohol dissolve 0.0025 g.

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

Insol. in anhydrous pyridine and in 97% pyridine + Aq. Very sl. sol. in 95% pyridine + Aq; sl sol. in 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1903, 30. 1107.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790), acetone; (Naumann, B. 1904, 37. 4329), (Eidmann, C. C. 1899, II 1014).

Rubidium ruthenium trichloride.

See Chlororuthenite, rubidium.

Rubidium ruthenium tetrachloride.

See Chlororuthenate, rubidium.

Rubidium oxyruthenium chloride,

$\text{Rb}_2\text{RuO}_2\text{Cl}_4$

Ppt; decomp. by  $\text{H}_2\text{O}$ , sol in cold  $\text{HCl}$  (Howe, J. Am. Chem. Soc. 1901, 23. 779.)

Rubidium tellurium chloride.

See Chlorotellurate, rubidium.

Rubidium thallic chloride,  $2\text{RbCl}$ ,  $\text{TiCl}_3 + \text{H}_2\text{O}$

Can be recryst. from  $\text{H}_2\text{O}$  without change. (Patt, Am. J. Sci. 1895, (3) 49. 399.)

$3\text{RbCl}$ ,  $\text{TiCl}_3$ . Crystallizes from  $\text{HCl}$  solution. (Neumann, A. 244. 848.)

+  $\text{H}_2\text{O}$  Very sol in cold  $\text{H}_2\text{O}$  (Pratt, Am. J. Sci. 1895, (3) 49. 398.)

+  $2\text{H}_2\text{O}$  Efflorescent in dry air Sol. in 7.5 pts.  $\text{H}_2\text{O}$  at 18°, and 1.6 pts. at 100°. (Godefroy, Zetschr. d. allgem. oesterr. Apothekerv. 1880. No. 9.)

Rubidium stannic chloride.

See Chlorostannate, rubidium.

Rubidium titanium chloride,  $2\text{RbCl}$ ,  $\text{TiCl}_3 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Stahler, B. 1904, 37. 4408.)

Rubidium tungsten chloride,  $\text{Rb}_2\text{W}_2\text{Cl}_9$ .

Sl. sol in cold, more sol. in hot  $\text{H}_2\text{O}$

Sol. in very dil.  $\text{NaOH} + \text{Aq}$

Nearly insol. in most organic solvents. (Olsson, B. 1913, 46. 574.)

Rubidium uranous chloride,  $\text{Rb}_2\text{UCl}_6$ .

As K salt. (Aloy, Bull. Soc. 1899, (3) 21. 264.)

Rubidium uranyl chloride,  $2\text{RbCl}$ ,  $(\text{UO}_2)_2\text{Cl}_2 + 2\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

100 pts of the solution contain at

24 8° 80.3°

57 8 65.73 pts  $\text{UO}_2\text{Cl}_2$ ,  $2\text{RbCl}$

(Rumbach, B. 1904, 37. 467.)

Rubidium vanadium chloride,  $\text{Rb}_2\text{VCl}_5$

+  $\text{H}_2\text{O}$

Sl sol. in  $\text{H}_2\text{O}$  and alcohol.

Decomp by  $\text{H}_2\text{O}$  on standing so that it dissolves. (Stahler, B. 1904, 37. 4411.)

Rubidium zinc chloride,  $2\text{RbCl}$ ,  $\text{ZnCl}_2$

Easily sol in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$ . (Godefroy, B. 8. 9.)

Rubidium chloride selenium dioxide,  $\text{RbCl}$ ,  $2\text{SeO}_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Muthmann, B. 1893, 26. 1013.)

Rubidium chloriodide,  $\text{RbCl}_2\text{I}$ .

Properties are similar to those of  $\text{RbBrClI}$ . (Wells.)

$\text{RbCl}_2\text{I}$ . Sol. in alcohol, not attacked by ether. (Wells and Wheeler, Sill. Am. J. 144. 42.)

Sol in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25. 212.)

Nearly insol in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 28. 374.)

Very stable; sl sol in  $\text{H}_2\text{O}$  at 0°; only vey sl. sol in  $\text{HCl}$  (Eidmann, Arch. Pharm. 1894, 232. 32.) (C. C. 1894, I. 670.)

Rubidium fluoride,  $\text{RbF}$ .

Very sol in  $\text{H}_2\text{O}$  (Egging, Z. anorg. 1905, 46. 174.)

100 g.  $\text{H}_2\text{O}$  dissolve 130.6 g.  $\text{RbF}$  at 18° (de Forcrand, C. R. 1911, 152. 1210.)

Sol in dil.  $\text{HF}$  (Pennington, J. Am. Chem. Soc. 1896, 18. 57.)

Insol in liquid  $\text{NH}_3$ . (Corc, Am. Ch. J. 1898, 20. 829.)

Rubidium hydrogen fluoride,  $\text{RbF}$ ,  $\text{HF}$ .

Very deliquescent.

Insol. in alcohol and ether. (Chabré, C. R. 1905, 140. 91.)

Very hygroscopic Sol in  $\text{H}_2\text{O}$ . (Egging, Z. anorg. 1905, 46. 175.)

$\text{RbF}$ ,  $2\text{HF}$ . Very sl sol in  $\text{H}_2\text{O}$ . (Egging, Z. anorg. 1905, 46. 176.)

Rubidium silicon fluoride.

See Fluosilicate, rubidium.

Rubidium tantalum fluoride.

See Fluotantalate, rubidium.

Rubidium uranyl fluoride,  $4\text{RbF}$ ,  $\text{UO}_2\text{F}_2 + 6\text{H}_2\text{O}$ .

(Ditte, C. R. 91. 115.)

**Rubidium hydride, RbH**

Decomp. by  $H_2O$  with evolution of  $H_2$  (Moissan, C. R. 1903, 136. 589.)

**Rubidium hydroxide, RbOH**

Deliquescent, and very sol in  $H_2O$ . Sol. in alcohol. (Bunsen.)

Sat. RbOH + Aq contains 64.17% RbOH at 15°. (de Forcrand, C. R. 1900, 149. 1344.)

**Rubidium iodide, RbI.**

100 pts  $H_2O$  dissolve 137.5 pts. at 6.9°, 152 pts. at 17.4° (Reussig, A. 127. 33.)

Sat. RbI + Aq. at 25° contains 61.93% RbI (Foote and Chalker, Am. Ch. J. 1908, 39. 567.)

Sp. gr. of RbI + Aq containing

5%	10%	cold sat.	hot sat.
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Sp. gr. 1.0353 1.0755 1.726 1.9629 (Erdmann, Arch. Pharm. 1894, 232. 25.)

Sp. gr. of RbI + Aq containing g. equiv. RbI per l.

G equiv RbI	Sp. gr. 0°/0°	Sp. gr. 18°/18°	Sp. gr. 30°/30°
0.510	1.08347	1.08268	1.08226
1.025	1.16751	1.16569	1.16433
2.025	1.33012	1.32837	1.32631
4.015	1.64781	1.64144	1.63780

(Clausen, W. Ann. 1914, (4) 44. 1070.)

Nearly insol. in  $AsBr_3$  (Walden, Z. anorg. 1902, 29. 374.)

Sol. in  $AsCl_3$ . (Walden, Z. anorg. 1900, 25. 214.) liquid  $SO_2$ . (Walden, Z. anorg. 1902, 30. 161.)  $S_2Cl_2$ . (Walden, Z. anorg. 1900, 25. 217.)  $SO_2Cl_2$ . (Walden);  $POCl_3$ . (Walden.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

Solubility in organic solvents at t°.

C = pts. by wt. of RbI in 100 ccm. of the sat. solution

L = no. of litres which at the saturation temp. hold in solution 1 mol. RbI

Solvent	t°	C	L
Furfural	25°	4.93	4.31
Acetonitrile	25°	1.350	15.73
"	0°	1.478	14.36
Propionitrile	25°	0.305	69.61
"	0°	0.274	77.48
Nitromethane	25°	0.518	41.00
"	0°	0.567	37.44
Acetone	25°	0.674	31.5
"	0°	0.960	22.1

(Walden, Z. phys. Ch. 1906, 55. 718.)

**Rubidium triiodide, RbI<sub>3</sub>**

Very sol. in  $H_2O$ . Sol. in about  $\frac{1}{3}$  pt  $H_2O$  at 20°; sol. in alcohol. Decomp. by ether. (Wells and Wheller, Sill. Am. J. 143. 475.)

Solubility determinations show that RbI<sub>3</sub> is the only polyiodide of rubidium formed at 25°. RbI<sub>2</sub> and RbI<sub>4</sub>, mentioned by Abegg and Hamburger, (Z. anorg. 50, 403) could not be obtained. (Foote and Chalker, Am. Ch. J. 1908, 39. 567.)

**Rubidium silver iodide, 2RbI, AgI.**

Easily decomp. by  $H_2O$ . (Wells and Wheeler, Sill. Am. J. 144. 155.)

RbI, AgI +  $\frac{1}{2}H_2O$  (Marsh, Chem. Soc. 1913, 103. 783.)

RbI, 2AgI. Not deliquescent.

Very sol. in acetone (Marsh, Chem. Soc. 1913, 103. 783.)

**Rubidium tellurium iodide.**

See Iodotellurate, rubidium.

**Rubidium thallio iodide, RbI, TlI<sub>3</sub> + 2H<sub>2</sub>O.**

Decomp. by  $H_2O$ . (Pratt, Am. J. Sci. 1895, (3) 49. 403.)

**Rubidium nitride,**

Decomp. by heat (Franz Fischer, B. 1910, 43. 1468.)

See also Rubidium azotimide.

**Rubidium dioxide, RbO<sub>2</sub>.**

Decomp. by  $H_2O$ . (Erdmann, A. 1897, 294. 68.)

**Rubidium sulphide, Rb<sub>2</sub>S + 4H<sub>2</sub>O**

Deliquescent; very sol. in  $H_2O$  (Biltz, Z. anorg. 1906, 43. 299.)

**Rubidium disulphide, Rb<sub>2</sub>S<sub>2</sub>**

Anhydrous.

Sol. in  $H_2O$ .

Very hygroscopic. (Biltz, Z. anorg. 1906, 50. 72.)

+  $H_2O$ . From Rb<sub>2</sub>S<sub>2</sub> + Aq.

Hydroscopic. (Biltz.)

**Rubidium trisulphide, Rb<sub>2</sub>S<sub>3</sub>.**

Anhydrous

Sol. in  $H_2O$ .

Hydroscopic. (Biltz, Z. anorg. 1906, 50. 75.)

+  $H_2O$ . From Rb<sub>2</sub>S<sub>3</sub> + Aq (Biltz.)

**Rubidium tetrakisulphide, Rb<sub>2</sub>S<sub>4</sub> + 2H<sub>2</sub>O.**

Sol. in  $H_2O$ . (Biltz, Z. anorg. 1906, 43. 304.)

**Rubidium pentasulphide, Rb<sub>2</sub>S<sub>5</sub>.**

Deliquescent. Decomp. by  $H_2O$ .

Very easily sol. in 70% alcohol.

Insol. in ether, ethyl sulphide or  $CHCl_3$ . (Biltz, B. 1905, 38. 127.)

**Rubidium hydrogen sulphide, RbHS**

Deliquescent, very sol. in  $H_2O$  (Biltz, Z anorg 1900, 48. 300.)

**Rubidium copper tetrasulphide, RbCuS<sub>4</sub>**

Decomp. very slowly in the air  
Sl sol in  $H_2O$ .

Very slowly decomp. by cold conc., more rapidly by hot conc., and still more rapidly by dil. HCl,  $H_2SO_4$  and  $HNO_3$ . Sl. sol in alcohol. (Biltz, B. 1907, 40. 978.)

**Ruthenic acid.****Barium ruthenate, BaRuO<sub>4</sub> + H<sub>2</sub>O.**

Ppt. (Debray and Joly, C R 106. 1494)

**Calcium ruthenate, CaRuO<sub>4</sub>.**

Ppt.

**Magnesium ruthenate, MgRuO<sub>4</sub>**

Ppt.

**Potassium ruthenate, K<sub>2</sub>RuO<sub>4</sub> + H<sub>2</sub>O.**

Very sol. in  $H_2O$ .

**Perruthenic acid.****Potassium perruthenate, KRuO<sub>4</sub>.**

Sl sol. in  $H_2O$  (Debray and Joly, C R 106. 1494)

**Sodium perruthenate, NaRuO<sub>4</sub> + H<sub>2</sub>O.**

Sl. sol. in  $H_2O$ .

**Ruthenium, Ru.**

Not attacked by acids, except aqua regia, which dissolves it only very slightly. (Claus, Pogg. 65. 218.)

**Ruthenium ammonium comps.**

See Ruthenodiamine comps, etc

**Ruthenium tribromide, RuBr<sub>3</sub>.**

Sol. in  $H_2O$ . Solution decomposes slowly on standing, but rapidly on heating. (Gutbier, Z. anorg. 1905, 45. 178.)

**Ruthenium tribromide, ammonia,**

$2RuBr_3 \cdot 7NH_3$ .

Sol. in  $H_2O$  and ammonia with slight warming.

Insol. in alcohol (Gutbier, Z. anorg. 1905, 45. 182.)

**Ruthenium dichloride, RuCl<sub>2</sub>.**

Insol. in acids, even in aqua regia. Sl. attacked by acids. Traces are dissolved by boiling with conc. KOH + Aq +  $xH_2O$ . Known only in aqueous solution. (Claus, A. 59. 238.)

**Ruthenium trichloride, RuCl<sub>3</sub>.**

Deliquescent. Sol. in  $H_2O$  and alcohol, but solution is decomp. by heating into  $Ru_2O_3$  and HCl. (Claus.)

Pure  $RuCl_3$  is insol in cold  $H_2O$ , mineral, or organic acids. Slowly decomp. by boiling  $H_2O$ . Insol in  $CCl_4$ ,  $CS_2$ ,  $CHCl_3$ ,  $PCl_3$ , or ether. Slowly sol. in hot absolute alcohol, but decomp. into  $Ru(OH)Cl_2$  by 95% alcohol. (Joly, C. R. 114. 292)

Hydroscopic

Sol in  $H_2O$ , decomp. at 50°.

Sol in alcohol (Gutbier, Z anorg. 1905, 45. 174.)

See also Ruthenium nitroschloride.

**Ruthenium tetrachloride, RuCl<sub>4</sub>.**

Sol. in  $H_2O$  and alcohol (Claus)

**Ruthenium trichloride with MCl.**

See Chlororuthenite, M.

**Ruthenium tetrachloride with MCl.**

See Chlororuthenate, M.

**Ruthenium sesquihydroxide, Ru<sub>2</sub>O<sub>3</sub>H<sub>2</sub>.**

Sol in acids; insol in alkalis. Less sol. in  $NH_4OH$  + Aq than any other oxide of the Pt metals (Claus)

**Ruthenium dihydroxide, RuO<sub>2</sub>H<sub>2</sub> + 3H<sub>2</sub>O**

Sol in acids and alkalis. (Claus, A. 59. 237)

Contains NO Joly, C. R. 107. 994)

**Ruthenium triiodide, RuI<sub>3</sub>.**

Ppt (Claus.)

Insol. in  $H_2O$ , KI + Aq, and alcohol. (Gutbier, Z. anorg. 1905, 45. 181.)

**Ruthenium triiodide ammonia,**

$2RuI_3 \cdot 7NH_3$ .

Sol in  $H_2O$  and ammonia with slight warming.

Insol in alcohol. (Gutbier, Z. anorg. 1905, 45. 182.)

**Ruthenium nitroschloride, RuCl<sub>2</sub>(NO) + H<sub>2</sub>O, and 5H<sub>2</sub>O**

Slowly sol. in cold, easily in hot  $H_2O$ . (Joly, C. R. 108. 855.)

**Ruthenium dihydronitroschloride,**

$NO \cdot Ru_2H_2Cl_3 \cdot 2HCl$ .

Sol in  $H_2O$ . (Brizard, A. ch. 1900, (7) 71. 353.)

**Ruthenium silver nitroschloride,**

$NO \cdot Ru_2H_2Cl_3 \cdot 2HCl, 3AgCl$ .

Ppt (Brizard, A. ch. 1900, (7) 21, 357.)

**Ruthenium nitrosesquioxide, Ru<sub>2</sub>O<sub>3</sub>(NO)<sub>2</sub> + 2H<sub>2</sub>O.**

Ppt (Joly, C. R. 108. 854.)

**Ruthenium dihydronitrosohydroxide,**  
 $\text{NO} \cdot \text{Ru}_2\text{H}_2(\text{OH})_2 + 2\text{H}_2\text{O}$ Sl sol. in cold  $\text{H}_2\text{O}$  with decomp (Brizard, A. ch. 1900, (7) 21. 349)**Ruthenium dihydronitrosooxychloride,**  
 $\text{NO} \cdot \text{Ru}_2\text{H}_2\text{Cl}_2\text{OH} + 2\text{H}_2\text{O}$ 

Ppt (Brizard, A. ch. 1900, (7) 21. 349.)

**Ruthenium monoxide, RuO.**

Insol. in acids. (Claus, A 59. 236.)

**Ruthenium sesquioxide, Ru<sub>2</sub>O<sub>3</sub>.**Insol in acids. Mixture of Ru and RuO<sub>2</sub>. (Debray and Joly, C. R. 108. 1494.)

See Ruthenium nitrososesequioxide.

**Ruthenium dioxide, RuO<sub>2</sub>.**

Insol. in acids (Debray and Joly.)

**Ruthenium trioxide, RuO<sub>3</sub>**

"Ruthenic acid." Known only in its salts.

**Ruthenium tetroxide, RuO<sub>4</sub>.**Rather difficultly and slowly sol in  $\text{H}_2\text{O}$  (Claus.)Decomp in aqueous solution into  $\text{Ru}_2\text{O}_7 + 2\text{H}_2\text{O}$ . (Debray and Joly)**Ruthenium pentoxide, Ru<sub>2</sub>O<sub>5</sub>.**

(Debray and Joly, C. R. 106. 1494.)

+  $2\text{H}_2\text{O}$ . Ppt. (Debray and Joly)**Ruthenium heptoxide, Ru<sub>2</sub>O<sub>7</sub>.**

"Perruthenic acid." Known only in its salts.

**Ruthenium oxide, Ru<sub>4</sub>O<sub>6</sub>.**

(Debray and Joly)

**Ruthenium oxychloride, Ru(OH)Cl<sub>2</sub>.**Very sol. in  $\text{H}_2\text{O}$ , but decomp. by an excess. (Joly, C. R. 114. 293.)**Ruthenium silicide, RuSi.**Insol. in boiling acids; slowly attacked by a mixture of fused  $\text{KHSO}_4$  and  $\text{KNO}_3$ . (Moissan, C. R. 1903, 137. 231)**Ruthenium trisulphide, RuS<sub>3</sub>.**

Ppt. (Antony, Gazz. ch. it 1900, 30. 539)

**Ruthenomonamine hydroxide,** $\text{Ru}(\text{OH})_2(\text{NH}_3)_2 + 4\text{H}_2\text{O}$ 

See Ruthenosamine hydroxide.

**Ruthenediamine carbonate,** $\text{Ru}(\text{N}_2\text{H}_5)_2\text{CO}_3 + 5\text{H}_2\text{O}$ Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Claus.)**Ruthenosdamine chloride,** $\text{Ru}(\text{N}_2\text{H}_5\text{Cl})_2 + 3\text{H}_2\text{O}$ Not very sol in cold, easily sol. in hot  $\text{H}_2\text{O}$ . Insol in alcohol

See Ruthenonitrosodiamine comps.

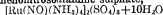
— **mercuric chloride, Ru(N<sub>2</sub>H<sub>5</sub>Cl)<sub>2</sub>, HgCl<sub>2</sub>.**Nearly insol. in cold, sol in hot  $\text{H}_2\text{O}$ . (Gibbs, Sill Am J (2) 34, 350.)— **chloroplatinate, Ru(N<sub>2</sub>H<sub>5</sub>Cl)<sub>2</sub>, PtCl<sub>4</sub>**Sl. sol in  $\text{H}_2\text{O}$ . (Claus)— **hydroxide, Ru(N<sub>2</sub>H<sub>5</sub>OH)<sub>2</sub>**

Known only in aqueous solution.

— **nitrate, Ru(N<sub>2</sub>H<sub>5</sub>NO<sub>2</sub>)<sub>2</sub> + 2H<sub>2</sub>O**Somewhat difficultly sol in cold, easily in hot  $\text{H}_2\text{O}$  Insol. in alcohol— **sulphate, Ru(N<sub>2</sub>H<sub>5</sub>)<sub>2</sub>SO<sub>4</sub> + 4H<sub>2</sub>O**Moderately sol in  $\text{H}_2\text{O}$ . Insol. in alcohol (Claus.)**Ruthenocyanhydric acid, H<sub>4</sub>Ru(CN)<sub>6</sub>.**Easily sol in  $\text{H}_2\text{O}$  and alcohol Less sol in ether (Claus, J. B. 1855. 444.)**Potassium ruthenocyanide, K<sub>4</sub>Ru(CN)<sub>6</sub> + 3H<sub>2</sub>O.**Sl. efflorescent Very sol in  $\text{H}_2\text{O}$ , sl. sol. in dil alcohol (Claus.)**Ruthenonitrosodiamine bromide,** $\text{Ru}(\text{NO})(\text{NH}_3)_2\text{Br}_2$ Sl sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 111. 969.) $\text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_2\text{Br}_2$ . Less sol than corresponding chloride (Joly, C. R. 108. 300)— **chloride, Ru(NO)(NH<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub>.**Sl. sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 111. 969.) $\text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_2\text{Cl}_2$ . Sol. in  $\text{H}_2\text{O}$  (Joly, C. R. 108. 1300.) $\text{Ru}(\text{NO})(\text{NH}_3)_2\text{Cl}_2 + 2\text{H}_2\text{O} =$  $\text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_2\text{Cl}_2, \text{HCl} + \text{H}_2\text{O} (?)$ Very sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 111. 969.)— **chloroplatinate, Ru(NO)(OH)(NH<sub>3</sub>)<sub>2</sub>PtCl<sub>6</sub>.**Scarcely sol in boiling  $\text{H}_2\text{O}$ . (Joly, C. R. 108. 1300.) $\text{Ru}(\text{NO})(\text{NH}_3)_2\text{Cl}_2, \text{PtCl}_4$  Ppt (Joly, C. R. 111. 969)— **iodide, Ru(NO)(NH<sub>3</sub>)<sub>2</sub>I<sub>2</sub>**Sl sol in  $\text{H}_2\text{O}$  (Joly, C. R. 111. 969) $\text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_2\text{I}_2$  Less sol. than the corresponding bromide (Joly, C. R. 108. 1300.)— **nitrate, Ru(NO)(NH<sub>3</sub>)<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.**More sol in  $\text{H}_2\text{O}$  than $\text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_2(\text{NO}_3)_2$ . (Joly, C. R. 111. 969.)

$\text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_4(\text{NO}_3)_2$  Sl. sol. in cold  $\text{H}_2\text{O}$ ; insol in conc  $\text{HNO}_3 + \text{Aq.}$  (Joly, C. R. 108. 1300.)

#### Ruthenonitrosodiamine sulphate,



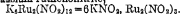
Sl. sol in  $\text{H}_2\text{O}$  (Joly, C. R. 111. 969)  
 $[\text{Ru}(\text{NO})(\text{NH}_3)_4](\text{SO}_4)_2 \cdot \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$  Decomp. by cold  $\text{H}_2\text{O}$  (Joly)  
 $\text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_4\text{SO}_4 + \text{H}_2\text{O}$  Most sol. in  $\text{H}_2\text{O}$  of this class of salts (Joly, C. R. 108. 1300.)

#### Ruthenonitrous acid.

Ammonium ruthenonitrite,  $\text{RuH}_2(\text{NO}_2)_4$ ,  
 $8\text{NH}_4\text{NO}_2 + 2\text{H}_2\text{O}$ .

Easily sol in  $\text{H}_2\text{O}$ ; practically insol. in  $\text{KCl} + \text{Aq.}$  (Brizard, A. ch. 1900, (7) 21. 368)

#### Potassium ruthenonitrite,



Easily sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Gibbs, Sill. Am. J. (2), 34. 344)  
 Sl. sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{KNO}_3 + \text{Aq.}$  (Claus)

$\text{K}_4\text{Ru}_2(\text{NO}_2)_{10} = \text{Ru}_2\text{O}_3(\text{N}_2\text{O}_5)_2, 4\text{KNO}_2$ .  
 Very sol. in  $\text{H}_2\text{O}$  (Joly and Vèzes, C. R. 109. 667)

$\text{K}_5\text{Ru}_2(\text{NO}_2)_{14} = \text{Ru}_2\text{O}_3(\text{N}_2\text{O}_5)_3, 8\text{KNO}_2$  Sl. sol in  $\text{H}_2\text{O}$ . Sol in cold dil acids (Joly and Vèzes.)

$\text{Ru}_2\text{H}_2(\text{NO}_2)_4, 3\text{KNO}_2 + 4\text{H}_2\text{O}$  Very sol. in  $\text{H}_2\text{O}$  Aqueous solution decomp. sl. on long boiling Almost insol. in conc.  $\text{KCl} + \text{Aq.}$  (Brizard, C. R. 1899, 129. 216)

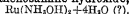
Silver ruthenonitrite,  $\text{NO Ru}_2\text{H}_2(\text{NO}_2)_4$ ,  
 $3\text{AgNO}_2 + 2\text{H}_2\text{O}$ .

Ppt. (Brizard, A. ch. 1900, (7) 21. 368.)

Sodium ruthenonitrite,  $\text{Ru}_2(\text{NO}_2)_4, 4\text{NaNO}_2 + 4\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  without decomp. (Joly, C. R. 1894, 118. 469)

#### Ruthenosamine hydroxide,



Very deliquescent, and sol in  $\text{H}_2\text{O}$ . (Claus)

#### Samarium, Sm.

The element has not been isolated.

Samarium bromide,  $\text{SmBr}_3 \cdot 6\text{H}_2\text{O}$ .

Very deliquescent. (Cleve.)

Samarium carbide,  $\text{SmC}_2$ .

Decomp by water and acids. (Moissan, C. R. 1900, 131. 925)

Samarium dichloride,  $\text{SmCl}_2$ .

Decomp by  $\text{H}_2\text{O}$  with liberation of  $\text{H}_2$  and formation of samarium oxide and samarium oxychloride Insol. in  $\text{CS}_2$ ,  $\text{CHCl}_3$ , benzene, abs alcohol, pyridine and toluene. (Matignon, C. R. 1906, 142. 85)

Samarium trichloride,  $\text{SmCl}_3$ .

The anhydrous salt is very hygroscopic and easily sol in  $\text{H}_2\text{O}$ . (Matignon, C. R. 1902, 134. 1309)

Very sol in  $\text{H}_2\text{O}$ . Very sol. in abs. alcohol 0.38 g are sol. in 100 grams pyridine at ord temp.; insol in quinoline (Matignon, A. ch. 1906, (8) 8. 406.)

$+3\text{H}_2\text{O}$ . Deliquescent.

Samarium chloride ammonia,  $\text{SmCl}_2 + \text{NH}_3$ ,

$+2\text{NH}_3$ ,  $+3\text{NH}_3$ ;  $+4\text{NH}_3$ ;  $+5\text{NH}_3$ ;

$+8\text{NH}_3$ ,  $+9.5\text{NH}_3$ ,  $+11.5\text{NH}_3$ .

(Matignon, C. R. 1905, 140. 143)

Samarium fluoride,  $\text{SmF}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

Precipitate Insol in  $\text{H}_2\text{O}$  and dil. acids. (Cleve)

Samarium iodide,  $\text{SmI}_2$

(Matignon, A. ch. 1906, (8) 8. 413.)

Samarium hydroxide,  $\text{Sm}_2(\text{OH})_6$

Insol in alkalis; easily sol in acids, and decomposes ammonium salts (Cleve, C. N. 51. 145.)

Samarium oxide,  $\text{Sm}_2\text{O}_3$

Easily sol. in acids (Cleve, C. N. 51. 145.)

Samarium peroxide,  $\text{Sm}_4\text{O}_6$

Precipitate (Cleve)

Samarium oxychloride,  $\text{SmOCl}$ .

(Matignon, A. ch. 1906, (8) 8. 412)

Samarium sulphide,  $\text{Sm}_2\text{S}_3$ .

(Matignon, A. ch. 1906, (8) 8. 415.)

#### Scandium, Sc.

Element has not been isolated

Scandium bromide,  $\text{Sc}_2\text{Br}_6 + 3\text{H}_2\text{O}$ , and  $+12\text{H}_2\text{O}$ .

(Crookes, Roy. Soc. Proc. 1908, 80. A, 518.)

Scandium chloride,  $\text{Sc}_2\text{Cl}_6 + 3\text{H}_2\text{O}$ , and  $+12\text{H}_2\text{O}$

(Crookes, Roy. Soc. Proc. 1908, 80. A, 518.)

Scandium hydroxide.

Easily sol in conc  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq.}$  (Crookes, Roy. Soc. Proc. 1908, 80. A, 518.)

**Scandium oxide,  $\text{Sc}_2\text{O}_3$** 

Easily sol. by boiling with conc.  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$

**Scandium sulphide,  $\text{Sc}_2\text{S}_3$** 

Decomp. by  $\text{H}_2\text{O}$  and by acids with evolution of  $\text{H}_2\text{S}$ . (Wirth, Z. anorg. 1914, 87. 5)

**Selenantimonic acid.**

Sodium selenantimonate,  $\text{Na}_3\text{SbSe}_4 + 9\text{H}_2\text{O}$ .

Sol. in 2 pts. cold  $\text{H}_2\text{O}$ . Insol. in alcohol. (Hofacker, A. 107. 6)

Sl. sol. in  $\text{H}_2\text{O}$ , unstable. (Pouget, A. ch. 1899, (7) 18. 562.)

**Selenantimonous acid.**

Potassium orthoselenantimonite,  $\text{K}_2\text{SbSe}_3$

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 560.)

Potassium paraselenantimonite,  $\text{K}_2\text{Sb}_4\text{Se}_7 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; unstable (Pouget, A. ch. 1899, (7) 18. 560)

Sodium orthoselenantimonite,  $\text{Na}_3\text{SbSe}_3 + 9\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Aqueous solution on standing deposits red crystals of sodium selenantimonate,  $\text{Na}_3\text{SbSe}_4 + 9\text{H}_2\text{O}$  (Pouget, A. ch. 1899, (7) 18. 562.)

Sodium paraselenantimonite,  $\text{Na}_3\text{Sb}_4\text{Se}_7$ .

(Pouget, A. ch. 1899, (7) 18. 561)

**Selenic acid,  $\text{H}_2\text{SeO}_4$** 

Very sol. in  $\text{H}_2\text{O}$  with evolution of heat

If aqueous solution is evaporated at temp. of  $165^\circ$ , acid has 2.524 sp. gr.; at temp. of  $267^\circ$ , acid has 2.60 sp. gr.; at temp. of  $285^\circ$ , acid has 2.625 sp. gr. Decomp. to  $\text{H}_2\text{SeO}_3$  at higher temp. (Mitscherlich, Pogg. 9. 623.)

By evaporation at  $265^\circ$ , acid of 2.609 sp. gr. containing 95%  $\text{H}_2\text{SeO}_4$  is obtained. If brought at same temp. in vacuo over  $\text{H}_2\text{SO}_4$ , acid of 2.627 sp. gr. with 97.5%  $\text{H}_2\text{SeO}_4$  is obtained. (Fabian, A. Suppl. 1. 243.)

**Sp. gr. of  $\text{H}_2\text{SeO}_4 + \text{Aq}$ .**

% $\text{H}_2\text{SeO}_4$	Sp. gr.	% $\text{H}_2\text{SeO}_4$	Sp. gr.
99.73	2.6083	90.0	2.3848
99.50	2.6051	89.0	2.3568
99.00	2.6975	88.0	2.3291
98.5	2.5863	87.0	2.3061
98.0	2.5767	86.0	2.2795
97.5	2.5695	85.0	2.5558
97.0	2.5601	84.0	2.2258
96.0	2.5388	83.0	2.1946
95.0	2.5163	82.0	2.1757
94.0	2.4925	81.0	2.1479
93.0	2.4596	80.0	2.1216
92.0	2.4322	79.0	2.0922
91.0	2.4081	78.50	1.9675

(Cameron and Macallan, Lond. R. Soc. Proc. 46. 13.)

Sp. gr. of  $\text{H}_2\text{SeO}_4 + \text{Aq}$  at  $20^\circ$  compared with  $\text{H}_2\text{O}$  at  $4^\circ$ .

Wts. corrected to vacuum

Sp. gr.	% $\text{H}_2\text{SeO}_4$	Sp. gr.	% $\text{H}_2\text{SeO}_4$	Sp. gr.	% $\text{H}_2\text{SeO}_4$
1.000		1.295	32.64	1.590	54.62
1.005	0.9	1.300	33.08	1.595	54.92
1.010	1.56	1.305	33.50	1.600	55.28
1.015	2.12	1.310	33.92	1.605	55.62
1.020	2.92	1.315	34.36	1.610	55.96
1.025	3.62	1.320	34.82	1.615	56.30
1.030	4.16	1.325	35.26	1.620	56.60
1.035	4.70	1.330	35.72	1.625	56.88
1.040	5.32	1.335	36.10	1.630	57.20
1.045	6.08	1.340	36.43	1.635	57.48
1.050	6.66	1.345	36.88	1.640	57.70
1.055	7.34	1.350	37.34	1.645	58.04
1.060	7.92	1.355	37.80	1.650	58.47
1.065	8.56	1.360	38.24	1.655	58.86
1.070	9.20	1.365	38.66	1.660	59.24
1.075	9.82	1.370	39.10	1.665	59.56
1.080	10.44	1.375	39.50	1.670	59.74
1.085	11.02	1.380	39.98	1.675	59.94
1.090	11.62	1.385	40.06	1.680	60.18
1.095	12.20	1.390	40.66	1.685	60.36
1.100	12.88	1.395	41.10	1.690	60.58
1.105	13.58	1.400	41.56	1.695	60.80
1.110	14.14	1.405	41.98	1.700	61.06
1.115	14.66	1.410	42.36	1.705	61.36
1.120	15.20	1.415	42.78	1.710	61.64
1.125	15.74	1.420	43.16	1.715	61.90
1.130	16.32	1.425	43.56	1.720	62.24
1.135	16.86	1.430	43.94	1.725	62.48
1.140	17.38	1.435	44.32	1.730	62.76
1.145	17.90	1.440	44.52	1.735	63.06
1.150	18.44	1.445	45.00	1.740	63.32
1.155	18.92	1.450	45.32	1.745	63.60
1.160	19.48	1.455	45.68	1.750	63.86
1.165	20.02	1.460	46.04	1.755	64.04
1.170	20.58	1.465	46.36	1.760	64.24
1.175	21.08	1.470	46.70	1.765	64.42
1.180	21.60	1.475	47.01	1.770	64.62
1.185	22.22	1.480	47.32	1.775	64.84
1.190	22.66	1.485	47.66	1.780	65.06
1.195	23.18	1.490	47.98	1.785	65.28
1.200	23.70	1.495	48.28	1.790	65.48
1.205	24.26	1.500	48.54	1.795	65.66
1.210	24.84	1.505	48.92	1.800	65.90
1.215	25.30	1.510	49.30	1.805	66.12
1.220	25.84	1.515	49.68	1.810	66.36
1.225	26.30	1.520	50.02	1.815	66.64
1.230	26.84	1.525	50.34	1.820	66.90
1.235	27.28	1.530	50.68	1.825	67.16
1.240	27.70	1.535	51.04	1.830	67.46
1.245	28.18	1.540	51.38	1.835	67.72
1.250	28.58	1.545	51.66	1.840	68.02
1.255	29.06	1.550	51.98	1.845	68.30
1.260	29.44	1.555	52.28	1.850	68.50
1.265	29.82	1.560	52.56	1.855	68.70
1.270	30.26	1.565	52.88	1.860	68.92
1.275	30.76	1.570	53.28	1.865	69.12
1.280	31.26	1.575	53.56	1.870	69.34
1.285	31.74	1.580	53.94	1.875	69.56
1.290	32.18	1.585	54.30	1.880	69.72

Sp. gr. of  $\text{H}_2\text{SeO}_4 + \text{Aq}$ —*Concluded*

Sp gr	% $\text{H}_2\text{SeO}_4$	Sp gr	% $\text{H}_2\text{SeO}_4$	Sp gr	% $\text{H}_2\text{SeO}_4$
1.885	69.04	2.125	80.25	2.365	89.14
1.890	70.14	2.130	80.42	2.370	89.30
1.895	70.38	2.135	80.68	2.375	89.48
1.900	70.64	2.140	80.74	2.380	89.60
1.905	70.78	2.145	80.90	2.385	89.72
1.910	71.00	2.150	81.14	2.390	89.84
1.915	71.21	2.155	81.36	2.395	89.96
1.920	71.38	2.160	81.60	2.400	90.10
1.925	71.68	2.165	81.80	2.405	90.20
1.930	72.00	2.170	82.02	2.410	90.30
1.935	72.38	2.175	82.22	2.415	90.46
1.940	72.06	2.180	82.44	2.420	90.74
1.945	72.88	2.185	82.64	2.425	91.00
1.950	73.12	2.190	82.78	2.430	91.24
1.955	73.34	2.195	82.96	2.435	91.46
1.960	73.54	2.200	83.10	2.440	91.70
1.965	73.74	2.205	83.24	2.445	92.00
1.970	73.98	2.210	83.44	2.450	92.28
1.975	74.22	2.215	83.62	2.455	92.56
1.980	74.44	2.220	83.78	2.460	92.85
1.985	74.66	2.225	83.96	2.465	93.02
1.990	74.86	2.230	84.10	2.470	93.20
1.995	75.08	2.235	84.34	2.475	93.36
2.000	75.28	2.240	84.48	2.480	93.68
2.005	75.46	2.245	84.60	2.485	94.02
2.010	75.68	2.250	84.82	2.490	94.32
2.015	75.88	2.255	85.02	2.495	94.48
2.020	76.06	2.260	85.26	2.500	94.64
2.025	76.14	2.265	85.44	2.505	94.80
2.030	76.48	2.270	85.60	2.510	94.96
2.035	76.68	2.275	85.78	2.515	95.32
2.040	76.84	2.280	85.96	2.520	95.58
2.045	77.08	2.285	86.16	2.525	95.86
2.050	77.36	2.290	86.38	2.530	96.10
2.055	77.50	2.295	86.60	2.535	96.41
2.060	77.62	2.300	86.82	2.540	96.68
2.065	77.80	2.305	87.04	2.545	96.92
2.070	78.06	2.310	87.26	2.550	97.12
2.075	78.24	2.315	87.46	2.555	97.30
2.080	78.48	2.320	87.66	2.560	97.48
2.085	78.68	2.325	87.84	2.565	97.68
2.090	78.84	2.330	88.00	2.570	97.94
2.095	79.08	2.335	88.18	2.575	98.20
2.100	79.28	2.340	88.34	2.580	98.46
2.105	79.50	2.345	88.48	2.585	98.70
2.110	79.68	2.350	88.66	2.590	99.04
2.115	79.90	2.355	88.82	2.595	99.36
2.120	80.10	2.360	88.98		

(Diemer and Lenher. J. phys. Chem. 1909, 13. 509.)

Sol. in conc. or fuming  $\text{H}_2\text{SO}_4$ .  
 Insol in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)  
 Decomp. by alcohol.  
 +  $\text{H}_2\text{O}$ . (Cameron and Macallan, C. N. 59. 232.)  
 +  $2\text{H}_2\text{O}$ , and +  $6\text{H}_2\text{O}$  (?). (C. and M.)  
 +  $4\text{H}_2\text{O}$ . (Kreuzmann and Hofmeier, M. 1908, 29. 1117.)

## Selenates.

All the neutral and acid salts of  $\text{H}_2\text{SeO}_4$  are sol in  $\text{H}_2\text{O}$ , except  $\text{BaSeO}_4$ ,  $\text{SrSeO}_4$ ,  $\text{CaSeO}_4$ , and  $\text{PbSeO}_4$ , which are nearly or quite insol in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$

Aluminum selenate,  $\text{Al}_2(\text{SeO}_4)_3$ .

Resembles in every way aluminum sulphate. (Berzelius.)

## Aluminum ammonium selenate,



More sol in  $\text{H}_2\text{O}$  than the corresponding sulphate. (Wohlwill, A. 114. 191.)

Aluminum cesium selenate,  $\text{Al}_2\text{Cs}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

(Peterson, B. 9. 1563.)

Much more sol in  $\text{H}_2\text{O}$  than the corresponding sulphate (Fabre, C. R. 105. 114.)

Aluminum potassium selenate,  $\text{Al}_2\text{K}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

More sol in  $\text{H}_2\text{O}$  than common alum. (Weber, Pogg. 108. 615.)

Aluminum rubidium selenate,  $\text{Al}_2\text{Rb}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

(Peterson, B. 9. 1563.)

Much more sol in  $\text{H}_2\text{O}$  than the corresponding sulphate (Fabre, C. R. 105. 114.)

Aluminum sodium selenate,  $\text{Al}_2\text{Na}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

Sl. efflorescent. Very sol in  $\text{H}_2\text{O}$ . (Wohlwill, A. 114. 191.)

Aluminum thallium sulphate,  $\text{Al}_2\text{Th}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 105. 114.)

Aluminum selenate potassium sulphate,  $\text{Al}_2(\text{SeO}_4)_3, \text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (v. Gerichten, A. 168. 222.)

Ammonium selenate,  $(\text{NH}_4)_2\text{SeO}_4$ .

Easily sol in  $\text{H}_2\text{O}$ .

100 g.  $\text{H}_2\text{O}$  dissolve 117 g.  $(\text{NH}_4)_2\text{SeO}_4$  at  $7^\circ$ ; 164 g. at  $59^\circ$ ; 197 g. at  $100^\circ$ . (Tutton, Proc. Roy. Soc. 1907, 79. A. 351.)  
 Insol in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Ammonium hydrogen selenate,  $\text{NH}_4\text{HSeO}_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Topsoe.)

Ammonium cadmium selenate,  $(\text{NH}_4)_2\text{SeO}_4, \text{CdSeO}_4 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Topsoe, W. A. B. 66. 2. 2.)  
 +  $6\text{H}_2\text{O}$  Efflorescent. Very easily sol in  $\text{H}_2\text{O}$ . (Topsoe.)

**Ammonium cerous selenate**,  
 $(\text{NH}_4)_2\text{Ce}_2(\text{SeO}_4)_4 + 9\text{H}_2\text{O}$   
 Easily sol. in  $\text{H}_2\text{O}$ . (John.)

**Ammonium chromium selenate**,  
 $(\text{NH}_4)_2\text{Cr}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$   
 Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 105. 114.)

**Ammonium cobaltous selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{CoSeO}_4 + 6\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Ammonium cupric selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{CuSeO}_4 + 6\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Ammonium didymium selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{Dy}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)  
 $+10\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 43. 363.)

**Ammonium erbium selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{Er}_2(\text{SeO}_4)_3 + 4\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium ferrous selenate**,  $(\text{NH}_4)_2\text{Fe}(\text{SeO}_4)_2$ ,  
 $+6\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)  
 $+2\text{H}_2\text{O}$

**Ammonium lanthanum selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{La}_2(\text{SeO}_4)_3 + 9\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium magnesium selenate**,  
 $(\text{NH}_4)_2\text{Mg}(\text{SeO}_4)_2 + 6\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Ammonium manganous selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{MnSeO}_4 + 6\text{H}_2\text{O}$ .  
 Not deliquescent. Easily sol. in  $\text{H}_2\text{O}$ .  
 (Topsoë.)

**Ammonium nickel selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{NiSeO}_4 + 6\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Ammonium samarium selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{Sm}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium thallium selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{Tl}_2(\text{SeO}_4)_2 + 8\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Fortin, C. C. 1903, II. 706.)

**Ammonium uranyl selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $(\text{UO}_2)_2\text{SeO}_4 + 2\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$ . (Sendtner.)

**Ammonium yttrium selenate**,  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{Y}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium zinc selenate**,  
 $(\text{NH}_4)_2\text{SeO}_4$ ,  $\text{ZnSeO}_4 + 6\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Antimony selenate**.  
 Insol. in  $\text{H}_2\text{O}$ . Not very sol. in acids. Sol.  
 in  $\text{H}_2\text{SeO}_4$ . (Cameron and Macallan.)

**Barium selenate**,  $\text{BaSeO}_4$ .  
 Somewhat more sol. in  $\text{H}_2\text{O}$  and dil. acids  
 than  $\text{BaSO}_4$ . (Rose.) 100 ccm.  $\text{H}_2\text{O}$  dissolve  
 11.8 mg. in the cold, and 13.8 mg. at  $100^\circ$ .  
 (Pettersson, Z. anal. 12. 287.)  
 Not decomp. by  $\text{H}_2\text{SO}_4$ . Insol. in  $\text{HNO}_3$  +  
 Aq. (Berzelius), but decomp. by solution of  
 alkali carbonates at ordinary temp.  
 Very slowly decomp. by  $\text{HCl}$  + Aq. (Rose,  
 Pogg. 95. 426.)

**Bismuth selenate**.  
 Insol. in, and not decomp. by cold or hot  
 $\text{H}_2\text{O}$ . (Cameron and Macallan.)

**Cæsium selenate**,  $\text{Cs}_2\text{SeO}_4$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Pettersson, B. 9. 1561.)  
 100 g.  $\text{H}_2\text{O}$  at  $12^\circ$  dissolve 244.8 g.  $\text{Cs}_2\text{SeO}_4$ .  
 (Tutton, Chem. Soc. 1897, 71. 850.)  
 Sp. gr. of  $\text{Cs}_2\text{SeO}_4$  + Aq. at  $20^\circ$  compared  
 with  $\text{H}_2\text{O}$  at  $4^\circ$ , containing:

% $\text{Cs}_2\text{SeO}_4$	45.94	53.43
Sp. gr.	1.5841	1.7432

(Tutton.)

**Cæsium hydrogen selenate**,  $\text{CsHSO}_4$ .  
 Ppt. Very hygroscopic. (Norris, Am. Ch.  
 J. 1901, 28. 322.)

**Cæsium chromic selenate**,  $\text{Cs}_2\text{Cr}_2(\text{SeO}_4)_4 +$   
 $24\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 105. 114.)

**Cæsium cobaltous selenate**,  $\text{Cs}_2\text{Co}(\text{SeO}_4)_2 +$   
 $6\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Cæsium indium selenate**,  $\text{CsIn}(\text{SeO}_4)_2 +$   
 $12\text{H}_2\text{O}$ .  
 Efflorescent; sol. in  $\text{H}_2\text{O}$ . (Mathers, J.  
 Am. Chem. Soc. 1908, 30. 215.)

**Cæsium iron (ferric) selenate**,  $\text{Cs}_2\text{Fe}_2(\text{SeO}_4)_4$   
 $+24\text{H}_2\text{O}$ .  
 Sl. sol. in  $\text{H}_2\text{O}$ . (Roncogliolo, Gazz. ch.  
 it. 1905, 35. (2) 553.)

**Cæsium magnesium selenate**,  $\text{Cs}_2\text{SeO}_4$ ,  
 $\text{MgSeO}_4 + 6\text{H}_2\text{O}$ .  
 (Tutton, Chem. Soc. 1905, 87, 1163.)

**Cæsium zinc selenate**,  $\text{Cs}_2\text{Zn}(\text{SeO}_4)_2 + 6\text{H}_2\text{O}$ .  
 (Tutton, Zeit. Kryst. 1900, 33. 14.)

Cadmium selenate,  $\text{CdSeO}_4 \cdot 2\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$  (v. Hauer, W. A. B. 39. 299.)

Cadmium potassium selenate,  $\text{CdSeO}_4, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; can be recrystallized without decomp. (v. Hauer, W. A. B. 54. 209.)

Calcium selenate,  $\text{CaSeO}_4 \cdot 2\text{H}_2\text{O}$ .

Less sol. in hot than in cold  $\text{H}_2\text{O}$ . (v. Hauer, J. pr. 80. 214.)

Sat.  $\text{CaSeO}_4 + \text{Aq}$  contains at.

—1° +5° 20° 37° 67°  
7.4 7.3 7.6 6.8 5.1%  $\text{CaSeO}_4$ .

(Etard, A. ch. 1894, (7) 2. 551.)

Cerous selenate,  $\text{Ce}_2(\text{SO}_4)_3 \cdot 6\text{H}_2\text{O}$ ,  $9\text{H}_2\text{O}$ , or  $12\text{H}_2\text{O}$

More sol. in cold than hot  $\text{H}_2\text{O}$  (Jolin) +4 $\text{H}_2\text{O}$ . Very easily in cold, sl. sol. in hot  $\text{H}_2\text{O}$  (Cingolani, C. C. 1908, I. 1606.)

Stable above 100°.

+5 $\text{H}_2\text{O}$ . Stable at 92–100°.

+7 $\text{H}_2\text{O}$ . Stable at 80–92°.

+8 $\text{H}_2\text{O}$ . Stable at 50–78°.

+10 $\text{H}_2\text{O}$ . Stable at 34–40°.

+11 $\text{H}_2\text{O}$ . Stable at 12–23°.

+12 $\text{H}_2\text{O}$ . Stable at 0–12°. (Cingolani, C. A. 1908, 2658.)

Solubility of  $\text{Ce}_2(\text{SeO}_4)_3$  in  $\text{H}_2\text{O}$  at t°.

(G. salt calculated as anhydrous  $\text{Ce}_2(\text{SO}_4)_3$  dissolved in 100 cc.  $\text{H}_2\text{O}$ .)

t°	Using $\text{Ce}_2(\text{SeO}_4)_3 + 11\text{H}_2\text{O}$	Using $\text{Ce}_2(\text{SeO}_4)_3 + 12\text{H}_2\text{O}$	t°	Using $\text{Ce}_2(\text{SeO}_4)_3 + 11\text{H}_2\text{O}$	Using $\text{Ce}_2(\text{SeO}_4)_3 + 12\text{H}_2\text{O}$
0°		39 55	80°	13.68	
11 6	37				13 12
12.6		36 9	78 2	5 52	
26 6	33 84		80 5		4 56
28 8		33 2	91	2.02	
34.2	33 15		95 4	1 53	
45 6	32.16		98	...	1.785
45.9		31 89	100	..	2 513

(Cingolani, l. c.)

Cerous potassium selenate,  $\text{Ce}_2(\text{SeO}_4)_3, 5\text{K}_2\text{SeO}_4$ .

More sol. in  $\text{H}_2\text{O}$  than the corresponding sulphate. (Jolin)

Cerous sodium selenate,  $\text{Ce}_2(\text{SeO}_4)_3, \text{Na}_2\text{SeO}_4 + 5\text{H}_2\text{O}$ .

Quite sol. in  $\text{H}_2\text{O}$ . (John.)

Chromic potassium selenate,  $\text{Cr}_2\text{K}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

Resembles the sulphate in every particular.

Chromic rubidium selenate,  $\text{Cr}_2\text{Rb}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ .

Chromic sodium selenate,  $\text{Cr}_2\text{Na}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$   
Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 105. 114.)

Chromic thalious selenate,  $\text{Cr}_2\text{Ti}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 105. 114.)

Chromic selenate potassium sulphate,  $\text{Cr}_2(\text{SeO}_4)_3, \text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (v. Gorchichten)

Cobaltous selenate, basic,  $4\text{CoO}, 3\text{SeO}_2 + \text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ ; sol. in acids (Bogdan, Bull. Soc. (3) 9. 586)

$\text{Co}_3(\text{OH})_2(\text{SeO}_4)_3$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Bogdan, C. C. 1895. 630.)

Cobaltous selenate,  $\text{CoSeO}_4 \cdot 5\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Topsoe.)

+6 $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  (Topsoe.)

+7 $\text{H}_2\text{O}$ . Efflorescent. Extremely sol. in  $\text{H}_2\text{O}$ . (Topsoe.)

+13 $\text{H}_2\text{O}$ . Very unstable. (Copaux, A. ch. 1905, (8) 6. 553.)

Cobaltous potassium selenate,  $\text{CoSeO}_4, \text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ .

More sol. in  $\text{H}_2\text{O}$  than corresponding sulphate. (v. Hauer, W. A. B. 39. 837)

Cobaltous rubidium selenate,  $\text{CoRb}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Topsoe)

Cobaltous thalious selenate,  $\text{CoTi}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Topsoe)

Cupric selenate, basic,  $3\text{CuO}, 2\text{SeO}_4 + 4\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Bogdan, Bull. Soc. (3) 9. 588.)  
+5 $\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Metzner, C. R. 1898, 127. 55.)

Cupric selenate,  $\text{CuSeO}_4 \cdot 5\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ :—

257 g. salt in 1 l. sat. solution at 15°.

346 " " " 1 " " 35°

435 " " " 1 " " 55°

Aq. solution decomp. at 70°. (Metzner, C. R. 1898, 127. 55.)

+ $\text{H}_2\text{O}$ , and +2 $\text{H}_2\text{O}$ . (Metzner.)

Cupric hydrazine selenate,  $\text{N}_2\text{H}_4 \cdot \text{H}_2\text{SeO}_4, \text{CuSeO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

Decomp. in aq. solution (Rimini, C. C. 1907, I. 86.)

Cupric magnesium selenate, $\text{CuMg}_2(\text{SeO}_4)_4 + 28\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ . (Wohlwill.)	Glucinum selenate, $\text{HfSeO}_4 + 4\text{H}_2\text{O}$ Very sol in $\text{H}_2\text{O}$ (Atterberg.)
Cupric nickel selenate, $\text{CuSeO}_4$ , $\text{NiSeO}_4 + 14\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ . (Wohlwill.)	Gold (auric) selenate, $\text{Au}_2(\text{SeO}_4)_3$ . Insol in $\text{H}_2\text{O}$ Sol in hot conc. $\text{H}_2\text{SeO}_4 + \text{Aq}$ Somewhat sol. in $\text{H}_2\text{SO}_4$ and $\text{HNO}_3 + \text{Aq}$ . Decomp. by $\text{HCl} + \text{Aq}$ . (Lenher, J. Am. Chem. Soc. 1902, 24, 355.)
Cupric potassium selenate, $\text{CuSeO}_4$ , $\text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ . Sl. sol. in $\text{H}_2\text{O}$ . (Topsoe.)	Indium selenate, $\text{In}_2(\text{SeO}_4)_3 + 10\text{H}_2\text{O}$ Hygroscopic; easily sol in $\text{H}_2\text{O}$ (Mathers, J. Am. Chem. Soc. 1908, 30, 214.)
Cupric zinc selenate, $\text{CuZn}_2(\text{SeO}_4)_4 + 28\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ (Wohlwill.)	Iron (ferrous) selenate, $\text{FeSeO}_4 + 5\text{H}_2\text{O}$ . Sol in $\text{H}_2\text{O}$ (Wohlwill, A. 114, 169) $+ 7\text{H}_2\text{O}$ Efflorescent, and sol in $\text{H}_2\text{O}$ . (Topsoe.)
Cupric selenate ferrous sulphate, $2\text{CuSeO}_4$ , $3\text{FeSO}_4 + 35\text{H}_2\text{O}$ . Sol in $\text{H}_2\text{O}$ (Wohlwill.)	Iron (ferrous) potassium selenate, $\text{FeSeO}_4$ , $\text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ . Easily sol. in $\text{H}_2\text{O}$ . Solution decomp. somewhat on standing. (Topsoe.)
Cupric selenate magnesium sulphate, $\text{CuSeO}_4$ , $3\text{MgSO}_4 + 28\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ . (Wohlwill.)	Iron (ferric) rubidium selenate, $\text{Rb}_2\text{Fe}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ . Sl. sol. in $\text{H}_2\text{O}$ . (Roncogliolo, Gazz. ch. it. 1905, 35, (2) 553.)
Cupric selenate zinc sulphate, $\text{CuSeO}_4$ , $3\text{ZnSO}_4 + 28\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ . (Wohlwill.)	Iron (ferric) selenate potassium sulphate, $\text{Fe}_2(\text{SeO}_4)_3$ , $\text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$ . Sol in $\text{H}_2\text{O}$ . (v. Gerichten.)
Didymium selenate, $\text{Dy}_2(\text{SeO}_4)_3 + 5\text{H}_2\text{O}$ , and $6\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ . $+ 8\text{H}_2\text{O}$ Easily sol. in $\text{H}_2\text{O}$ . (Cleve.) $+ 10\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ . (Cleve.)	Lanthanum selenate, $\text{La}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ , and $10\text{H}_2\text{O}$ . Easily sol. in cold $\text{H}_2\text{O}$ . (Cleve) $+ 12\text{H}_2\text{O}$ . (Frerichs and Smith, A. 191, 355.)
Didymium potassium selenate, $\text{Dy}_2(\text{SeO}_4)_3$ , $\text{K}_2\text{SeO}_4 + 9\text{H}_2\text{O}$ . Not deliquescent Easily sol. in $\text{H}_2\text{O}$ . (Cleve)	Lanthanum potassium selenate, $\text{La}_2(\text{SeO}_4)_3$ , $\text{K}_2\text{SeO}_4 + 9\text{H}_2\text{O}$ . Quite sol. in $\text{H}_2\text{O}$ . (Cleve.)
Didymium sodium selenate, $\text{Dy}_2(\text{SeO}_4)_3$ , $\text{Na}_2\text{SeO}_4 + 4\text{H}_2\text{O}$ . Easily sol in $\text{H}_2\text{O}$ . (Cleve)	Lanthanum sodium selenate, $\text{La}_2(\text{SeO}_4)_3$ , $\text{Na}_2\text{SeO}_4 + 4\text{H}_2\text{O}$ . Easily sol. in $\text{H}_2\text{O}$ . (Cleve)
Dysprosium selenate, $\text{Dy}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}$ . Easily sol. in $\text{H}_2\text{O}$ ; insol. in alcohol. (Jantsch, B. 1911, 44, 1275.)	Lead selenate, basic, $2\text{PbO}$ , $\text{SeO}_2$ . Decomp. by acids with separation of $\text{PbSeO}_4$ . $3\text{PbO}$ , $\text{PbSeO}_4 + \text{H}_2\text{O}$ . Ppt. (Strömholm, Z. anorg. 1904, 38, 443.)
Erbium selenate, $\text{Er}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}$ , and $9\text{H}_2\text{O}$ . Easily sol in $\text{H}_2\text{O}$ . (Topsoe)	Lead selenate, $\text{PbSeO}_4$ . Insol. in $\text{H}_2\text{O}$ or $\text{HNO}_3 + \text{Aq}$ . (Schafarik, W. A. B. 47, 256) Min. <i>Kerselenate</i>
Erbium potassium selenate, $\text{Er}_2(\text{SeO}_4)_3$ , $\text{K}_2\text{SeO}_4 + 8\text{H}_2\text{O}$ . Easily sol. in $\text{H}_2\text{O}$ . (Cleve)	Lithium selenate, $\text{Li}_2\text{SeO}_4 + \text{H}_2\text{O}$ . Not deliquescent. Easily sol. in $\text{H}_2\text{O}$ . (Topsoe.)
Gadolinium selenate, $\text{Gd}_2(\text{SeO}_4)_3 + 10\text{H}_2\text{O}$ . Decomp. in the air. (Benedicks, Z. anorg. 1900, 22, 410.)	
Gadolinium potassium selenate, $\text{Gd}_2(\text{SeO}_4)_3$ , $3\text{K}_2\text{SeO}_4 + 4\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ . (Benedicks, Z. anorg. 1900, 22, 412)	

**Magnesium selenate,  $\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$ .**

Solubility resembles closely that of  $\text{MgSO}_4$  (Topsoë.)

**Magnesium potassium selenate,  $\text{MgK}_2(\text{SeO}_4)_2 \cdot 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$  (Topsoë.)

**Magnesium rubidium selenate,  $\text{MgSeO}_4 \cdot \text{Rb}_2\text{SeO}_4 \cdot 6\text{H}_2\text{O}$** 

(Tutton, Chem. Soc. 1905, 87, 1163)

**Manganous selenate,  $\text{MnSeO}_4 \cdot 2\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)  
+  $5\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Solution  
decomp on warming or standing (Topsoë)

**Manganous potassium selenate,  $\text{K}_2\text{SeO}_4 \cdot \text{MnSeO}_4$ .**

Not deliquescent. Easily sol. in  $\text{H}_2\text{O}$  (Topsoë)

**Mercurous selenate,  $6\text{Hg}_2\text{O}, 5\text{SeO}_2$ .**

Very sl sol. in  $\text{H}_2\text{O}$ . Sl attacked by boiling  $\text{HNO}_3$ . Insol. in  $\text{HCl} + \text{Aq}$ . (Köhler, Pogg. 89, 146)

$\text{Hg}_2\text{SeO}_4$ . Very sl. sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{HCl} + \text{Aq}$ . (Cameron and Davy, C N 44, 63.)

**Mercuric selenate, basic,  $6\text{HgO}, 2\text{SeO}_2 + \text{H}_2\text{O}$** 

Insol. in  $\text{H}_2\text{O}$ , or cold  $\text{HNO}_3 + \text{Aq}$ . Sol. in hot  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ . (Köhler)

$\text{HgSeO}_4, 2\text{HgO}$ . Sol. in 10,330 pts  $\text{H}_2\text{O}$  (Cameron and Davy.)

**Mercuric selenate,  $\text{HgSeO}_4 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  with formation of basic salt. (Köhler.)

Sol. in  $\text{H}_2\text{SeO}_4, \text{H}_2\text{SO}_4, \text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ , but decomp. by  $\text{H}_2\text{O}$  to  $2\text{HgO}, \text{HgSeO}_4$ . (Cameron and Davy, C. N. 44, 63.)

**Nickel selenate,  $\text{NiSeO}_4 \cdot 6\text{H}_2\text{O}$ .**

Very easily sol. in  $\text{H}_2\text{O}$ . (v. Hauer, W. A B 39, 305.)

**Nickel potassium selenate,  $\text{NiSeO}_4, \text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Nickel thallium selenate,  $\text{NiSeO}_4, \text{Th}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Petersson.)

**Platinum selenate.**

Sol. in boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . Insol. in alcohol (Cameron and Macallan, Lond. R. Soc. Proc 46, 13)

**Potassium selenate,  $\text{K}_2\text{SeO}_4$ .**

Nearly equally sol. in cold and hot  $\text{H}_2\text{O}$ . (Mitscherlich, Pogg. 9, 623.)

100 g  $\text{H}_2\text{O}$  dissolve 110.5 g.  $\text{K}_2\text{SeO}_4$  at  $0^\circ$ ; 112.8 g. at  $20^\circ$ , 122.2 g. at  $100^\circ$ . (Étard, C. R. 1888, 106, 741)

Sat.  $\text{K}_2\text{SeO}_4 + \text{Aq}$  contains at.

$-20^\circ$	$-5^\circ$	$+5^\circ$
51.5	51.7	52.0% $\text{K}_2\text{SeO}_4$

$18^\circ$	$97^\circ$
52.6	54.9% $\text{K}_2\text{SeO}_4$

(Étard, A. ch. 1894, (7) 2, 550)

100 g.  $\text{H}_2\text{O}$  at  $12^\circ$  dissolve 115.0 g.  $\text{K}_2\text{SeO}_4$ . (Tutton, Chem. Soc. 1897, 71, 850)

Sp. gr of  $\text{K}_2\text{SeO}_4 + \text{Aq}$  at  $20^\circ$  compared with  $\text{H}_2\text{O}$  at  $4^\circ$ , containing:

% $\text{K}_2\text{SeO}_4$	35.76	41.79	50.00
Sp. gr	1.3591	1.4385	1.5590

(Tutton, Chem. Soc. 1897, 71, 851.)

**Potassium hydrogen selenate,  $\text{KHSO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Potassium praseodymium selenate,  $3\text{K}_2\text{SeO}_4, \text{Pr}_2(\text{SeO}_4)_3 + 4\text{H}_2\text{O}$ .**

Sl sol. in  $\text{H}_2\text{O}$ . (von Scheele, Z. anorg. 1898, 18, 361)

**Potassium samarium selenate,  $\text{K}_2\text{SeO}_4, \text{Sm}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$** 

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 43, 166.)

**Potassium sodium selenate,  $3\text{K}_2\text{SeO}_4, \text{Na}_2\text{SeO}_4$** 

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Potassium thallium selenate,  $\text{K}_2\text{SeO}_4, \text{Th}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}$ .**

Very sol. in dil. acids. (Fortini, C. C. 1903, II, 705.)

**Potassium uranyl selenate,  $\text{K}_2\text{SeO}_4, (\text{UO}_2)\text{SeO}_4 + 2\text{H}_2\text{O}$ .**

Sl sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Sendtner.)

**Potassium yttrium selenate,  $\text{K}_2\text{SeO}_4, \text{Y}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Potassium zinc selenate,  $\text{K}_2\text{SeO}_4, \text{ZnSeO}_4 + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

+  $6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Potassium selenate aluminum sulphate,  $\text{K}_2\text{SeO}_4, \text{Al}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (v. Gerichten)

Potassium selenate chromic sulphate,  
 $K_2SeO_4, Cr_2(SO_4)_3 + 24H_2O$ .  
 Sol. in  $H_2O$ . (v. Gerichten.)

Potassium selenate ferric sulphate,  $K_2SeO_4, Fe_2(SO_4)_3 + 24H_2O$ .  
 Sol. in  $H_2O$ . (v. Gerichten.)

Potassium selenate manganous sulphate,  
 $K_2SeO_4, MnSO_4 + 6H_2O$ .  
 Sol. in  $H_2O$ . (v. Gerichten, A. 168. 225)

Potassium selenate manganic sulphate,  
 $K_2SeO_4, Mn_2(SeO_4)_3 + 24H_2O$ .  
 Sol. in  $H_2O$ . (v. Gerichten.)

Praseodymium selenate,  $Pr_2(SeO_4)_3$   
 Sol. in  $H_2O$ . (von Schule, Z. anorg. 1898,  
 18, 360.)  
 $+8H_2O$ . Sl. sol. in  $H_2O$ ; sol. in  $H_2SO_4$ .  
 (von Schule.)

Rubidium selenate,  $Rb_2SeO_4$ .  
 Sol. in  $H_2O$ . (Petersson)  
 100 g.  $H_2O$  at  $12^\circ$  dissolve 158.9 g.  $Rb_2SeO_4$ .  
 (Tutton, Chem. Soc. 1897, 71. 850)  
 Sp. gr. of  $Rb_2SeO_4 + Aq$  at  $20^\circ$  compared  
 with  $H_2O$  at  $4^\circ$ , containing:  

% $Rb_2SeO_4$	40.60	47.07
Sp. gr.	1.4688	1.5806

 (Tutton.)

Rubidium hydrogen selenate,  $RbHSeO_4$ .  
 Sol. in equal pts.  $H_2O$ ; very hygroscopic.  
 (Norris, Am. Ch. J. 1901, 26. 321)

Rubidium zinc selenate,  $Rb_2Zn(SeO_4)_2 + 6H_2O$ .  
 (Tutton, Zeit. Kryst. 1900, 33. 8.)

Samarium selenate,  $Sm_2(SeO_4)_3 + 8H_2O$ .  
 More sol. in  $H_2O$  than  $Sm_2(SO_4)_3$ .  
 $+12H_2O$ . Efflorescent. (Cleve)

Scandium selenate,  $Sc_2(SeO_4)_3 + 2H_2O$ , and  
 $+8H_2O$ .  
 (Crookes, Roy. Soc. Proc. 1908, 80, A.  
 518.)

Silver selenate,  $Ag_2SeO_4$ .  
 As  $Ag_2SO_4$ . (Mitscherlich, Pogg. 12. 138.)

Silver selenate ammonia,  $Ag_2SeO_4, 4NH_3$ .  
 Easily sol. in  $H_2O$  or  $NH_4OH + Aq$  without  
 decomp. (Mitscherlich, Pogg. 12. 141.)

Sodium selenate,  $Na_2SeO_4$ .  
 Very sol. in  $H_2O$ , forming supersat. solu-  
 tions. Cryst. also with  $10H_2O$ , which  
 effloresce. Maximum point of solubility is  
 at  $33^\circ$ . (Mitscherlich.)

# Solubility in $H_2O$ at $t^\circ$ .

$t^\circ$	% $Na_2SeO_4$	Mols $H_2O$ to 1 mol $Na_2SeO_4$	Mols anhy- drous salt to 100 mols $H_2O$
35 2	45 47	12 59	7.94
39 5	45 26	12. 70	7.87
50	44 49	13 10	7.63
75	42 83	14 00	7.14
100	42 14	14 42	6.93

(Funk, B. 1900, 33. 3697.)

# $+10H_2O$ Solubility in $H_2O$ at $t^\circ$ .

$t^\circ$	% $Na_2SeO_4$	Mols $H_2O$ to 1 mol $Na_2SeO_4$	Mols anhy- drous salt to 100 mols $H_2O$
0	11 74	79.08	1.26
15	25 01	31 48	3.18
25 2	36 91	17 95	5.57
27	39 18	16 30	6.13
30	44 05	13 33	7.50

(Funk.)

Sp. gr. of sat. solution at  $18^\circ = 1.315$ .  
 (Funk.)

Sodium selenate vanadate.  
 See Selenovanadate, sodium.

Strontium selenate,  $SrSeO_4$ .  
 Insol. in  $H_2O$  or  $HNO_3 + Aq$ ; decomp. by  
 long boiling with  $HCl + Aq$

Tellurium selenate,  $2TeO_2, SeO_3$ .  
 As sulphate. (Metzner, A. ch. 1898, (7)  
 16. 203)

Thallous selenate,  $Tl_2SeO_4$ .  
 Sl. sol. in cold, much more in hot  $H_2O$ .  
 Insol. in alcohol and ether. (Kuhmann.)  
 100 g.  $H_2O$  dissolve 2.13 g. at  $9.3^\circ$ ; 2.4 g.  
 at  $12^\circ$ ; 10.86 g. at  $100^\circ$ . (Tutton, Proc.  
 Roy. Soc. 1907, 79. A. 351.)  
 28 g. are sol. in 100 g.  $H_2O$  at  $20^\circ$ , 8.5 g.  
 at  $80^\circ$ . (Glauser, Z. anorg. 1910, 66. 437.)

Thallous hydrogen selenate,  $HTlSeO_4 + 3H_2O$ .  
 (Oettinger.)

Thallous zinc selenate,  $Tl_2SeO_4, ZnSeO_4 + 6H_2O$ .  
 Easily sol. in  $H_2O$ , but less than the cor-  
 responding sulphate. (Werther, Bull. Soc.  
 1865. 60.)

Thorium selenate,  $Th(SeO_4)_4 + 9H_2O$ .  
 100 pts.  $H_2O$  dissolve 0.498 pt.  $Th(SeO_4)_4$   
 at  $0^\circ$ , and 1.972 pts. at  $100^\circ$ . (Cleve.)

Tin (stannic) selenate, basic,  $\text{SnO}(\text{SeO}_4) + \text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 231)

Uranyl selenate,  $(\text{UO}_2)_2\text{SeO}_4, \text{H}_2\text{SeO}_4 + 18\text{H}_2\text{O}$ .

Very deliquescent.  
 $2(\text{UO}_2)_2\text{SeO}_4, \text{H}_2\text{SeO}_4 + 12\text{H}_2\text{O}$  Efflorescent. Sol. in  $\text{H}_2\text{O}$  (Sendtner, A. 195. 325.)

Ytterbium selenate,  $\text{Yb}_2(\text{SeO}_4)_3$ .

Anhydrous.  
 $+15\text{H}_2\text{O} (?)$ ,  $+8\text{H}_2\text{O}$  Ppt. (Cleve, Z anorg 1902, 32. 145)

Yttrium selenate,  $\text{Y}_2(\text{SeO}_4)_3$

Anhydrous Sol. in  $\text{H}_2\text{O}$  with hissing and evolution of heat. (Popp)  
 $+8\text{H}_2\text{O}$  Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)  
 $+9\text{H}_2\text{O}$  Efflorescent.

Zinc selenate,  $\text{ZnSeO}_4 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Topsos)  
 $+6\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Topsos.)  
 $+7\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ .

Selenious acid,  $\text{H}_2\text{SeO}_3$ .

Deliquescent in moist, efflorescent in dry air. Very sol. in cold, and in nearly every proportion in hot  $\text{H}_2\text{O}$  Easily sol. in alcohol. (Berzelius)

Sp gr of  $\text{H}_2\text{SeO}_3$  and of  $\text{H}_2\text{SeO}_3 + \text{Aq}$  at  $t^\circ$   
 Two series of experiments.

	$t^\circ$	Sp. gr at $t^\circ$
$\text{H}_2\text{SeO}_3 + \text{Aq}$ (A)	18 0	1.4386
1 vol A + 0.5 vol. $\text{H}_2\text{O}$	18.0	1.3179
" + 1 0 "	17 7	1.2337
" + 1 5 "	16.6	1.2045
" + 2 0 "	14.0	1.1984
" + 2 5 "	17.0	1.1712
" + 3 0 "	19.2	1.1600
$\text{H}_2\text{SeO}_3 + \text{Aq}$ (B)	15.8	1.4698
1 vol B + 0.5 vol. $\text{H}_2\text{O}$	16.5	1.3191
" + 1 0 "	13 0	1.2515
" + 1 5 "	14 2	1.2074
" + 2 0 "	17 0	1.1992
" + 2.5 "	16 5	1.1793
" + 3.0 "	14 2	1.1678

(de Connock, C. C. 1905, I. 1693.)

See also Selenious dioxide.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830)

Selenites.

Alkali selenites are sol. in  $\text{H}_2\text{O}$ . The other neutral selenites are insol. in  $\text{H}_2\text{O}$ , but sol. in  $\text{HNO}_3 + \text{Aq}$ , Pb, and Ag salts slowly. The

neutral salts are insol. in  $\text{HCl} + \text{Aq}$ . The acid salts of the heavy metals are sol. in  $\text{H}_2\text{O}$ .

Aluminum selenite, basic,  $4\text{Al}_2\text{O}_3, 9\text{SeO}_2 + 36\text{H}_2\text{O}$ .

Precipitato. (Nilson, Upsala, 1876.)

Aluminum selenite,  $\text{Al}_2(\text{SeO}_3)_3$ .

Precipitato. (Berzelius)  
 $+7\text{H}_2\text{O}$ . Sl sol. in  $\text{H}_2\text{O}$ . (Nilson.) Sol. in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ .  
 $+3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Boutzoureano, A. ch (6) 17. 289.)

Aluminum selenite, acid,  $\text{Al}_2\text{O}_3, 4\text{SeO}_2 + 3\text{H}_2\text{O}$

(Boutzoureano)  
 $2\text{Al}_2\text{O}_3, 9\text{SeO}_2 + 12\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Nilson.)  
 $\text{Al}_2\text{O}_3, 6\text{SeO}_2$  Very sol. in  $\text{H}_2\text{O}$ . (Berzelius)  
 $+5\text{H}_2\text{O}$ . (Nilson.)  
 $+2\text{H}_2\text{O}$ . (Boutzoureano.)

Ammonium selenite,  $(\text{NH}_4)_2\text{SeO}_3$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .  
 Precipitated from aqueous solution by alcohol. Insol. in ether. (Muspratt, A. 70. 275)

Ammonium hydrogen selenite,  $\text{NH}_4\text{HSeO}_3$ .

Not deliquescent Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

Ammonium trihydrogen selenite,

$\text{NH}_4\text{H}_2(\text{SeO}_3)_3$ .

Deliquescent. (Berzelius.)

Ammonium vanadium selenite.

See Vanadiouselenite, ammonium.

Ammonium uranyl selenite,  $(\text{NH}_4)_2\text{SeO}_3$ ,  $(\text{UO}_2)_2\text{SeO}_3$ .

Completely insol. in  $\text{H}_2\text{O}$ . (Sendtner)

Antimony selenite,  $\text{Sb}_2(\text{SeO}_3)_3, \text{SeO}_2$

(Nilson, Bull. Soc. (2) 23. 494.)

Barium selenite,  $\text{BaSeO}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . So in acids. (Nilson)  
 $+ \text{H}_2\text{O}$  (Nilson)

Barium pyroselenite,  $\text{BaSe}_2\text{O}_6$

Very sl. sol. in cold, more in warm  $\text{H}_2\text{O}$ . (Berzelius)

Bismuth selenite,  $\text{Bi}_2(\text{SeO}_3)_3, \text{H}_2\text{SeO}_3$ .

(Nilson)

$\text{Bi}_2(\text{SeO}_3)_3$ . (Nilson.)

Cadmium selenite,  $\text{CdSeO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . (Muspratt, Chem Soc. 2. 65.)

$2\text{CdO}$ ,  $3\text{SeO}_2 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , sol. in acids. (Boutzoureano.)  
 $+ \frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids (Boutzoureano.)

Cadmium selenite ammonia,  $\text{CdSeO}_3, \text{NH}_3$ .  
 Insol. in cold or hot  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17. 289.)

Calcium selenite,  $\text{CaSeO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .  
 Very sl. sol in  $\text{H}_2\text{O}$ . (Berzelius) More sol. in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ .  
 $+ 2\text{H}_2\text{O}$ . (Nilson.)

Calcium hydrogen selenite,  $\text{CaH}_2(\text{SeO}_3)_2 + \text{H}_2\text{O}$ .  
 Quite sol. in  $\text{H}_2\text{O}$ . (Nilson.)  
 $\text{Ca}_2\text{H}_2\text{Se}_2\text{O}_{11}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Nilson.)

Cerous selenite, basic,  $2\text{Ce}_2\text{O}_3, 5\text{SeO}_2 + 30\text{H}_2\text{O}$ .  
 Precipitate. (Nilson.)

Cerous selenite,  $\text{Ce}_2(\text{SeO}_3)_3 + 3\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$ . Sol. in much selenious acid. (Jolin.)  
 $+ 12\text{H}_2\text{O}$ . (Nilson.)

Cerous selenite, acid,  $\text{Ce}_2\text{O}_3, 4\text{SeO}_2 + 5$ , or 6  $\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$ , but sol. in selenious, and other acids. (Jolin.)  
 $\text{Ce}_2\text{O}_3, 6\text{SeO}_2 + 5\text{H}_2\text{O}$ . Not decomp. by  $\text{H}_2\text{O}$ . (Nilson.)

Ceric selenite,  $\text{Ce}(\text{SeO}_3)_2$ .  
 Insol. in  $\text{H}_2\text{O}$ .  
 Sl. sol. in conc.  $\text{HNO}_3$ . Sol. in dil. acids. Sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ . (Barbicri, B. 1910, 43. 2215.)

Chromium selenite, basic,  $4\text{Cr}_2\text{O}_3, 9\text{SeO}_2 + 64\text{H}_2\text{O}$ .  
 Precipitate. (Nilson.)

Chromic selenite,  $\text{Cr}_2(\text{SeO}_3)_3 + 3\text{H}_2\text{O}$ .  
 (Boutzoureano.)  
 $+ 15\text{H}_2\text{O}$ . (Nilson.)  
 Very sl. sol. or insol. in  $\text{H}_2\text{O}$ , sl. sol. in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ ; sol. in hot conc.  $\text{HCl} + \text{Aq}$  (Taquet, C. R. 96. 107.)

Chromic selenite, acid,  $\text{Cr}_2\text{O}_3, 4\text{SeO}_2 + 13\text{H}_2\text{O}$ .  
 Slowly sol. in  $\text{HCl} + \text{Aq}$  Insol. in  $\text{H}_2\text{O}$ . (Nilson.)  
 $\text{Cr}_2\text{O}_3, 5\text{SeO}_2 + 9\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Nilson.)

Chromic diselenite.  
 Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Taquet, C. R. 97. 1435.)

Cobaltous selenite,  $\text{CoSeO}_3$ .  
 Insol. in  $\text{H}_2\text{O}$ . (Berzelius)  
 $+ \frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Boutzoureano, A. ch. (6) 17. 289)

Cobaltous hydrogen selenite,  $\text{CoH}_2(\text{SeO}_3)_2$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)  
 $+ 2\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  with decomp. (Boutzoureano.)

Cuprous selenite.  
 Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Berzelius)

Cupric selenite, basic,  $2\text{CuO}, \text{SeO}_2$ .  
 Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Boutzoureano)  
 Sol. in acids.

Cupric selenite,  $\text{CuSeO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . (Berzelius.)  
 $+ \text{H}_2\text{O}$ , and  $2\text{H}_2\text{O}$ . (Boutzoureano.)  
 $+ 2\text{H}_2\text{O}$  Min. *Chalcocite* Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . (Friedel and Sarasin, Zent. Kryst 1881, 6. 300.)

Cupric selenite, acid,  $\text{CuO}, 2\text{SeO}_2 + \text{H}_2\text{O} = \text{CuH}_2(\text{SeO}_3)_2$ .  
 Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Nilson)  
 $+ 2\text{H}_2\text{O}$ . As above (Boutzoureano.)  
 $+ 4\text{H}_2\text{O}$  As above. (B.)

Cupric selenite ammonia,  $\text{CuSeO}_3, \text{NH}_3 + \text{H}_2\text{O}$ .  
 Decomp. by  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17. 289.)

Didymium selenite, basic,  $3\text{D}_2\text{O}_3, 8\text{SeO}_2 + 28\text{H}_2\text{O}$ .  
 Precipitate. (Nilson.)  
 $+ 21\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  (Cleve, Bull. Soc. (2) 43. 363.)

Didymium selenite,  $\text{D}_2(\text{SeO}_3)_2 + 6\text{H}_2\text{O}$ .  
 Precipitate. (Smith.)

Didymium selenite, acid,  $\text{D}_2\text{O}_3, 4\text{SeO}_2 + 5\text{H}_2\text{O}$ .  
 Precipitate (Cleve.)  
 Composition is  $\text{D}_2(\text{SeO}_3)_2 + 6\text{H}_2\text{O}$ . (Smith.)  
 $+ 9\text{H}_2\text{O}$ . (Nilson.)  
 $2\text{D}_2\text{O}_3, 9\text{SeO}_2 + 18\text{H}_2\text{O}$ . (Nilson.)

Erbium selenite,  $\text{Er}_2(\text{SeO}_3)_3 + 5\text{H}_2\text{O}$ , and  $9\text{H}_2\text{O}$ .  
 Precipitate. (Nilson.)

Erbium hydrogen selenite,  $\text{Er}_2\text{H}_2(\text{SeO}_3)_4 + 4\text{H}_2\text{O}$ .  
 Decomp. by hot  $\text{H}_2\text{O}$

- Gadolinium hydrogen selenite**,  $\text{Gd}_2(\text{SeO}_3)_3 \cdot \text{H}_2\text{SeO}_3 + 6\text{H}_2\text{O}$ .  
Ppt. (Benedicks, Z anorg. 1900, 22, 413.)
- Glucinum selenite, basic**,  $5\text{GfO} \cdot 2\text{SeO}_2 + 10\text{H}_2\text{O}$ .  
Precipitate (Nilson.) According to Atterberg, is  $7\text{GfO} \cdot 3\text{SeO}_2 + 14\text{H}_2\text{O}$ .  
 $2\text{GfO} \cdot \text{SeO}_2 + 4\text{H}_2\text{O}$ . (Atterberg, Bull. Soc. (2) 19, 497.)  
 $3\text{GfO} \cdot 2\text{SeO}_2 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  (Atterberg.)
- Glucinum selenite**,  $\text{GfSeO}_4 + 2\text{H}_2\text{O}$ .  
Sol. in little  $\text{H}_2\text{O}$ , decomp. by excess. (Nilson.)
- Glucinum selenite, acid**.  
(a)  $3\text{GfO} \cdot 5\text{SeO}_2 + 3\text{H}_2\text{O}$ ; (b)  $\text{GfO} \cdot 2\text{SeO}_2 + \text{H}_2\text{O}$ ; (c)  $3\text{GfO} \cdot 7\text{SeO}_2 + 5\text{H}_2\text{O}$ ; (d)  $\text{GfO} \cdot 3\text{SeO}_2 + 2\text{H}_2\text{O}$ . All are very sl. sol. in cold or warm  $\text{H}_2\text{O}$ . a, b, and c are sol. in warm  $\text{H}_2\text{O}$  containing  $\text{HCl}$ ; d is sol. only in boiling dil.  $\text{HCl} + \text{Aq}$ . (Nilson.)
- Indium selenite, basic**,  $\text{In}_3\text{Se}_2\text{O}_{16} + 64\text{H}_2\text{O}$ . (Nilson.)
- Indium selenite**,  $\text{In}_2(\text{SO}_3)_2 + 6\text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ . (Nilson.)
- Indium hydrogen selenite**,  $\text{In}_2(\text{SeO}_3)_2 \cdot 3\text{H}_2\text{SeO}_3 + 4\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Nilson.)  
 $2\text{In}_2(\text{SeO}_3)_2 \cdot 3\text{H}_2\text{SeO}_3 + 12\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Nilson.)
- Iron (ferrous) selenite**.  
Ppt. Sol. in  $\text{HCl} + \text{Aq}$  with partial separation of Se. (Berzelius.)
- Iron (ferrous) hydrogen selenite**.  
Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)
- Iron (ferric) selenite, basic**,  $2\text{Fe}_2\text{O}_3 \cdot 3\text{SeO}_2 + x\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)  
 $\text{Fe}_2\text{O}_3 \cdot 2\text{SeO}_2$ . Insol. in  $\text{H}_2\text{O}$ , easily sol. in acids. (Boutzoureano, A. ch. (6) 17, 289.)  
 $3\text{Fe}_2\text{O}_3 \cdot 8\text{SeO}_2 + 28\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Nilson.)
- Iron (ferric) selenite**,  $\text{Fe}_2(\text{SeO}_3)_3 + 4\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ . (Muspratt, Chem. Soc. 2, 52.)  
 $+ \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17, 289.)  
 $+ 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (B.)  
 $+ 10\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (B.)
- Iron (ferric) selenite, acid**,  $\text{Fe}_2\text{O}_3 \cdot 6\text{SeO}_2 + x\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$  (Berzelius.)  
 $+ 2\text{H}_2\text{O}$  (Boutzoureano, A. ch. (6) 17, 289.)  
 $\text{Fe}_2\text{O}_3 \cdot 4\text{SeO}_2 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , sol. in acids (Boutzoureano.)
- Lanthanum selenite, basic**,  $3\text{La}_2\text{O}_3 \cdot 8\text{SeO}_2 + 28\text{H}_2\text{O}$ .  
Precipitate. (Nilson.)
- Lanthanum selenite**,  $\text{La}_2(\text{SeO}_3)_3 + 9\text{H}_2\text{O}$ , or  $12\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ . (Nilson.)
- Lanthanum selenite, acid**,  $\text{La}_2\text{H}_4(\text{SeO}_3)_6 + 4\text{H}_2\text{O}$ .  
(Nilson.)  
 $\text{La}_2\text{H}_2(\text{SeO}_3)_4 + 2\text{H}_2\text{O}$ . (Cleve.)
- Lead selenite**,  $\text{PbSeO}_3$ .  
Scarcely sol. in  $\text{H}_2\text{O}$ , even when it contains  $\text{H}_2\text{SeO}_3$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq}$ . (Berzelius.)
- Lithium selenite**,  $\text{Li}_2\text{SeO}_3 + \text{H}_2\text{O}$ .  
Difficultly sol. in  $\text{H}_2\text{O}$ . (Nilson, Bull. Soc. (2) 21, 253.)
- Lithium hydrogen selenite**,  $\text{LiHSO}_3$ .  
Very sol. in  $\text{H}_2\text{O}$ . (Nilson.)
- Lithium trihydrogen selenite**,  $\text{LiH}_3(\text{SeO}_3)_2$ .  
Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Nilson.)
- Lithium vanadium selenite**.  
See Vanadioselenite, lithium.
- Magnesium selenite**,  $\text{MgSeO}_3 + 2\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids, especially if warm, also in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . (Boutzoureano, A. ch. (6) 18, 302.)  
 $+ 3\text{H}_2\text{O}$ . Very sl. sol. in hot  $\text{H}_2\text{O}$ . (Berzelius.)  
 $+ 6\text{H}_2\text{O}$ . As the  $2\text{H}_2\text{O}$  salt. (Boutzoureano.)  
 $+ 7\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in acetic, and mineral acids. (Hilger, Z. anal. 13, 132.)
- Magnesium hydrogen selenite**,  $\text{MgH}_2(\text{SeO}_3)_2 + 3\text{H}_2\text{O}$ .  
Very deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Nilson.)  
Insol. in alcohol. (Muspratt.)  
 $\text{MgO} \cdot 2\text{SeO}_2$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Boutzoureano.)
- Magnesium tetrahydrogen selenite**,  $\text{MgH}_4(\text{SeO}_3)_3$ , and  $+ 3\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Nilson.)

**Manganous selenite,  $\text{MnSeO}_3 + \text{H}_2\text{O}$ .**

Precipitate (Nilson.)

+  $2\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ . (Berzelius)

Sol. in cold  $\text{HCl} + \text{Aq}$ . (Muspratt)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Boutzoureano.)

**Manganous selenite, acid,  $\text{MnSe}_2\text{O}_5$ .**

Sol. in  $\text{H}_2\text{O}$ . (Berzelius, Nilson.)

$\text{MnO}$ ,  $2\text{SeO}_2 + \text{H}_2\text{O} = \text{MnH}_2(\text{SeO}_4)_2$  (Boutzoureano, A. ch. (6) 17. 289.)

+  $5\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$  to  $\text{MnSeO}_3$ . (Boutzoureano.)

**Manganic selenite, basic,  $\text{Mn}_2\text{O}_3, 2\text{SeO}_2$ .**

Insol. in  $\text{H}_2\text{O}$ , cold  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq}$ , insol. in hot dil.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$  (Laugier, C. R. 104. 1508.)

Sol. in warm  $\text{HCl} + \text{Aq}$  with decomp

**Manganic selenite,  $\text{Mn}_2(\text{SeO}_3)_2 + 5\text{H}_2\text{O}$ .**  
(Laugier.)

**Manganic selenite, acid,  $\text{Mn}_2\text{O}_3, 4\text{SeO}_2$**

Insol. in  $\text{H}_2\text{O}$ , cold  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3 + \text{Aq}$  Insol. in hot  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3 + \text{Aq}$ . Sol. in cold  $\text{HCl} + \text{Aq}$ ; and in  $\text{H}_2\text{SO}_4 + \text{Aq}$  with separation of Se. (Laugier, C. R. 104. 1508.)

**Mercurous selenite, basic,  $3\text{Hg}_2\text{O}, 2\text{SeO}_2 + 5\text{H}_2\text{O}$ .**

(Boutzoureano.)

**Mercurous selenite,  $\text{Hg}_2\text{SeO}_3$**

Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . Sol. in hot  $\text{HNO}_3 + \text{Aq}$ . (Köhler, Pogg. 89. 146.)

Sl. sol. in  $\text{HCl} + \text{Aq}$ , and  $\text{KOH} + \text{Aq}$  (Berzelius.)

**Mercurous selenite, acid,  $3\text{Hg}_2\text{O}, 4\text{SeO}_2$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . Sl. sol. in boiling  $\text{HNO}_3 + \text{Aq}$ . (Köhler)

**Mercuric selenite, basic,  $7\text{HgO}, 4\text{SeO}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq}$ . Easily sol. in  $\text{HCl} + \text{Aq}$  (Köhler, Pogg. 89. 146.)

**Mercuric selenite,  $\text{HgSeO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . (Berzelius.) Nearly insol. in  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{K}_2\text{SeO}_3 + \text{Aq}$ . (Divers, Chem. Soc. 48. 585.)

Insol. in dil.  $\text{HNO}_3 + \text{Aq}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (Rosenheim and Pritze, Z. anorg. 1909, 63. 278.)

Solubility in  $\text{Na}_2\text{SeO}_3 + \text{Aq}$  at  $25^\circ$ .

$\text{Na}_2\text{SeO}_3 + \text{Aq}$ Normality	% $\text{HgSeO}_3$
2.0	2.73
1.0	1.39
0.5	0.70
0.25	0.53
0.125	0.32
0.0625	0.18

(Rosenheim and Pritze, Z. anorg. 1909, 63. 281.)

$\text{HgSeO}_3, \text{H}_2\text{SeO}_3$  Easily sol. in  $\text{H}_2\text{O}$ ; very sl. sol. in alcohol. (Berzelius)

See also selenium dioxide.

**Mercuric sodium selenite,  $\text{HgSeO}_3, \text{Na}_2\text{SeO}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  and alkalis with pptn. of  $\text{HgSeO}_3$  (Rosenheim and Pritze, Z. anorg. 1909, 63. 279.)

**Mercuric selenite sodium chloride,  $\text{HgSeO}_3, \text{NaCl} + 2\text{H}_2\text{O}$**

Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim and Pritze, Z. anorg. 1909, 63. 280.)

**Nickel selenite,  $\text{NiSeO}_3 + \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . (Muspratt, Chem. Soc. 2. 52.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17. 28.)

**Nickel selenite, acid.**

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Potassium selenite,  $\text{K}_2\text{SeO}_3 + \text{H}_2\text{O}$**

Very deliquescent. Sol. in nearly all proportions in  $\text{H}_2\text{O}$  Insol. in alcohol, which separates it as oil from aqueous solution. (Muspratt, Chem. Soc. 2. 52.)

**Potassium hydrogen selenite,  $\text{KHSeO}_3$ .**

Very deliquescent. Very sl. sol. in alcohol. (Muspratt, Chem. Soc. 2. 52.)

**Potassium trihydrogen selenite,  $\text{KH}_3(\text{SeO}_3)_2$ .**

Very deliquescent. Pptd. from  $\text{H}_2\text{O}$  by alcohol. (Muspratt)

Not deliquescent. (Nilson)

**Potassium hydrogen pyroselenite,  $\text{KHSe}_2\text{O}_5 + \text{H}_2\text{O}$ .**

(Muthmann, B. 1893, 26. 1015.)

**Potassium uranyl selenite,  $\text{K}_2\text{SeO}_3, (\text{UO}_2)_2\text{SeO}_4$ .**

Absolutely insol. in  $\text{H}_2\text{O}$ . (Sendtner.)

**Praseodymium hydrogen selenite,**

$\text{Pr}_2(\text{SeO}_3)_3, \text{H}_2\text{SeO}_3 + 3\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  (von Scheele, Z. anorg. 1898, 18. 362.)

**Samarium selenite, basic,  $3\text{Sm}_2\text{O}_3, 8\text{SeO}_2 + 7\text{H}_2\text{O}$**

Precipitate. (Cleve.)

**Samarium selenite, acid,  $\text{Sm}_2\text{O}_3, 4\text{SeO}_2 + 5\text{H}_2\text{O}$ .**

Precipitate. (Cleve.)

**Scandium selenite,  $\text{Sc}_2(\text{SeO}_3)_2 + \text{H}_2\text{O}$ .**

Insol. precipitate.

Scandium hydrogen selenite,  $\text{Sc}_2(\text{SeO}_3)_3$ ,  $3\text{H}_2\text{SeO}_3$ .

Insol. in  $\text{H}_2\text{O}$  Not attacked by cold dil. acids, but easily if warmed

Silver selenite,  $\text{Ag}_2\text{SeO}_3$ .

Very sl sol. in cold, somewhat more sol in hot  $\text{H}_2\text{O}$ . Easily sol in hot  $\text{HNO}_3 + \text{Aq.}$  from which it is precipitated by  $\text{H}_2\text{O}$ . (Berzelius)

Insol. in  $\text{K}_2\text{SeO}_3 + \text{Aq.}$  sl sol. in dil  $\text{HNO}_3 + \text{Aq.}$  (Divers, Chem. Soc. 49. 585.)

Silver selenite ammonia,  $\text{Ag}_3\text{SeO}_3 \cdot \text{NH}_3$ .

Insol. in boiling  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17. 289.)

Sodium selenite,  $\text{Na}_2\text{SeO}_3$ .

Very sol in  $\text{H}_2\text{O}$  Insol. in alcohol. (Berzelius)  
+  $5\text{H}_2\text{O}$

Sodium selenite, acid,  $\text{NaHSO}_3$ .

Permanent. Sol. in  $\text{H}_2\text{O}$   
 $\text{Na}_2\text{Se}_2\text{O}_5$  Sol in  $\text{H}_2\text{O}$ . (Sacc, A. ch. (3) 21. 119.)  
 $\text{NaHS}_2(\text{SeO}_3)_2$  Not deliquescent Sol in  $\text{H}_2\text{O}$ .

Sodium vanadium selenite.

See Vanadioselenite, sodium.

Strontium selenite,  $\text{SrSeO}_3 + 7\text{H}_2\text{O}$

Precipitate. Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq.}$  (Musprratt)

Strontium hydrogen selenite,  $\text{SrH}_2(\text{SeO}_3)_2$

Easily sol. in hot or cold  $\text{H}_2\text{O}$ . (Nilson.)  
Nearly insol. in hot or cold  $\text{H}_2\text{O}$ . (Berzelius.)

Thallous selenite,  $\text{Tl}_2\text{SeO}_3$ .

Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol and ether. (Kuhlmann, Bull. Soc. (2) 1. 330.)

Thallous hydrogen selenite,  $\text{TlHSeO}_3$ .

More sol in  $\text{H}_2\text{O}$  than the above comp. (Kuhlmann)

Thallic selenite,  $\text{Tl}_2(\text{SeO}_3)_3$ .

Insol. in  $\text{H}_2\text{O}$  Sol. in dil.  $\text{HNO}_3$ .  
Easily decomp. by  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ . (Marino, Z. anorg. 1909, 62. 177.)

Thorium selenite,  $\text{Th}(\text{SeO}_3)_2 + \text{H}_2\text{O}$ , or  $8\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$  (Nilson.)

Thorium selenite, acid,  $2\text{ThO}_3$ ,  $7\text{SeO}_3 + 16\text{H}_2\text{O}$ .

$\text{ThO}_2$ ,  $5\text{SeO}_3 + 8\text{H}_2\text{O}$ . (Nilson.)

Tin (stannic) selenite.

Insol in  $\text{H}_2\text{O}$ ; sol in  $\text{HCl} + \text{Aq.}$  from which it is pptd by  $\text{H}_2\text{O}$  (Berzelius.)

Uranic selenite,  $\text{U}_2\text{O}_3 \cdot \text{SeO}_3$ .

Insol in  $\text{H}_2\text{O}$ . (Boutzoureano)  
+  $2\text{H}_2\text{O}$ . (B)

Uranic selenite, acid,  $2\text{U}_2\text{O}_3$ ,  $3\text{SeO}_3 + 7\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17. 289.)

Uranyl selenite,  $(\text{UO}_2)\text{SeO}_3 + 2\text{H}_2\text{O}$

Precipitate. (Nilson)

Uranyl selenite, acid,  $3\text{UO}_3$ ,  $5\text{SeO}_3 + 7\text{H}_2\text{O}$ , or  $9\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$ .  
 $\text{UO}_3$ ,  $2\text{SeO}_3 + \text{H}_2\text{O} = (\text{UO}_3)_2\text{H}_2(\text{SeO}_3)_2$ .  
Absolutely insol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SeO}_3 + \text{Aq.}$  (Sendtner, A. 195. 325)

Vanadium selenite.

See Vanadioselenious acid.

Ytterbium selenite,  $\text{Yb}_2(\text{SeO}_3)_2$

Insol. precipitate

Ytterbium hydrogen selenite,  $\text{Yb}_2\text{H}_2(\text{SeO}_3)_4 + 4\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$

Yttrium selenite,  $\text{Y}_2(\text{SeO}_3)_3 + 12\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq.}$  (Berzelius.)  
Sol in hot  $\text{H}_2\text{SeO}_3 + \text{Aq}$  (Nilson.)

Yttrium hydrogen selenite,  $\text{Y}_2\text{H}_2(\text{SeO}_3)_4 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  (Cleve.)

Zinc selenite,  $\text{ZnSeO}_3$ .

Insol. in  $\text{H}_2\text{O}$ , sol. in acids (Boutzoureano, A. ch. (6) 18. 289.)  
+  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{SeO}_3$ , or  $\text{HNO}_3 + \text{Aq.}$  (Musprratt, Chem Soc. 2. 52.)

Zinc hydrogen selenite,  $\text{ZnH}_2(\text{SeO}_3)_2$ .

Easily sol in  $\text{H}_2\text{O}$ . (Berzelius.)  
+  $2\text{H}_2\text{O}$ . Sol in cold  $\text{H}_2\text{O}$ . (Boutzoureano.)  
 $\text{ZnO}$ ,  $4\text{SeO}_3 + 3\text{H}_2\text{O}$  Easily sol. in  $\text{H}_2\text{O}$ . (Wöhler, A. 63. 279.)

Zinc selenite ammonia,  $\text{ZnSeO}_3 \cdot \text{NH}_3$ .

Insol. in cold or hot  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17. 289)

Zirconium selenite, basic,  $4\text{ZrO}_3$ ,  $3\text{SeO}_3 + 18\text{H}_2\text{O}$

Precipitate. Sl. sol. in  $\text{HCl} + \text{Aq.}$  (Nilson.)

**Zirconium selenite,  $Zr(SeO_3)_2$** 

Absolutely insol. in  $H_2O$ ; difficultly sol. in boiling  $HCl + Aq.$  (Nilson)  
 $+ H_2O.$  (Nilson.)

**Selenium, Se.**

Insol. in  $H_2O$  Schultz (J. pr. (2) 32. 390) has obtained a soluble colloidal modification which can be isolated by dialysis.

Insol. in  $HCl + Aq$  Decomp. by  $HNO_3 + Aq$  Sol. in fuming  $H_2SO_4.$  (Schultz-Sellac, B. 4. 113)

1000 pts.  $CS_2$  dissolve 1 pt. cryst. Se at boiling-point ( $46.6^\circ$ ), and 0.16 pt. at  $0^\circ$  (Mitscherlich, J. B. 1855. 314) Solubility of Se in  $CS_2$  is variable—1 pt. Se is sol. in 1376–2464–3746 pts.  $CS_2$  at  $20^\circ$  (Rummelsberg, B. 7. 609). Cryst. Se, which is sol. in  $CS_2$ , becomes insol. in  $CS_2$  after heating to  $110^\circ$ , but after fusion is again sol. (Otto).

**Four modifications.**—(1) Amorphous red, (2) crystalline red, (3) granular gray, (4) laminated. 1 and 2 are sol. in  $CS_2$ , 3 and 4 are insol. in  $CS_2$ . All forms are sol. in  $SeCl_2$ , from which crystallizes a black modification, insol. in  $CS_2$ .  $CCl_4$  with trace of  $CS_2$  dissolves red Se slightly, black Se not at all  $Se(C_2H_5)_2$  dissolves all modifications in small but apparently equal quantities. (Rathke, A. 152. 181)

According to Saunders (J. phys. Chem. 1900, 4. 428) selenium exists in three modifications.

1. Liquid, including vitreous, amorphous, and colloidal selenium.

**a. Vitreous.**

Sol. in liquid  $NH_3$  at  $25^\circ$  (Franklin, Am. Ch. J. 1898, 20. 820)

Insol. in liquid  $NH_3$  between  $-30^\circ$  and  $+10^\circ$ . Franklin's results are due to impure selenium and not completely dry  $NH_3$ . (Hugot, A. Ch. 1900, (7) 21. 5.)

Almost insol. in  $CS_2$ . (Schutzenberger, Chimie générale 1. 438.)

Action of light increases solubility in  $CS_2$ . (Saunders, J. phys. Chem. 1900, 4. 456)

Solubility in methylene iodide at  $12^\circ$  is 1.3 pts. in 100 (Retgers, Z. anorg. 1893, 3. 343.)

Sol. in  $SeCl_2$ , ethyl selenide, and in ethyl sulphide.

Very sol. in  $Se_2Cl_2$ . (Rathke, A. 1869, 152. 181.)

**b. Amorphous.**

Completely sol. in  $CS_2$  at ord. temp. if Se has not been heated. If heated or extracted with warm  $CS_2$  it becomes partly insol. (Peterson, Z. phys. Chem. 1891, 81. 612.)

Passes into red crystalline form in solution in  $CS_2$ ,  $C_6H_6$ , isobutyric acid, acetophenone, acetone,  $CHCl_3$ , thiophene, toluene, benzonitrile, ethyl acetate, and alcohol. (Saunders, J. phys. Chem. 1900, 4. 463.)

Solution in quinoline, aniline, pyridine,

etc., cause conversion into gray metallic form

**c Colloidal**

Forms colloidal solution with  $H_2O$ .

A colloidal solution of Se in  $H_2O$  can be obtained. It is not decomp. by boiling, but is decomp. by electrolytes with separation of red selenium. (Guthrie, Z. anorg. 1902, 32. 106.)

**2. Red crystalline**

Sol. in  $CS_2$ ,

3 Gray, crystalline or metallic.

Sol. in selenium chloride and other solvents as vitreous Se. (Rathke, A. 1869, 152. 181.)

Sl. sol. in  $CS_2$ , toluene, nitrobenzene, quinoline, aniline, and  $KOH$ . Pptd. from conc.  $KOH + Aq$  in long needles with mp.  $219^\circ$ . (Coste, C. R. 1903, 149. 674.)

Sol. in many organic substances at high temp as quinoline, ethyl benzoate, aniline and naphthalene (Saunders, J. phys. Chem. 1900, 4. 469)

Completely insol. in  $CS_2$ . (Saunders, J. phys. Chem. 1900, 4. 474.)

Solubility of the two modifications of gray crystalline Se in  $CS_2$ :

100 cc. boiling  $CS_2$  dissolve mg. Se

I	II	III
Mg. Se	Mg. Se	Mg. Se
3 2	4 1	2 7
2 8	4 0	2 2
3 6	2 9	1 9
3.3	2 8	1 0
2 2	2 9	2 0
	4 0	

I Se heated 1 hr. at  $140^\circ$ . Modification A

II Modification A.

III Se heated 48 hrs. at  $190^\circ$ – $200^\circ$ . Modification B

(Marc, Z. anorg. 1907, 53. 302.)

$Se_2Br_2$  dissolves 22% Se (Schneider, Pogg. 128. 327)

Red Se is sol. in  $(NH_4)_2SO_3 + Aq$  (Uelmann, A. 116. 122.)

Sol. in alkalis and Mg sulphates +  $Aq$ .

365 pts.  $K_2SO_3 + Aq$  dissolve 102 pts. Se.

360 pts.  $MgSO_4 \cdot 3H_2O + Aq$  dissolve 116 pts. Se.

Insol. in  $BaSO_3 + Aq$  (Rathke and Zechische, J. pr. 92. 145.)

Sol. in  $KCN + Aq$  with formation of  $KSeCN$  (Franklin, Am. Ch. J. 1898, 20. 830)

100 pts. methylene iodide dissolve 1.3 pts. Se at  $12^\circ$ . (Retgers, Z. anorg. 3. 343.)

Sol. in quinoline, but reacts with the solvent with evolution of  $H$  (Beckmann and Gabel, Z. anorg. 1903, 51. 236.)

**Selenium monobromide,  $\text{Se}_2\text{Br}_2$** 

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. thereby. Decomp. by absolute alcohol and benzene. Sol. in  $\text{C}_2\text{H}_5\text{I}$ , but soon decomposed. Miscible with  $\text{CS}_2$ ; less sol. in  $\text{CHCl}_3$  and  $\text{C}_2\text{H}_5\text{Br}$  (Schneider, Pogg. 128. 327.)

**Selenium tetrabromide,  $\text{SeBr}_4$** 

Sol. in  $\text{H}_2\text{O}$  with decomp. Decomp. by alcohol. Sol. in  $\text{HCl} + \text{Aq}$ ; sl. sol. in  $\text{CS}_2$ ,  $\text{CHCl}_3$ , and  $\text{C}_2\text{H}_5\text{Br}$ . (Schneider, Pogg. 129. 460.)

Decomp. by  $\text{C}_2\text{H}_5\text{I}$ .

**Selenium bromotrichloride,  $\text{SeCl}_3\text{Br}$** 

Insol. in  $\text{CS}_2$ . (Fvans and Ramsay, Chem Soc 45. 62.)

**Selenium tetrabromide sulphur trioxide,  $\text{SeBr}_4 \cdot 2\text{SO}_3$** 

Decomp. by  $\text{H}_2\text{O}$ . (Prandtl, Z anorg 1909, 62. 242.)

**Selenium tribromochloride,  $\text{SeClBr}_3$** 

See Selenium chlorotribromide.

**Selenium monochloride,  $\text{Se}_2\text{Cl}_2$** 

Gradually decomp. by  $\text{H}_2\text{O}$ . Dissolves all modifications of selenium on heating (Rathke, A. 162. 181). Insol. in conc.  $\text{H}_2\text{SO}_4$ , easily sol. in fuming  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{CHCl}_3$ ,  $\text{C}_2\text{H}_5$ ,  $\text{CCl}_4$ . Gradually decomp. by  $\text{H}_2\text{O}$ , alcohol, and ether. (Divers and Shmose, B. 17. 862.) Sol. in  $\text{CS}_2$ . (Evans and Ramsay, Chem Soc. 45. 62.)

**Selenium tetrachloride,  $\text{SeCl}_4$** 

Deliquescent on moist air. Decomp. with  $\text{H}_2\text{O}$ . (Berzelius, A. ch. 9. 225.) Insol. in  $\text{CS}_2$ . Easily sol. in hot  $\text{POCl}_3$ , from which it crystallizes on cooling. (Michaelis, Zeit. Chem (2) 6. 460.) Very sl. sol. in  $\text{CS}_2$ . (Evans and Ramsay, Chem Soc. 45. 62.)

**Selenium dichlorobromide,  $\text{SeCl}_2\text{Br}_2$** 

(Evans and Ramsay, Chem. Soc. 45. 62.)

**Selenium chlorotribromide,  $\text{SeClBr}_3$** 

Very sl. sol. in  $\text{CS}_2$ . (Evans and Ramsay.)

**Selenium trichlorobromide,  $\text{SeCl}_3\text{Br}$** 

See Selenium bromotrichloride.

**Selenium fluoride.**

Sol. in conc.  $\text{HF} + \text{Aq}$ . Decomp. immediately by  $\text{H}_2\text{O}$  (Knox.)

**Selenium moniodide,  $\text{SeI}_2$** 

Decomp. by  $\text{H}_2\text{O}$ . All solvents of iodine dissolve out that element. (Schneider, Pogg. 129. 627.)

**Selenium tetraiodide,  $\text{SeI}_4$** 

Slowly decomp. by much  $\text{H}_2\text{O}$ . Iodine is dissolved out by all solvents of that element. (Schneider, Pogg. 129. 627.)

**Selenium nitride.**

See Nitrogen selenide.

**Selenium monoxide,  $\text{SeO}$  (?)**

Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

Does not exist. (Sacc.)

**Selenium dioxide,  $\text{SeO}_2$** 

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Sol. in glacial  $\text{HCl} + \text{H}_2\text{O}_2$ . (Hinsberg, A. 260. 40.)

Solubility in  $\text{H}_2\text{O}$  between  $-3^\circ$  and  $+36^\circ = 45.0 + 0.7692t$ . (Étard, C R 1888, 106. 742.)

1 pt. is sol. in 2.67 pts.  $\text{H}_2\text{O}$  at  $11.3^\circ$

1 pt. " " " 2.60 " " "  $14^\circ$

1 pt. " " " 2.54 " " "  $15.6^\circ$

(de Coninck, C R 1906, 142. 571.)

Sp. gr of  $\text{SeO}_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{SeO}_2$	Sp. gr
15.1	1	0.9923
15.3	2	1.0068
13.0	3	1.0200
13.0	4	1.0302
14.5	5	1.0346
14.8	6	1.0402
14.1	7	1.0535
15.0	8	1.0571
15.6	9	1.0719
15.2	10	1.0743

(de Coninck, C R. 1906, 142. 571.)

See also Selenic acid.

1 pt.  $\text{SeO}_2$  is sol. in 9.84 pts. alcohol ( $93^\circ$ ) at  $14^\circ$ .

1 pt.  $\text{SeO}_2$  is sol. in 15.0 pts. methyl alcohol at  $11.8^\circ$ .

1 pt.  $\text{SeO}_2$  is sol. in 23.0 pts. acetone at  $15.3^\circ$ .

1 pt.  $\text{SeO}_2$  is sol. in 90.0 pts. acetic acid at  $12.9^\circ$ . (de Coninck, C. R. 1906, 142. 572.)

Traces dissolve in acetic anhydride. Sol. in phenyl mercaptan. (Hinsberg, A. 1890, 260. 40.)

Insol. in pure  $\text{C}_6\text{H}_6$ . (Clausmizer, A. 1879, 196. 271.)

See Selenic acid.

**Selenium trioxide,  $\text{SeO}_3$** 

Not obtained in a pure state. (Cameron and Macallan.)

See Selenic acid.

Selenium dioxide hydrobromic acid,  $\text{SeO}_2$ ,  
4HBr

Decomp. at  $55^\circ$  (Ditte, A. ch. (5) 10. 82.)

$\text{SeO}_2$ , 5HBr. Decomp. at  $65^\circ$  (Ditte, A. ch. (5) 10. 82.)

Selenium dioxide hydrochloric acid,  $\text{SeO}_2$ ,  
2HCl

Decomp. at  $26^\circ$

$\text{SeO}_2$ , 4HCl. Decomp. at  $0^\circ$ . Sol in  $\text{H}_2\text{O}$  without evolution of gas (Ditte, A. ch. (5) 10. 82)

Selenium dioxide sulphur trioxide,  $\text{SeO}_2$ ,  
 $\text{SO}_3$

Decomp. violently by  $\text{H}_2\text{O}$ . (Weber, B 19. 3185.)

Composition may be  $(\text{SeO})\text{SO}_4$  (?)

Selenium oxy-compounds.

See Selenyl compounds.

Selenium diphosphide,  $\text{P}_2\text{Se}$ .

See Phosphorus monoselenide.

Selenium tetraphosphide,  $\text{P}_4\text{Se}$ .

See Phosphorus semiselenide.

Selenium monosulphide,  $\text{SeS}$ .

Insol in  $\text{H}_2\text{O}$  and ether. Sol in  $\text{CS}_2$ . Decomp. by alcohol. (Ditte, C R 73. 625, 660.)

Other compounds of Se and S are probably mixtures of the two elements

Selenium disulphide,  $\text{SeS}_2$ .

Compound of this formula is a mixture of  $\text{SeS}$  and  $\text{S}$ . (Ditte, C. R. 73. 625, 660.)

Selenium sulphoxide,  $\text{SeSO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in fuming  $\text{H}_2\text{SO}_4$ , conc.  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{H}_2\text{SO}_4$  of 1.806 sp. gr. without decomp. (Weber, Pogg. 166. 531.)

Decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{SO}_4$ . (Divers and Shmossé, B. 17. 858.)

Seleniuretted hydrogen,  $\text{H}_2\text{Se}$ .

See Hydrogen selenide.

Selenoarsenic acid.

Potassium selenoarsenate,  $\text{KAsSe}_3 + 2\text{H}_2\text{O}$ .

Only sl. sol. in cold  $\text{H}_2\text{O}$ ; sol. in warm  $\text{H}_2\text{O}$  with decomp.; more stable in  $\text{KOH} + \text{Aq.}$  (Clever, Z. anorg. 1895, 10. 132.)

Sodium selenoarsenate,  $\text{Na}_3\text{AsSe}_4 + 9\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; very unstable. (Szary, B. 1895, 28. 2654)

Selenoarsenious acid.

Sodium selenoarsenite,  $\text{Na}_3\text{AsSe}_3 + 9\text{H}_2\text{O}$ .

Moderately sol. in  $\text{H}_2\text{O}$ . (Clever and Muthmann, Z. anorg. 1895, 10. 139.)

Selenobismuthous acid.

Potassium metaselenobismuthite,  $\text{Bi}_3\text{Se}_3$ ,  $\text{K}_3\text{Se}$  or  $\text{KBiSe}_3$ .

Insol. in cold  $\text{HCl} + \text{Aq.}$  Sol. on warming, with evolution of  $\text{H}_2\text{Se}$ . (Hilger and van Scherpenberg, Mitt. Pharm. II. 4)

Selenocyanhydric acid,  $\text{HSeCN}$ .

Known only in aqueous solution.

Ammonium selenocyanide,  $\text{NH}_4\text{SeCN}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

Barium —,  $\text{Ba}(\text{SeSCN})_2$ .

Very sol. in  $\text{H}_2\text{O}$ .

Lead —,  $\text{Pb}(\text{SeCN})_2$ .

Sl sol in cold, sol. with al. decomp. in boiling  $\text{H}_2\text{O}$ . Insol. in alcohol.

Mercurous —,  $\text{Hg}_2(\text{SeCN})_2$ .

Ppt

Mercuric —,  $\text{Hg}(\text{SeCN})_2$ .

Sl sol in cold  $\text{H}_2\text{O}$ . Easily sol. in  $\text{MCN}$ ;  $\text{MSCN}$ , or  $\text{MSeCN} + \text{Aq.}$ , also sol. in hot  $\text{HgCl}_2 + \text{Aq.}$  (Cameron and Davy, C. N. 44. 63)

Decomp by hot  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1909, 63. 276.)

Mercuric potassium —,  $\text{Hg}(\text{SeCN})_2$ ,  
 $\text{KSeCN}$ .

Easily sol in  $\text{H}_2\text{O}$ . Sl. sol. in cold alcohol. (Cameron and Davy, C. N. 44. 63)

Mercuric selenocyanide chloride,

$\text{Hg}(\text{SeCN})_2$ ,  $\text{HgCl}_2$ .

Sol. in boiling  $\text{H}_2\text{O}$  and in abs. alcohol. Decomp. by long boiling with  $\text{H}_2\text{O}$ . (Rosenheim and Pritze, Z. anorg. 1909, 63. 276.)

Platinum potassium — (Potassium platino-selenocyanide),  $\text{K}_2\text{Pt}(\text{SeCN})_4$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Clarke, B. 11. 1325.)

Potassium —,  $\text{KSeCN}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  with absorption of heat. More sol. in  $\text{H}_2\text{O}$  than  $\text{KSCN}$ . Sol. in alcohol.

Potassium — mercuric bromide,  $\text{KSeCN}$ ,  
 $\text{HgBr}_2$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$  or alcohol. (Cameron and Davy, C. N. 44. 63.)

Potassium selenocyanide mercuric chloride,  
 $\text{KSeCN}$ ,  $\text{HgCl}_2$ .

As the bromide.

Potassium — mercuric iodide,  $\text{KSeCN}$ ,  
 $\text{HgI}_2$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$  or alcohol  
 (Cameron and Davy.)

Potassium — mercuric sulphocyanide,  
 $\text{KSeCN}$ ,  $\text{Hg(SCN)}_2$ .

Sl. sol. in cold, much more in hot  $\text{H}_2\text{O}$  or  
 alcohol. Somewhat sol. in ether. (Cameron  
 and Davy.)

Silver —,  $\text{AgSeCN}$

Insol. in  $\text{H}_2\text{O}$ . Almost insol. in  $\text{NH}_4\text{OH}$  +  
 Aq or cold dil. acids. Quickly decomp. by  
 hot conc. acids.

Sodium —,  $\text{NaSeCN}$

Very sol. in  $\text{H}_2\text{O}$ .

Selenomolybdc acid.

Potassium selenomolybdate,  $5\text{K}_2\text{O}$ ,  $6\text{SeO}_2$ ,  
 $17\text{MoO}_3$ .

Readily sol. in  $\text{H}_2\text{O}$  without decomp.  
 (Gibbs, *Am. Ch. J.* 1895, 17, 177.)

Selenopentathionic acid.

Sodium selenopentathionate,  $\text{Na}_2\text{S}_5\text{SeO}_6$ .

A dil. solution may be boiled for some time  
 without change (Norris and Fay, *Am. Ch. J.*  
 1900, 23, 121.)

Selenophosphoric acid.

Ammonium selenophosphate,  
 $2(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{SeO}_2 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Wenland, *B.*  
 1903, 36, 1402.)

Potassium selenophosphate,  
 $2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{SeO}_2 + 3\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  with decomp.  
 $3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{SeO}_2 + 5.5\text{H}_2\text{O}$ . Easily  
 sol. in  $\text{H}_2\text{O}$ . (Wenland.)

Rubidium selenophosphate,  
 $2\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{SeO}_2 + 3\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  with decomp. (Wenland.)

Triselenophosphorous acid.

Potassium triselenophosphite,  
 $\text{K}_3\text{HPSe}_3 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Decomp. by moist air and dil. acids, sol  
 in conc.  $\text{KOH}$  + Aq; sl. sol. in cold, easily sol.  
 in hot  $\text{H}_2\text{O}$  (Muthmann, *Z. anorg.* 1897,  
 13, 198.)

Selenosamic acid,  $\text{HSeO}_2\text{NH}_2$ .

Known only in its salts.

Ammonium selenosamate,  $(\text{NH}_4)_2\text{SeO}_2\text{NH}_2$ .

Deliquescent. Decomp. slowly by  $\text{H}_2\text{O}$   
 into  $(\text{NH}_4)_2\text{SeO}_3$ .

1 pt. is sol. in 116 pts. cold alcoholic am-  
 monia at  $12^\circ$ . More sol. in hot alcoholic  
 ammonia. Sl. attacked by cold  $\text{HCl}$  or  $\text{HNO}_3$ .  
 (Cameron and Macallan, *C. N.* 1888, 57, 163.)

Ammonium hydrogen selenosamate,  
 $\text{NH}_4\text{H}(\text{SeO}_2\text{NH}_2)$ .

Deliquescent. Sol. in 14 pts. alcohol at  
 $14^\circ$  (Cameron and Macallan, *Proc. Roy. Soc.*  
 44, 112.)

Selenostannic acid.

Ammonium selenostannate,  $3\text{SnSe}_2$ ,  $(\text{NH}_4)_2\text{Se}$   
 $+ 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, *C. R.* 95, 641.)

Platinum potassium —,  $\text{K}_2\text{Se}$ ,  $3\text{PtSe}$ ,  $\text{SnSe}_2$ .  
 Insol. in hot or cold  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ , or  
 $\text{KOH}$  + Aq. Not attacked by hot  $\text{HCl}$  + Aq  
 (Schneider, *J. pr.* (2) 44, 507.)

Platinum sodium —,  $\text{Na}_2\text{Se}$ ,  $3\text{PtSe}$ ,  $\text{SnSe}_2$ .  
 Properties as the corresponding K salt.  
 (Schneider.)

Potassium —,  $\text{K}_2\text{SnSe}_3 + 3\text{H}_2\text{O}$

Easily sol. in  $\text{H}_2\text{O}$ . (Ditte, *C. R.* 95, 441.)

Selenosulphantimonic acid.

Sodium selenosulphantimonate,  $\text{Na}_3\text{SbSe}_3 +$   
 $9\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Hofacker, *A.* 107, 6.)  
 $\text{Na}_3\text{SbS}_{1.5}\text{Se}_{1.5} + 9\text{H}_2\text{O}$ . Somewhat sol. in  
 $\text{H}_2\text{O}$ . (Pouget, *A. ch.* 1899, (7) 18, 564.)

Selenosulphantimonous acid.

Potassium selenosulphantimonite,  
 $\text{Sb}_2\text{S}_3\text{Se}_3\text{K}_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Pouget, *A. ch.* 1899, (7)  
 18, 563.)

Sodium selenosulphantimonite,  $\text{Na}_3\text{SbS}_{1.5}\text{Se}_{1.5}$   
 $+ 9\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Pouget, *A. ch.* 1899, (7) 18,  
 564.)

Selenosulpharsenic acid.

Potassium selenosulpharsenate,  $3\text{K}_2\text{S}$ ,  $\text{As}_2\text{Se}_3$   
 $+ 12\text{H}_2\text{O}$ .

Very unstable in the air. Very sol. in  $\text{H}_2\text{O}$ .  
 Fairly stable in aqueous solution. Decomp.  
 by acids (Clever, *Z. anorg.* 1895, 10, 134.)

**Sodium selenosulpharsenate**,  $\text{Na}_7\text{As}_2\text{S}_5\text{Se} + 8\text{H}_2\text{O}$ .

Decomp. by acids; stable in dry air. (Messinger, B. 1897, 30. 801.)

$3\text{Na}_2\text{S}_2\text{As}_2\text{Se}_2 + 18\text{H}_2\text{O}$  Quite sol. in  $\text{H}_2\text{O}$ ; quite stable in air. (Clever, Z. anorg. 1895, 10. 140.)

$\text{Na}_4\text{As}_2\text{S}_5\text{Se}_3 + 16\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ ; decomp. by acids (Messinger, B. 1897, 30. 803.)

$\text{Na}_4\text{As}_2\text{S}_7\text{Se} + 16\text{H}_2\text{O}$ . Stable in dry air; easily sol. in  $\text{H}_2\text{O}$ ; decomp. by acids. (Messinger, B. 1897, 30. 800.)

$\text{Na}_3\text{As}_2\text{S}_5\text{Se}_2 + 9\text{H}_2\text{O}$ . Decomp in aq solution by dil. acids. (Messinger, B. 1897, 30. 802.)

$\text{Na}_3\text{As}_2\text{SSe}_3 + 8\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ , decomp. by aq acids, hygroscopic. (Messinger.)

### Selenosulphophosphorous acid.

**Potassium selenosulphophosphite**,  $2\text{K}_2\text{S}_2\text{P}_2\text{Se}_2 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , decomp. by acids. (Muthmann, Z. anorg. 1897, 13. 198.)

### Selenosulphostannic acid.

**Ammonium selenosulphostannate**,  $(\text{NH}_4)_2\text{S}_2\text{SnSe}_2 + 3\text{H}_2\text{O}$

Easily decomp (Ditte, C. R. 1882, 95. 643)

**Potassium —**,  $\text{K}_2\text{SnSe}_2\text{S} + 3\text{H}_2\text{O}$ .

Very easily sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

**Sodium —**,  $\text{Na}_2\text{SnSe}_2\text{S} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641)

### Selenosulphoxyarsenic acid.

**Sodium selenosulphoxyarsenate**,  $\text{Na}_4\text{AsO}_2\text{SSe} + 10\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  but solution rapidly decomp (Messinger, B. 1897, 30. 798.)

$\text{Na}_4\text{As}_2\text{S}_2\text{SeO}_3 + 24\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Messinger.)

$\text{Na}_4\text{As}_2\text{Se}_2\text{O}_4 + 20\text{H}_2\text{O}$ . Stable in dry air. Sl. sol in  $\text{H}_2\text{O}$ ; decomp. by dil. acids (Messinger)

$\text{Na}_4\text{As}_2\text{S}_2\text{Se}_2\text{O}_3 + 20\text{H}_2\text{O}$ . Ppt. (Messinger.)

$\text{Na}_2\text{As}_2\text{S}_2\text{Se}_2\text{O}_3 + 36\text{H}_2\text{O}$ . Decomp. by aq acids; sol. in  $\text{H}_2\text{O}$ ; quite stable. (Messinger.)

### Selenosulphur trioxide, $\text{SeSO}_3$ .

See Selenium sulphoxide.

### Selenosulphuric acid, $\text{H}_2\text{SeSO}_4$ .

Known only in its salts.

**Potassium selenosulphate**,  $\text{K}_2\text{SeSO}_4 + x\text{H}_2\text{O}$

Deliquescent in moist air; decomp by  $\text{H}_2\text{O}$

(Rathke, J. pr. 95. 1)

### Selenotritithionic acid, $\text{H}_2\text{S}_2\text{SeO}_4$ .

Known only in solution, which is stable in dark (Schulze, J. pr. (2) 32. 390.)

### Barium selenotritithionate.

Sol in  $\text{H}_2\text{O}$ . (Rathke)

### Potassium —, $\text{K}_2\text{SeS}_2\text{O}_6$ .

Sol in  $\text{H}_2\text{O}$  with gradual decomp. (Rathke J. pr. 95. 8; 97. 56.)

### Diselenotritithionic acid, $\text{H}_2\text{S}_2\text{Se}_2\text{O}_4$ .

Exceedingly unstable. (Schulze.)

### Selenovanadic acid.

**Lithium selenovanadate**,  $4\text{Li}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 30\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ . (Prandtl and Lustig, Z. anorg. 1907, 53. 401.)

**Potassium selenovanadate**,  $2\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 12\text{SeO}_2 + 12\text{H}_2\text{O}$ .

(Prandtl and Lustig.)

$3\text{K}_2\text{O}, 5\text{V}_2\text{O}_5, 18\text{SeO}_2 + 40\text{H}_2\text{O}$ . (Prandtl and Lustig)

$4\text{K}_2\text{O}, 6\text{V}_2\text{O}_5, 21\text{SeO}_2 + 37\text{H}_2\text{O}$  (Prandtl and Lustig)

$5\text{K}_2\text{O}, 10\text{V}_2\text{O}_5, 26\text{SeO}_2 + 43\text{H}_2\text{O}$ . (Prandtl and Lustig)

**Sodium selenovanadate**,  $4\text{Na}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 20\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$  Solution decomp gradually. (Prandtl and Lustig)

$2\text{Na}_2\text{O}, 7\text{V}_2\text{O}_5, 10\text{SeO}_2 + 13\text{H}_2\text{O}$ . (Prandtl and Lustig.)

$2\text{Na}_2\text{O}, 7\text{V}_2\text{O}_5, 12\text{SeO}_2 + 45\text{H}_2\text{O}$ , and  $+90\text{H}_2\text{O}$  (Prandtl and Lustig.)

### Selenoxyarsenic acid.

**Ammonium selenoxyarsenate**,  $2(\text{NH}_4)_2\text{O}, 2\text{SeO}_2, \text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  with decomp. (Weinland, B. 1903, 36. 1403.)

**Barium sodium selenoxyarsenate**,  $\text{BaNaAsO}_5\text{Se} + 9\text{H}_2\text{O}$

Ppt (Weinland, Z. anorg. 1897, 14. 56.)

**Potassium selenoxyarsenate**,  $2\text{K}_2\text{O}, 2\text{SeO}_2, \text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  with decomp (Weinland and Bartlingek, B. 1903, 36. 1403.)

$7\text{K}_2\text{O}, 10\text{SeO}_2, 2\text{As}_2\text{O}_5 + 11\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Weinland and Bartlingek.)

$3\text{K}_2\text{O}, \text{As}_2\text{Se}_6 + 10\text{H}_2\text{O}$ . Easily decomp. by

moisture Very sol in  $H_2O$ . (Clever, Z anorg 1895, 10. 126)

Rubidium selenoxyarsenats,  $2Rb_2O$ ,  $2SeO_3$ ,  $As_2O_3 + 3H_2O$

Sol in  $H_2O$  with decomp (Weinland and Bartlmegg)

Sodium selenoxyarsenate,  $Na_3AsSeO_3$ .

Fairly stable in air and in aq solution. (Weinland, B 1896, 29. 1010.)

$Na_3AsSeO_3 + 12H_2O$  Stable in the air when pure; sol. in  $H_2O$  with decomp (Weinland, Z anorg 1897, 14. 50)

$Na_3AsSeO_3 + 12H_2O$ . Very sol in  $H_2O$ , very unstable (Szarvasy, B. 1895, 28. 2657.)

$3Na_2O$ ,  $3Na_2Se$ ,  $As_2O_3 + 50H_2O$ . Easily sol. in  $H_2O$ . Solution may be boiled for a long time without decomp. (Clever, Z. anorg. 1895, 10. 136.)

### Selenoxyphosphoric acid.

Ammonium triselenmonoxyphosphate,  $(NH_4)_3PSe_3O + 10H_2O$

Ppt (Ephraim, B 1910, 43. 280)

Ammonium hydrogen diselenmonoxyphosphate,  $(NH_4)_2H(PSe_2O)_2 + 18H_2O$ .

Ppt. (Ephraim)

Barium hydrogen diselendioxyposphate,  $BaH_2PSe_2O_4 + 14H_2O$ .

Decomp in moist air (Ephraim)

Potassium selenoxyphosphate,  $K_3PSe_3O_4 + H_2O$

Decomp by  $HNO_3$  Insol in alcohol and ether (Ephraim)

Sodium monoselenotrioxyposphate,  $Na_3PSe_3O_4 + 20H_2O$ .

Decomp by  $H_2O$  (Ephraim)

Sodium triselenmonoxyphosphate,  $Na_3PSe_3O + 10H_2O$ .

Sol. in  $H_2O$ . Decomp. in aq. solution. Easily sol. in conc  $NaOH + Aq$ . (Muthmann, Z. anorg. 1897, 13. 199)

Selenyl bromide,  $SeOBr_2$  (?).

(Schneider, Pogg 129. 450)

Selenyl bromide sulphur trioxide,  $SeOBr_2$ ,  $SO_3$

(Prandtl, Z. anorg. 1909, 62. 242.)

Selenyl chloride,  $Se_2O_3Cl_2$ .

Easily decomp by  $H_2O$  (Weber, Pogg. 118. 615.)

Selenyl sulphur chloride.

See Sulphoselenyl chlorids.

Selenyl stannic chloride,  $2SeOCl_2$ ,  $SnCl_4$

Extremely deliquescent. Completely sol. in  $H_2O$ . (Weber, B. A. B. 1865. 154.)

Selenyl titanium chloride,  $2SeOCl_2$ ,  $TiCl_4$

Decomp. by  $H_2O$  with separation of an insol residue. Decomp by  $NH_4OH + Aq$  (Weber, B. A. B 1865. 154)

### Sesquauramine.

See Sesquauramine.

Sesquihydraurylamine,  $(HOAu)_3N$ ,  $NH_3$ .

See Sesquihydraurylamins.

Silicic acid,  $SiO_2$ ,  $xH_2O$ .

See also Silicon dioxids.

Silicic acid is sol in 1000 pts. pure  $H_2O$ . (Kurwan)

When pptd from alkali silicates +  $Aq$  by  $CO_2$ , 0.021 pt.  $SiO_2$  remains dissolved in 100 pts  $H_2O$  (Struckmann, A. 94. 341.)

When pptd. as above, 100 pts.  $H_2O$  dissolve 0.09 pt  $SiO_2$  in 3 days; 100 pts  $H_2CO_3 + Aq$  dissolve 0.078 pt  $SiO_2$  in 3 days. But if heated much more dissolves, the jelly itself becoming liquid, such jelly containing 2.49 pts  $SiO_2$  to 100 pts  $H_2O$ . This solution is not pptd by considerable quantities of alcohol, but conc  $(NH_4)_2CO_3$ ,  $NaCl$ , or  $CaCl_2 + Aq$ , etc., cause gelatinization (Maschke, J. pr. 68. 234)

Solubility in  $H_2O$  depends on the amt. of  $H_2O$ , in presence of which the silicic acid is set free by dil. acids,  $CO_2$ , or alkali salts +  $Aq$ . If  $H_2O$  is present in sufficient quantity to retain the silicic acid, much more will remain in solution than can be dissolved by digesting the gelatinous acid with  $H_2O$  afterwards. 1 pt  $SiO_2$  can thus be held in solution by 500 pts  $H_2O$ . Presence of  $NH_4OH$ ,  $(NH_4)_2CO_3$ , or  $NH_4Cl$  (in solutions of which  $SiO_2$  is remarkably insol.) diminishes the power of  $H_2O$  to retain  $SiO_2$  in solution.  $SiO_2$  is always more sol. in dil than conc.  $NH_4OH + Aq$  (Liebig, A. 94. 373)

Silicic acid from the coagulation of the colloidal form (see p. 802) is sol in about 5000 pts.  $H_2O$  when formed from a 1% solution, and 10,000 pts. when formed from a 5% solution, but is insol after being dried. (Graham, A. 121. 36)

Silicic acid is more sol in dil. acids than in  $H_2O$ , because, when acid is added in excess to moderately dil  $K_2SiO_3 + Aq$ , the solution remains clear, but if only enough acid is added to neutralize the base present, silicic acid will gradually separate out. If acid is added to conc  $K_2SiO_3 + Aq$ , silicic acid separates out insol. in excess of acid, but if 20-30 pts.  $H_2O$  are present to 1 pt  $K_2SiO_3$ , and an excess of acid added at once, the silicic acid will remain in solution. This result is obtained with  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$ , or

$\text{HCl} \cdot \text{H}_2\text{O}_2 + \text{Aq.}$  These solutions may dissolve a neutral salt until saturated and no silicic acid will separate out. Therefore it is the acid that holds the  $\text{SiO}_2$  in solution, and not the  $\text{H}_2\text{O}$ . (C. J. B. Karsten, (1826) Pogg. 6. 353.)

Even  $\text{CO}_2$  has the power of holding  $\text{SiO}_2$  in solution. (Karsten, *l. c.*)

Solubility in acids of silicic acid of Struckmann (see above). 100 pts. dil  $\text{HCl} + \text{Aq.}$  of 1.088 sp. gr. dissolve 0.0172 g.  $\text{SiO}_2$  in 11 days, 100 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  dissolve 0.0136 g.  $\text{SiO}_2$  in 7 days.

Silicic acid obtained by passing  $\text{SiF}_4$  into  $\text{H}_2\text{O}$  is sol. while still moist in 11,000 pts cold, and 5500 pts boiling  $\text{HCl} + \text{Aq.}$  of 1.115 sp. gr. (Fuchs, A. 82. 119.)

Silicic acid at the moment of separation (as in dissolving cast-iron, steel, etc.) is abundantly sol in aqua regia (3 pts.  $\text{HCl} + \text{Aq.}$  of sp. gr. 1.13 and 1 pt.  $\text{HNO}_3 + \text{Aq.}$  of sp. gr. 1.33). (Wittstein, Z. anal. 7. 433.)

The aq. solution obtained by the hydrolysis of ethyl silicate is more stable in acids + Aq. or alkali than in pure  $\text{H}_2\text{O}$ . (Jordis, Z. anorg. 1903, 35. 16.)

$\text{NH}_4\text{OH} + \text{Aq.}$  dissolves considerable freshly precipitated silicic acid,  $(\text{NH}_4)_2\text{CO}_3$  only a very little (Karsten, Pogg. 6. 357.)

Dry or ignited  $\text{SiO}_2$  is sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  100 pts.  $\text{NH}_4\text{OH} + \text{Aq.}$  containing 10%  $\text{NH}_3$  dissolve: 0.714 pt.  $\text{SiO}_2$  from gelatinous silicic acid; 0.303 pt. from artificially dried silicic acid; 0.377 pt. from amorphous  $\text{SiO}_2$ ; 0.017 pt. from quartz. (Pribram, Z. anal. 6. 119.)

$\text{NH}_4\text{OH} + \text{Aq.}$  dissolves 0.382 pt.  $\text{SiO}_2$  from dry silicic acid. 0.357 pt. from ignited  $\text{SiO}_2$ ; 0.00827 pt. from quartz. (Souhey, Z. anal. 11. 182.)

Silicic acid precipitated from alkali silicates + Aq. with  $\text{CO}_2$  is sol. as follows. 100 pts. pure  $\text{H}_2\text{O}$  dissolve 0.021 pt.  $\text{SiO}_2$ ; 100 pts.  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  containing 5%  $(\text{NH}_4)_2\text{CO}_3$ , 0.020 pt.; 100 pts. containing 1%  $(\text{NH}_4)_2\text{CO}_3$ , 0.062 pt.; 100 pts.  $\text{NH}_4\text{OH} + \text{Aq.}$  containing 19.2%  $\text{NH}_3$ , 0.071 pt.; 100 pts. containing 1.6%, 0.0986 pt. (Struckmann, A. 94. 341.)

100 pts.  $\text{NH}_4\text{OH} + \text{Aq.}$  (10%  $\text{NH}_3$ ) dissolve of: crystallized  $\text{SiO}_2$ , 0.017 pt.; amorphous  $\text{SiO}_2$ , ignited, 0.38 pt.; amorphous  $3\text{SiO}_2 \cdot 4\text{H}_2\text{O}$ , 0.21 pt.; amorphous silicic acid in form of jelly, 0.71 pt. Upon evaporation no ppt. is formed, even when 80 mols.  $\text{SiO}_2$  are present to 1 mol.  $\text{NH}_3$ . (Wittstein, J. B. 1866. 192.)

Sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq.}$ , especially if warm. (Dumas.)

Sol. in  $\text{K}_2\text{SiO}_3$  or  $\text{Na}_2\text{SiO}_3 + \text{Aq.}$  (Fuchs.)

Easily sol. in boiling  $\text{Na}_2\text{CO}_3 + \text{Aq.}$ , separating as a jelly on cooling. (Pfaff.)

$\text{NH}_4\text{Cl}$  or other  $\text{NH}_4$  salts ppt.  $\text{SiO}_2$  from solution in  $\text{Na}_2\text{CO}_3 + \text{Aq.}$

100 pts.  $\text{Ti}_2\text{O}$  in  $\text{H}_2\text{O}$  dissolve 4.17 pts. amorphous  $\text{SiO}_2$  in 24 hours' boiling. (Flemming, Jena. Zeit. 4. 36.)

Sol. in butyl amine (Wurtz, A. ch. (3) 42. 166.)

Not more sol. in  $\text{H}_2\text{O}$  containing sugar than in pure  $\text{H}_2\text{O}$ . (Petzholdt, J. pr. 60. 368.)

#### Soluble silicic acid.

*Colloidal form by dialysis* Solutions containing 4.9%  $\text{SiO}_2$  may be evaporated until they contain 14%  $\text{SiO}_2$ . The  $\text{SiO}_2$  is separated from its solution thus made in many ways—

(1) By standing. This happens the more easily the more conc. the solution is, and is hastened by heat. A 10–12% solution gelatinizes at ordinary temp. in a few hours, and immediately upon heating. A 5–6% solution may be kept 5–6 days, a 2% solution, 2–3 months, and a 1% solution may be kept 2 or more years without gelatinizing.

(2) When the solution is evaporated to dryness in vacuo at 15° a transparent glass is left which is insol in  $\text{H}_2\text{O}$ .

(3) The coagulation of colloidal silicic acid is accelerated by powdered graphite and other indifferent bodies, and it is brought about in a few minutes by a solution of the alkali carbonates, even when only  $\frac{1}{10,000}$  pt. of the carbonate is present (Graham, A. 121. 36.)

(4) Coagulation is also brought about by passing  $\text{CO}_2$  through the solution. (Liebig.)

$\text{CO}_2$  does not cause coagulation. (Maschke.) Coagulation is not caused by  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{H}_2\text{C}_2\text{H}_3\text{O}_4$ , or  $\text{NH}_4\text{OH} + \text{Aq.}$  or by neutral or acid salts + Aq. (Graham.)

$\text{NaCl}$  and  $\text{Na}_2\text{SO}_4 + \text{Aq.}$  coagulate the solution. (Maschke.)

Alcohol, sugar, glycerine, or caramel do not coagulate.

Soluble  $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ ,  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ , albumen, and casein precipitate soluble  $\text{SiO}_2$ . (Graham, A. 121. 36.)

The jelly from colloidal  $\text{SiO}_2$  is very sol. in slightly alkaline  $\text{H}_2\text{O}$  1 pt.  $\text{NaOH}$  in 10,000 pts.  $\text{H}_2\text{O}$  dissolves in an hour at 100° an amt. of the jelly corresponding to 200 pts.  $\text{SiO}_2$  (Graham.)

#### Other colloidal forms.

Various solutions of silicic acid may be obtained as follows.

The jelly formed when  $\text{SiF}_4$  is passed through  $\text{H}_2\text{O}$  dissolves in a large amt. of  $\text{H}_2\text{O}$ , and  $\text{SiO}_2$  separates out on evaporation. This is still sol in  $\text{H}_2\text{O}$ , but is made insol. by evaporation with  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . (Berzelius.)

When  $\text{SiF}_4$  is absorbed by crystallized  $\text{H}_2\text{BO}_3$ , and the  $\text{HF}$  and  $\text{H}_2\text{BO}_3$  removed by a large excess of  $\text{NH}_4\text{OH} + \text{Aq.}$ , a silicic acid is obtained which is very sol. in  $\text{H}_2\text{O}$ . The solution is not decomposed by boiling, but on evaporation an insol. powder remains. (Berzelius, A. ch. 14. 366.)

When  $\text{K}_2\text{SiO}_3 + \text{Aq.}$  is precipitated by  $\text{CuCl}_2$ , the precipitate washed and dissolved in  $\text{HCl} + \text{Aq.}$  the solution treated with  $\text{H}_2\text{S}$  filtered and boiled, a solution of silicic acid is obtained

which gelatinizes with KOH or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Dover, A. ch. (3) 21. 40.)

When  $\text{Na}_2\text{SiO}_3 + \text{Aq}$  containing at most 3%  $\text{SiO}_2$  is saturated with  $\text{HCl} + \text{Aq}$  of 1.10 sp gr., and  $\text{Na}_2\text{SiO}_3$  added until the solution is slightly opalescent and carefully warmed to  $30^\circ$ , a gelatinous mass is obtained which will dissolve in  $\text{H}_2\text{O}$  by 12-16 hours' boiling if treated before being exposed to the air. The solution is slightly opalescent. The solution can be evaporated by heat until it contains 6%  $\text{SiO}_2$ . In a vacuum or over  $\text{H}_2\text{SO}_4$ , solutions containing 10% may be obtained. The electric current, freezing, alcohol, or  $\text{H}_2\text{SO}_4$  precipitate or coagulate the solution (Kühn, J. pr. 59. 1)

$\text{SiO}_2$  with  $\text{H}_2\text{O}$  gives off  $\text{H}_2\text{S}$  and forms a solution of  $\text{SiO}_2$  which, after dilution, can be kept for months. But when boiled or evaporated, or when a sol silicate is added, it becomes gelatinous. It leaves an insol. residue when evaporated to dryness. (Fremy, A. ch. (3) 38. 314)

Various forms of silicic acid have been described as definite compounds of  $\text{SiO}_2$  with varying amounts of  $\text{H}_2\text{O}$ , but it is doubtful if any true definite compounds exist, as the percentage of  $\text{H}_2\text{O}$  varies with the moisture of the air to which it is exposed. (See Ebelmen, A. ch. (3) 16. 120; Dover, A. ch. (3) 21. 40; Fuhs, A. 82. 19, Merz, J. pr. 99. 177; van Bemmelen, B. 11. 2232, etc.)

### Silicates.

The silicates are insol. in  $\text{H}_2\text{O}$  with the exception of the alkali salts, and these are sol only when the ratio of the base to the acid is above a certain limit.

#### Aluminum silicate, $2\text{Al}_2\text{O}_3, \text{SiO}_2 + 10\text{H}_2\text{O}$

Min. *Collyrite*. Sol in acids, with formation of  $\text{SiO}_2, x\text{H}_2\text{O}$ . Becomes transparent in  $\text{H}_2\text{O}$  and is decomp.

$4\text{Al}_2\text{O}_3, 3\text{SiO}_2$ . Min. *Dillinite*.  
 $\text{Al}_2\text{O}_3, \text{SiO}_2$ . Min. *Andalusite*, *Chastolite*, *Sillimanite*, *Dishene* or *Cyanite*. Insol. in acids

+5-7  $\text{H}_2\text{O}$ . Min. *Allophane*. Completely sol. in dil. acids; decomp. by conc. acids with separation of  $\text{SiO}_2, x\text{H}_2\text{O}$ .

$2\text{Al}_2\text{O}_3, 3\text{SiO}_2 + 4\text{H}_2\text{O}$ . Min. *Pholerville*. Insol. in  $\text{HNO}_3 + \text{Aq}$

+6 $\text{H}_2\text{O}$ . Min. *Glaucite*.  
 $\text{Al}_2\text{O}_3, 2\text{SiO}_2 + 2\text{H}_2\text{O}$ . Min. *Kaolin*, *Clay*. Insol. in dil.  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ ; moderately dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , when heated to evaporation, extracts  $\text{Al}_2\text{O}_3$  and some  $\text{SiO}_2$ , and leaves the rest of the  $\text{SiO}_2$  sol. in boiling  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . All the  $\text{Al}_2\text{O}_3$  is dissolved by heating with 5-8 pts.  $\text{H}_2\text{SO}_4 + 1$  pt.  $\text{H}_2\text{O}$  until  $\text{H}_2\text{SO}_4$  evaporates, and then treating with  $\text{H}_2\text{O}$ .

Quickly attacked by  $\text{H}_2\text{SiF}_6 + \text{Aq}$ .  
Decomp. by boiling  $\text{KOH} + \text{Aq}$ , with residue of  $\text{SiO}_2$  (Rammelsberg.)

$\text{KOH} + \text{Aq}$  extracts  $\frac{1}{4}$  of the  $\text{SiO}_2$  (Mala-

guti), is converted thereby into double silicates of K and Al, which are sol. in  $\text{HCl} + \text{Aq}$  (Lemberg)

Solubility in  $\text{KOH}$  and  $\text{HCl}$  increased if first heated to a low glow (Gluka, C. C. 1899, II. 1063.)

Colloidal clay (Schlössing, C. R. 79. 473) +4 $\text{H}_2\text{O}$ . *Hallwayite*. Decomp. by acids

$4\text{Al}_2\text{O}_3, 9\text{SiO}_2 + 12\text{H}_2\text{O}$ . Min. *Poissellan clay* from Passau  
 $\text{Al}_2\text{O}_3, 3\text{SiO}_2 + 3\text{H}_2\text{O}$ . Min. *Ryzomoffskine*.

$\text{Al}_2\text{O}_3, 4\text{SiO}_2 + 7\text{H}_2\text{O}$ . Min. *Montmorillonite*. Not decomp. by  $\text{HCl} + \text{Aq}$ , but by hot  $\text{H}_2\text{SO}_4$ .

+ $\text{H}_2\text{O}$ . Min. *Pyrophyllite*. Not decomp. by  $\text{H}_2\text{SO}_4$ .

+3 $\text{H}_2\text{O}$ . Min. *Anauxite*

$2\text{Al}_2\text{O}_3, 9\text{SiO}_2 + 6\text{H}_2\text{O}$ . Min. *Cimolite*

"Aluminum silicate" is insol. in acetone. (Naumann, B. 1904, 37. 4328); ethyl acetate (Naumann, B. 1910, 43. 314.)

#### Aluminum barium silicate, $\text{Al}_2\text{O}_3, \text{BaO}, 2\text{SiO}_2 + \text{H}_2\text{O}$ (?)

Min. *Edingtonite*. Decomp. by  $\text{HCl} + \text{Aq}$  with separation of  $\text{SiO}_2, x\text{H}_2\text{O}$ .

$5\text{Al}_2\text{O}_3, 4\text{BaO}, 10\text{SiO}_2$ . (Fremy and Feil, C. R. 86. 1033.)

$2\text{Al}_2\text{O}_3, 4\text{BaO}, 7\text{SiO}_2$ . Min. *Barylite*. Very sl. decomp. by alkali carbonates +  $\text{Aq}$  (Blomstrand)

#### Aluminum barium potassium silicate,

$\text{Al}_2\text{O}_3, (\text{Ba}, \text{K})_2\text{O}, 6\text{SiO}_2 + 2\text{H}_2\text{O}$ .

Min. *Harmotome*. When finely powdered, difficultly decomp. by  $\text{HCl} + \text{Aq}$  with separation of pulverulent  $\text{SiO}_2, x\text{H}_2\text{O}$ .

$\text{Al}_2\text{O}_3, (\text{Ba}, \text{K})_2\text{O}, 4\text{SiO}_2$ . Min. *Hagallophane*. Scarcely attacked by acids.

#### Aluminum caesium silicate, $\text{H}_2\text{Cs}_2\text{Al}_2\text{Si}_2\text{O}_{15}$ (?)

Min. *Pollucite*. Very sl. decomp. by  $\text{HCl} + \text{Aq}$

#### Aluminum calcium silicate, $\text{Al}_2\text{O}_3, \text{CaO}, 2\text{SiO}_2$ .

Min. *Anorthite*. Completely decomp. by  $\text{HCl} + \text{Aq}$  with separation of pulverulent  $\text{SiO}_2, x\text{H}_2\text{O}$ .

Min. *Barrowite*. Instantaneously decomp. by  $\text{HCl} + \text{Aq}$ , with separation of gelatinous  $\text{SiO}_2, x\text{H}_2\text{O}$

+4 $\text{H}_2\text{O}$ . Min. *Gasmontite*. Gelatinizes with  $\text{HCl} + \text{Aq}$

$\text{Al}_2\text{O}_3, \text{CaO}, 3\text{SiO}_2 + 3\text{H}_2\text{O}$ . Min. *Scolecite*. Easily sol. in  $\text{HCl} + \text{Aq}$ , without formation of gelatinous  $\text{SiO}_2$ . Sol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  with pptn. of  $\text{CaC}_2\text{O}_4$ .

Decomp. by, and sol to a certain extent in  $\text{H}_2\text{CO}_3 + \text{Aq}$ , and decomp. also even by pure  $\text{H}_2\text{O}$ . (Rogers, Am. J. Sci. (2) 5. 403.)

+5 $\text{H}_2\text{O}$ . Min. *Levyite*. Decomp. by acids without gelatinizing

$\text{Al}_2\text{O}_3, \text{CaO}, 4\text{SiO}_2 + 3\text{H}_2\text{O}$ . Min. *Caporcanite*. *Leonhardtite*. Efflorescent. Easily

sol in acids, with pptn. of gelatinous  $\text{SiO}_2$ ,  $x\text{H}_2\text{O}$ .

$\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $4\text{SiO}_2 + 4\text{H}_2\text{O}$ . Min. *Laumonite*. Easily gelatinized with  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ , but is not affected by  $\text{H}_2\text{SO}_4$  unless hot.

$\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $6\text{SiO}_2 + 5\text{H}_2\text{O}$ . Min. *Epistilbite*. Gelatinizes with conc.  $\text{HCl} + \text{Aq}$ . (Goldschmidt, Z. anal. 17. 267.)

Scarcely decomp. by boiling conc.  $\text{HCl} + \text{Aq}$ . (Jannasch and Teune, Miner. Jahrb. 1880, 1. 43.)

$+6\text{H}_2\text{O}$ . *Stilbite*. *Heulandite*. Slowly but completely gelatinized by  $\text{HCl} + \text{Aq}$ .

$\text{Al}_2\text{O}_3$ ,  $2\text{CaO}$ ,  $3\text{SiO}_2 + \text{H}_2\text{O}$ . Min. *Prehnite*. Imperfectly decomp. by acids before ignition, but easily afterwards.

$\text{Al}_2\text{O}_3$ ,  $3\text{CaO}$ ,  $3\text{SiO}_2$ . *Lune alumina garnet* *Grossularite*. Partially decomp. by acids before ignition, but easily afterwards.

$2\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $2\text{SiO}_2 + \text{H}_2\text{O}$ . *Margarite*. Not attacked by acids.

$3\text{Al}_2\text{O}_3$ ,  $4\text{CaO}$ ,  $6\text{SiO}_2 + \text{H}_2\text{O}$ . *Zoisite*. Partially decomp. by  $\text{HCl} + \text{Aq}$ .

$4\text{Al}_2\text{O}_3$ ,  $6\text{CaO}$ ,  $9\text{SiO}_2$ . Min. *Meionite*. Completely sol in  $\text{HCl} + \text{Aq}$ .

**Aluminum calcium ferric silicate**,  $2\text{Al}_2\text{O}_3$ ,  $4\text{CaO}$ ,  $\text{Fe}_2\text{O}_3$ ,  $6\text{SiO}_2 + \text{H}_2\text{O}$ .

Min. *Epulite*. Only sl. attacked by  $\text{HCl} + \text{Aq}$  before ignition.

**Aluminum calcium ferric magnesium silicate**,  $\text{H}_{14}\text{Ca}$ ,  $\text{Mg}$ ,  $\text{Al}_2$ ,  $\text{Fe}_2$ ,  $10\text{Si}_2\text{O}_{17}$ .

Min. *Vesuvianite*, *Idiocase*. Only partially decomp. by  $\text{HCl} + \text{Aq}$  before ignition.

**Aluminum calcium iron, etc., silicate borate**,  $\text{H}_2\text{R}^{\text{I}}(\text{Al}_2, \text{B}_2)\text{Si}_2\text{O}_{12}$ .

Min. *Azomite*. Not attacked by  $\text{HCl} + \text{Aq}$  before ignition.

**Aluminum calcium magnesium silicate**,  $4\text{H}_2\text{Ca}_2\text{Mg}_2\text{Si}_2\text{O}_{24}$ ,  $5\text{H}_2\text{CaMgAl}_2\text{O}_{12} = 15\text{Al}_2\text{O}_3$ ,  $13\text{CaO}$ ,  $37\text{MgO}$ ,  $24\text{SiO}_2 + 13\text{H}_2\text{O}$ .

Min. *Clintonite*. Completely decomp. by  $\text{HCl} + \text{Aq}$  without gelatinization.

$3\text{H}_2\text{Ca}_2\text{Mg}_2\text{Si}_2\text{O}_{24}$ ,  $4\text{H}_2\text{CaMgAl}_2\text{O}_{12}$ . Min. *Brenandite*. Not attacked by  $\text{HCl} + \text{Aq}$ .

Slowly decomp. by boiling conc.  $\text{H}_2\text{SO}_4$ .  $5\text{H}_2\text{Ca}_2\text{Mg}_2\text{Si}_2\text{O}_{24}$ ,  $8\text{H}_2\text{CaMgAl}_2\text{O}_{12}$ . Min. *Xanthophyllite*. Very sl. decomp. by hot  $\text{HCl} + \text{Aq}$ .

$3(\text{Ca}, \text{Mg})\text{O}$ ,  $\text{Al}_2\text{O}_3$ ,  $2\text{SiO}_2$ . Min. *Gehlenite*. Easily decomp. by acids.

**Aluminum calcium potassium silicate**,  $(\text{H}, \text{K})_2\text{CaAl}_2\text{Si}_2\text{O}_{12} + 6\text{H}_2\text{O}$ .

Min. *Chabasite*. Decomp. by  $\text{HCl} + \text{Aq}$ .  $(\text{K}_2, \text{Ca})\text{Al}_2\text{Si}_2\text{O}_{10} + 4\text{H}_2\text{O}$ . Min. *Zeagonite*. Completely sol in  $\text{HCl} + \text{Aq}$ .

**Aluminum calcium sodium silicate**,  $3\text{Al}_2\text{O}_3$ ,  $8\text{CaO}$ ,  $\text{Na}_2\text{O}$ ,  $9\text{SiO}_2$ .

Min. *Sarcosite*. Decomp. by acids.

$2\text{Al}_2\text{O}_3$ ,  $12(\text{Ca}, \text{Na}_2)\text{O}$ ,  $9\text{SiO}_2$  (?) Min. *Melilita*. Gelatinized by acids.

$\text{Na}_2\text{CaAl}_2\text{Si}_2\text{O}_{12}$  (?) Min. *Margarite*.  $\text{Na}_2\text{CaAl}_2\text{Si}_2\text{O}_{12}$  Min. *Favoside*. Decomp. by  $\text{HCl} + \text{Aq}$ .

$(\text{Na}_2, \text{Ca})\text{Al}_2\text{Si}_2\text{O}_{12}$ . Min. *Gmelinite*. Decomp. by  $\text{HCl} + \text{Aq}$ .

$(\text{Ca}, \text{Na}_2)\text{Al}_2\text{Si}_2\text{O}_{10} + 6\text{H}_2\text{O}$ . Min. *Forcite*. Difficultly decomp. by  $\text{HCl} + \text{Aq}$ .

$(\text{Ca}, \text{Na}_2)\text{Al}_2\text{Si}_2\text{O}_8 + 2\frac{1}{2}\text{H}_2\text{O}$ . Min. *Thomsonite*. Gelatinizes with  $\text{HCl} + \text{Aq}$ .

$x\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_{10}$ ,  $y\text{CaAl}_2\text{Si}_2\text{O}_8$ . Min. *Oligoclase*, *Lobadorite*. Sl. decomp. by acids, more easily the larger the amt. of  $\text{Ca}$  present.

**Aluminum calcium sodium silicate sulphate**,  $2(\text{Na}_2, \text{Ca})\text{Al}_2(\text{SiO}_3)_2$ ,  $(\text{Na}_2, \text{Ca})\text{SO}_4$ .

Min. *Hauyn*. Gelatinizes with  $\text{HCl} + \text{Aq}$ .

**Aluminum glaucum silicate**,  $\text{Al}_2\text{O}_3$ ,  $3\text{GIO}$ ,  $6\text{SiO}_2$ .

Min. *Beryl*. Emerald. Not decomp. by acids, excepting partially by  $\text{H}_2\text{SO}_4$  after being ignited.

$\text{Al}_2\text{O}_3$ ,  $2\text{GIO}$ ,  $2\text{SiO}_2 + \text{H}_2\text{O}$ . Min. *Eucrase*. Not attacked by acids.

**Aluminum ferrous silicate**,  $\text{Al}_2\text{Fe}(\text{SO}_4)_2$ .

Min. *Garnet*. Sl. decomp. by  $\text{HCl} + \text{Aq}$ .  $\text{H}_2\text{FeAl}_2\text{SiO}_7$ . Min. *Chlorioid*. Not attacked by  $\text{HCl} + \text{Aq}$ . Completely decomp. by  $\text{H}_2\text{SO}_4$ .

$\text{Al}_2\text{O}_3$ ,  $3\text{FeO}$ ,  $3\text{SiO}_2 + 3\text{H}_2\text{O}$ . Min. *Voigtite*.

**Aluminum iron lithium potassium silicate**,  $\text{K}_2\text{Li}_2\text{Fe}_2\text{Al}_2\text{Si}_2\text{O}_{12}$ .

Min. *Zinnwaldite*. Sl. decomp. by acids.

**Aluminum ferrous magnesium silicate**,  $6\text{Al}_2\text{O}_3$ ,  $3(\text{Mg}, \text{Fe})\text{O}$ ,  $6\text{SiO}_2 + \text{H}_2\text{O}$ .

Min. *Staurolite*. Not attacked by acids.

**Aluminum ferric magnesium silicate**,  $2(\text{Al}_2, \text{Fe})\text{O}_3$ ,  $2\text{MgO}$ ,  $5\text{SiO}_2$ .

Min. *Cordurite*. Sl. attacked by acids  $+ x\text{H}_2\text{O}$ . Min. *Esmarkite*, *Chlorophyllite*.

**Aluminum ferrous manganous silicate**,  $\text{Al}_2\text{O}_3$ ,  $\text{FeO}$ ,  $2\text{MnO}$ ,  $3\text{SiO}_2$ .

Min. *Partschuite*.

**Aluminum ferrous sodium, etc., silicate borate**,  $\text{H}^{\text{I}}(\text{Al}_2)(\text{B}_2)\text{Si}_2\text{O}_{12} + \text{R}^{\text{I}}(\text{Al}_2)(\text{B}_2)\text{Si}_2\text{O}_{12}$ , etc.

Min. *Toumaline*. Not decomp. by  $\text{HCl} + \text{Aq}$ ; very sl. decomp. by  $\text{H}_2\text{SO}_4$ .

**Aluminum lithium silicate**,  $\text{Al}_2\text{O}_3$ ,  $\text{Li}_2\text{O}$ ,  $5\text{SiO}_2$ .

Not attacked by acids. (Hautefeuille, C. R. 90. 541.)

$\text{Al}_2\text{O}_3$ ,  $\text{Li}_2\text{O}$ ,  $6\text{SiO}_2$ .

$\text{Al}_2\text{O}_3$ ,  $\text{Li}_2\text{O}$ ,  $4\text{SiO}_2$ . [Min. *Spodumene*. Not attacked by acids.]

$4\text{Al}_2\text{O}_3, 3\text{Li}_2\text{O}, 30\text{SiO}_2$ . Min *Petalite* Not attacked by acids

Aluminum lithium potassium silicate,  
 $(\text{Li}, \text{K})_3\text{Al}_2\text{Si}_4\text{O}_{13}$ .

Min *Lepidolite* SI decomp by acids.

Aluminum magnesium silicate,  $5\text{Al}_2\text{O}_3, 4\text{MgO}, 2\text{SiO}_2$ .

Min *Sapphirine*

Aluminum magnesium potassium silicate,  
 $2\text{H}_2\text{K}_2\text{Al}_2\text{Si}_6\text{O}_{21}, 2\text{Mg}_2\text{Si}_4\text{O}_{21}$ .

Min. *Lepidomelane* Easily decomp by HCl or  $\text{HNO}_3 + \text{Aq}$ , with residue of a skeleton of  $\text{SiO}_2$ .

$8\text{Al}_2\text{O}_3, 12\text{MgO}, 2\text{K}_2\text{O}, 12\text{SiO}_2 + \text{H}_2\text{O}$  Min. *Anomite*

$7\text{Al}_2\text{O}_3, 35\text{MgO}, 7\text{K}_2\text{O}, 36\text{SiO}_2$ . Min. *Phlogopite*

Aluminum manganous silicate,  $2\text{Al}_2\text{O}_3, 6\text{MnO}, 6\text{SiO}_2$ .

Not decomp by very dil HCl + Aq. (Gorgeu, C R 97. 1303)

Aluminum potassium silicate,  $\text{Al}_2\text{O}_3, \text{K}_2\text{O}, \text{SiO}_2$

Very slowly decomp. by cold  $\text{H}_2\text{O}$ , 12% is dissolved by hot  $\text{H}_2\text{O}$  Sol in alkali hydroxides + Aq, but insol in carbonates + Aq.

$\text{K}_2\text{O}, \text{Al}_2\text{O}_3, 2\text{SiO}_2$ . Insol in cold  $\text{H}_2\text{O}$ , but 6% dissolves on boiling Sol in dil. acids. Insol in alkali hydroxides or carbonates + Aq (Gorgeu, A ch (6) 10 45)

$\text{K}_2\text{O}, \text{Al}_2\text{O}_3, 3\text{SiO}_2 + 3\text{H}_2\text{O}$ . Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Deville, A ch. (3) 61. 313.)

$\text{K}_2\text{O}, \text{Al}_2\text{O}_3, 4\text{SiO}_2$ . Min *Leucite* Decomp by HCl + Aq with separation of pulverulent  $\text{SiO}_2$ .

+  $4\text{H}_2\text{O}$ . Ppt. (Deville, C R 54. 324)

$\text{H}_2\text{K}_2\text{Al}_2\text{Si}_2\text{O}_{12}$  Min. *Muscovite*, "Mica" Not attacked by HCl or  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

$\text{K}_2\text{Al}_2\text{Si}_2\text{O}_{11} + 3\text{H}_2\text{O}$ . Min. *Pinite*. Partly decomp. by HCl + Aq.

$\text{K}_2\text{Al}_2\text{Si}_2\text{O}_{11}$  Min *Orthoclase Feldspar* Scarcely attacked by acids. Slowly sol. in  $\text{H}_2\text{SO}_4$  or HCl + Aq when finely powdered (Rogers)

Aluminum potassium sodium silicate,  
 $\text{K}_2\text{Al}_2(\text{SiO}_3)_4, 5\text{Na}_2\text{Al}_2(\text{SiO}_3)_2 (?)$

Min *Nepheline*. Decomp. by HCl + Aq.

Aluminum silver silicate,  $\text{Al}_2\text{Ag}_2\text{Si}_2\text{O}_6$

Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Silber, B. 14. 941)

$\text{Al}_2\text{Ag}_2\text{Na}_2\text{Si}_2\text{O}_6$ . As above (Silber)

Aluminum sodium silicate,  $\text{Al}_2\text{O}_3, \text{Na}_2\text{O}, \text{SiO}_2$ . Insol in cold  $\text{H}_2\text{O}$ , but 38-40% dissolves in hot  $\text{H}_2\text{O}$  (Gorgeu)

$\text{Al}_2\text{O}_3, \text{Na}_2\text{O}, 2\text{SiO}_2$  Insol. in cold  $\text{H}_2\text{O}$ , boiling  $\text{H}_2\text{O}$  dissolves 1-2% Sol. in HCl or  $\text{HNO}_3$  diluted with 10-20 vols.  $\text{H}_2\text{O}$ . Insol

in alkali hydroxides or carbonates + Aq. (Gorgeu, A ch (6) 10. 145.)

Not attacked by  $\text{H}_2\text{O}$ . (Silber, B. 14. 941.) +  $3\text{H}_2\text{O}$ . Easily sol in HCl + Aq (v. Ammon.)

$\text{Al}_2\text{O}_3, \text{Na}_2\text{O}, 3\text{SiO}_2 + 3\text{H}_2\text{O}$  Decomp by acids (Deville, A ch (3) 61. 326)

$\text{Al}_2\text{O}_3, \text{Na}_2\text{O}, 4\text{SiO}_2 + 3\text{H}_2\text{O}$  Easily sol. in HCl + Aq. (v Ammon)

$2\text{Al}_2\text{O}_3, 3\text{Na}_2\text{O}, 3\text{SiO}_2$ . Insol in cold  $\text{H}_2\text{O}$ , but 27-30% dissolves on boiling. (Gorgeu.)

$\text{H}_4\text{Na}_2\text{Al}_2\text{Si}_4\text{O}_{14}$ . Min *Paragonite*. Decomp. by conc.  $\text{H}_2\text{SO}_4$ .

$\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_{12} + 2\text{H}_2\text{O}$  Min. *Analcite*. Readily decomp. by HCl + Aq

$\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_{10} + 2\text{H}_2\text{O}$  Min *Natrolite*. Sol. in  $\text{H}_2\text{O}$  with separation of  $\text{SiO}_2$ . Also sol in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$

$\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_{10}$ . Min *Albite* Not attacked by acids

Aluminum sodium silicate chloride,

$3\text{Na}_2\text{Al}_2(\text{SiO}_4)_3, 2\text{NaCl}$

Min *Sodalite* Easily decomp by HCl, and  $\text{HNO}_3 + \text{Aq}$

Aluminum sodium silicate sulphate,

$3\text{Na}_2\text{Al}_2(\text{SiO}_4)_3, \text{Na}_2\text{SO}_4$

Min. *Nissan* Easily decomp by HCl + Aq

Aluminum sodium silicate sulphide.

See Ultramarine.

Barium silicate,  $\text{BaSiO}_3$ .

Somewhat sol. in boiling  $\text{H}_2\text{O}$  Completely sol in dil. HCl + Aq (v Ammon)

+  $6\text{H}_2\text{O}$ , or  $7\text{H}_2\text{O}$  Boiling  $\text{H}_2\text{O}$  decomposes, and dissolves about  $\frac{1}{2}$  the weight of this substance. (le Chatelier, C R 92. 931.)

$2\text{BaO}, \text{SiO}_2$  Decomp. by  $\text{H}_2\text{O}$  into  $\text{BaSiO}_3 + 6\text{H}_2\text{O}$  (Laudrin)

Bismuth silicate,  $2\text{Bi}_2\text{O}_3, 3\text{SiO}_2$

Min *Eulytite*. Decomp. by HCl + Aq.

Bismuth ferric silicate,  $\text{Bi}_2\text{Fe}_2\text{Si}_2\text{O}_{17}$ .

Min *Bismuthoferrite*.

Boron calcium silicate.

See Borate silicate, calcium, and Silicate borate, calcium.

Cadmium silicate,  $\text{CdSiO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol in HCl + Aq with deposition of pulverulent  $\text{SiO}_2, 2\text{H}_2\text{O}$  (Rousseau and Tite, C. R. 114. 1262)

Cæsium silicate,  $\text{Cs}_2\text{SiO}_3$ .

(Kahlenberg, J. phys. Chem. 1898, 2. 82.)

Calcium silicate,  $\text{CaSiO}_3$ .Slowly sol in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ Sol. in about 100,000 pts.  $\text{H}_2\text{O}$  (Gorgeu, A. ch. 1885, (6) 4. 550)100 cc. sat. aq. solution of air dried calcium silicate contains 0.0046 g.  $\text{CaO} = 0.0095$  g.  $\text{CaSiO}_3$  at  $17^\circ$ . (Weisberg, Bull. Soc. 1896, (3) 15. 1097.)100 cc. sat. solution of air dried calcium silicate in 10% sugar solution at  $17^\circ$  contains 0.0065 g.  $\text{CaO} = 0.0135$  g.  $\text{CaSiO}_3$ ; 20% sugar solution, 0.0078 g.  $\text{CaO} = 0.0175$  g.  $\text{CaSiO}_3$ .After boiling and filtering hot, 10% sugar solution contains 0.0094 g.  $\text{CaO} = 0.0195$  g.  $\text{CaSiO}_3$ ; 20% sugar solution, 0.0120 g.  $\text{CaO} = 0.0249$  g.  $\text{CaSiO}_3$  (Weisberg)

Insol in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate (Naumann, B. 1910, 43. 314)

 $4\text{CaO}, 3\text{SiO}_2$ . (Laudrin) $5\text{CaO}, 3\text{SiO}_2 + 5\text{H}_2\text{O}$ . When freshly precipitated is somewhat sol in  $\text{H}_2\text{O}$  and easily decomp. by  $\text{HCl} + \text{Aq}$ . (v Ammon.) $\text{CaO}, 3\text{SiO}_2 + 2\text{H}_2\text{O}$ . (Hjeldt, J pr 94. 129.) $2\text{CaO}, 9\text{SiO}_2 + 3\text{H}_2\text{O}$ . Ppt. $\text{CaSiO}_3$  Min. *Wollastonite*. Gelatinizes with  $\text{HCl} + \text{Aq}$  $\text{CaSi}_2\text{O}_6 + 2\text{H}_2\text{O}$  Min. *Okenite*. Easily decomp. by cold  $\text{HCl} + \text{Aq}$  when powderedCalcium glucinum silicate sodium fluoride,  $(\text{Ca}, \text{Gl})_{19}\text{Si}_{11}\text{O}_{43}, 6\text{NaF}$ .Min. *Leucophane*. $7(\text{Ca}, \text{Gl})_1\text{Si}_2\text{O}_7, 6\text{NaF}$  Min. *Melanophane*.Calcium ferrous silicate,  $\text{CaSiO}_3, \text{FeSiO}_3$ .Min. *Hedenbergite*, *Pyroxene*. Sl decomp by acids.Calcium ferric silicate,  $\text{Ca}_2\text{Fe}_2(\text{SiO}_4)_2$ .Min. *Garnet* Sl. decomp by  $\text{HCl} + \text{Aq}$ . $2\text{CaSiO}_3, 11 \text{Fe}_2(\text{SiO}_4)_2$ . Min. *Szabote* Sl attacked by  $\text{HCl} + \text{Aq}$ , and still less by  $\text{H}_2\text{SO}_4 + \text{Aq}$ .Calcium ferroferric silicate,  $2\text{CaO}, 4\text{FeO}, \text{Fe}_2\text{O}_3, 4\text{SiO}_2 + \text{H}_2\text{O} = \text{H}_2\text{Ca}_2\text{Fe}_2\text{Fe}_2\text{Si}_4\text{O}_{18}$ Min. *Lievrite*, *Ikaite*. Easily gelatinizes with  $\text{HCl} + \text{Aq}$ 

Calcium ferrous magnesium silicate,

 $(\text{Ca}, \text{Fe}, \text{Mg})\text{SiO}_3$ .Min. *Amphibole*, *Hornblende*, *Asbestos*, *Actinolite*, *Tremolite*. Only sl. attacked by acids.Calcium ferroferric sodium silicate,  $\text{CaSiO}_3, \text{FeSiO}_3, \text{Fe}_2(\text{SiO}_4)_2, \text{Na}_2\text{SiO}_3$ .Min. *Aegirite*.Calcium magnesium silicate,  $\text{CaO}, \text{MgO}, 4\text{SiO}_2$ .

(Mutschler, A. 176. 86.)

 $\text{Ca}_2\text{SiO}_4, \text{Mg}_2\text{SiO}_4$ . Min. *Monticellite*. Completely sol. in dil.  $\text{HCl} + \text{Aq}$  $(\text{Ca}, \text{Mg})\text{SiO}_3$ . Min. *Diopside*, *Pyroxene*. Very sl. attacked by acidsCalcium manganous silicate,  $\text{CaSiO}_3, 2\text{MnSiO}_3$ .Min. *Bustamite*.

Calcium potassium silicate.

See under Glass.

Calcium sodium silicate,  $(\text{Ca}, \text{Na}_2, \text{H}_2)\text{SiO}_3$ .Min. *Pectolite*. Decomp by  $\text{HCl} + \text{Aq}$ .

See under glass.

Calcium sodium silicate zirconate,

 $\text{Na}_4\text{Ca}(\text{Si}, \text{Zr})_2\text{O}_{11} + 9\text{H}_2\text{O}$ .Min. *Wöhlerite*. Decomp. by  $\text{HCl} + \text{Aq}$ .Calcium uranyl silicate,  $3\text{CaO}, 5\text{UO}_2, 6\text{SiO}_2 + 18\text{H}_2\text{O}$ .Min. *Uranophane*. Gelatinizes with acids. $\text{CaO}, 3\text{UO}_2, 3\text{SiO}_2 + 9\text{H}_2\text{O}$  Min. *Uranotile*.Calcium silicate chloride,  $2\text{CaO}, \text{SiO}_2, \text{CaCl}_2$ .Insol. in  $\text{H}_2\text{O}$  or alcohol Sol in  $\text{HCl} + \text{Aq}$ . (le Chatelier, C R 97. 1510.)Calcium silicate fluoride,  $2\text{CaO}, 3\text{SiO}_2, 6\text{CaF}_2$ . (Deville, C. R. 52. 110.)

Calcium silicate potassium fluoride,

 $4\text{H}_2\text{CaSi}_2\text{O}_6, \text{KF} + 4\text{H}_2\text{O}$ .Min. *Apophyllite*. Decomp by  $\text{HCl} + \text{Aq}$ .

Calcium silicate stannate.

See Silicostannate, calcium.

Calcium silicate titanate,  $\text{CaO}, \text{SiO}_2, \text{TiO}_2$ .

(Hautefeuille, A. ch. (4) 4. 154)

Min. *Titanite*. Incompletely decomp. by  $\text{HCl} + \text{Aq}$ , wholly by  $\text{H}_2\text{SO}_4 + \text{Aq}$ Cerous silicate,  $\text{Ce}_2(\text{SiO}_4)_2$ More or less attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , according to the concentration. (Didier, C R. 101. 882.)

Cerium didymium lanthanum silicate,

 $2(\text{Ce}, \text{La}, \text{Di})_2\text{O}_3, 3\text{SiO}_2$ Min. *Cerite*. Gelatinizes with  $\text{HCl} + \text{Aq}$ .

Cerium glucinum yttrium silicate,

 $(\text{Y}, \text{Ce}, \text{Gl})_2\text{SiO}_4$ Min. *Gadolinite*. Easily gelatinized by  $\text{HCl} + \text{Aq}$ .Cerous silicate chloride,  $2\text{Ce}_2\text{O}_3, 3\text{SiO}_2$ , $4\text{CeCl}_2 = \text{Ce}_4(\text{SiO}_4)_3, 4\text{CeCl}_2$ .Insol. in  $\text{H}_2\text{O}$ , but slowly decomp thereby. (Didier, C. R. 101. 882.)

**Cobaltous silicate,  $\text{Co}_2\text{SiO}_4$ .**

Gelatinizes with  $\text{HCl} + \text{Aq.}$  (Bourgeois, C. R. 108. 1077)

**Cupric silicate,  $\text{CuH}_2\text{SiO}_4$ .**

Min. *Droptase* Sol in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq.}$  with separation of  $\text{SiO}_2$ . Not attacked by  $\text{KOH} + \text{Aq.}$

$\text{CuSiO}_3 + 2\text{H}_2\text{O}$ . Min. *Chrysocola*. Decomp. by  $\text{HCl} + \text{Aq.}$  +  $3\text{H}_2\text{O}$ . Min. *Asperolite*. Easily decomp. by  $\text{HCl} + \text{Aq.}$

"Cupric silicate" is insol. in methyl acetate. (Naumann, B. 1909, 42. 3790)

**Cupric silicate ammonia,  $\text{CuSi}_2\text{O}_5, 2\text{NH}_3$ .**

Ppt (Schiff, A. 123. 38)

**Glucinum silicate,  $\text{Gl}_2\text{SiO}_4$ .**

Min. *Phenacite* Not attacked by acids.

**Glucinum ferrous manganous silicate ferrous manganous sulphide,  $3(\text{Gl}, \text{Fe}, \text{Mn})_2\text{SiO}_4, (\text{Mn}, \text{Fe})\text{S}$** 

Min. *Helvina*. Decomp. by  $\text{HCl} + \text{Aq.}$

**Iron (ferrous) silicate,  $\text{Fe}_2\text{SiO}_4$ .**

Min. *Fayalite*. Gelatinizes with  $\text{HCl} + \text{Aq.}$

$\text{FeSiO}_3$ . Min. *Grunerite* +  $6\text{H}_2\text{O}$ . Min. *Chlorophite*.  $4\text{FeO}, \text{SiO}_2$ . (Zobel, Dingl 184. 111.)

**Iron (ferrio) silicate,  $\text{Fe}_3\text{Si}_2\text{O}_8 + 5\text{H}_2\text{O}$ .**

Min. *Nonttronite* Gelatinizes with hot acids.

$4\text{Fe}_2\text{O}_3, 9\text{SiO}_2 + 18\text{H}_2\text{O}$ . Min. *Hisingerite*.  $2\text{Fe}_2\text{O}_3, 9\text{SiO}_2 + 2\text{H}_2\text{O}$ . Min. *Anthosiderite*.

**Iron (ferroferrie) magnesium silicate,**

$(\text{Fe}, \text{Mg})_2\text{Fe}_2\text{Si}_2\text{O}_{10} + 4\text{H}_2\text{O}$

Min. *Cromastite*. Gelatinizes with acids.

**Iron (ferroferrie) sodium silicate,  $5\text{Na}_2\text{SiO}_3, 2\text{FeSiO}_3, 4\text{Fe}_2(\text{SiO}_3)_3$** 

Min. *Akrite* Sl decomp. by acids.

**Iron (ferrous) magnesium silicate,  $\text{Fe}_2\text{SiO}_4, \text{Mg}_2\text{SiO}_4$** 

Min. *Olivenne*, *Chrysokite*, *Peridot*. Gelatinizes with  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq.}$

$(\text{Fe}, \text{Mg})\text{SiO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . Min. *Picrophyllite*. +  $\frac{1}{2}\text{H}_2\text{O}$ . Min. *Monradite*.

$(\text{Fe}, \text{Mg})\text{SiO}_3$ . Min. *Bronzite*, *Hypersthene*. Not attacked by acids.

$2\text{MgSiO}_3, \frac{1}{2}\text{Fe}_2\text{SiO}_3$ . Min. *Anthophyllite*. Not attacked by acids.

**Iron (ferrous) manganous silicate,  $\text{Fe}_2\text{SiO}_4, \text{Mn}_2\text{SiO}_4$** 

Min. *Knebelite*. Gelatinizes with  $\text{HCl} + \text{Aq.}$

**Iron (ferrous) manganous silicate chloride,**

$7(\text{Fe}, \text{Mn})\text{SiO}_3, (\text{Fe}, \text{Mn})\text{Cl}_2 + 5\text{H}_2\text{O}$

Min. *Pyrosmaite*. " Completely decomp. by conc  $\text{HNO}_3 + \text{Aq.}$

**Iron (ferro) potassium silicate,  $\text{Fe}(\text{SiO}_3)_2, \text{K}_2\text{SiO}_3$ .**

(Hautefeuille and Perrey, C R 107. 1150.)

**Iron (ferro) sodium silicate,  $\text{Na}_2\text{Fe}_2\text{Si}_4\text{O}_{11}$ .**

Min. *Crokydolite*. Not attacked by acids.

**Lead silicate.**

Insol in acetone. (Naumann, B. 1904, 37. 4329); methyl acetate (Naumann, B. 1909, 42. 3790.)

See under Glass.

**Lithium silicate,  $\text{Li}_2\text{Si}_2\text{O}_7$ .**

$\text{Li}_2\text{SiO}_4$

$\text{Li}_2\text{SiO}_3$  More stable towards  $\text{H}_2\text{O}$  than the other alkali metasilicates. (Riecke and Endell, C C. 1911, I. 7)

Decomp. by boiling  $\text{H}_2\text{O}$  and acids. (Friedel, C. C. 1901, II. 89.)

Scarcely attacked by cold  $\text{H}_2\text{O}$ . (Friedel, Bull. Soc. Min. 1901, 24. 141.)

Insol in ethyl acetate. (Naumann, B. 1904, 37. 3601); methyl acetate (Naumann, B. 1909, 42. 3790.)

**Magnesium silicate,  $\text{Mg}_2\text{Si}_2\text{O}_7 + 2\text{H}_2\text{O}$ .**

Min. *Serpentine* Decomp. by  $\text{HCl} + \text{Aq.}$  more easily by  $\text{H}_2\text{SO}_4$ .

Min. *Chrysotile*  $\text{Mg}_3\text{Si}_2\text{O}_8 + 6\text{H}_2\text{O}$ . Min. *Gymnita*, *Soapstone* Decomp. by  $\text{H}_2\text{SO}_4$ .

$\text{MgSiO}_3$ . Not completely decomp. by  $\text{HCl} + \text{Aq.}$

+  $\frac{1}{2}\text{H}_2\text{O}$ . Min. *Aphrodite*. Decomp. by hot acids.

+  $\frac{1}{2}\text{H}_2\text{O}$ . Min. *Picrosine*. +  $1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in dil. acids (v. Ammon.)

Min. *Forsterite*.  $3\text{MgO}, 4\text{SiO}_2 + \text{H}_2\text{O}$  or  $4\text{MgO}, 5\text{SiO}_2 + \frac{1}{2}\text{H}_2\text{O}$ . Min. *Talc* or *Steatite*. Not attacked by  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq.}$

$\text{Mg}_2\text{Si}_2\text{O}_7 + 4\text{H}_2\text{O}$ . Min. *Spadaite*. Decomp. by conc  $\text{HCl} + \text{Aq.}$

$\text{Mg}_2\text{Si}_2\text{O}_7 + 4\text{H}_2\text{O}$ . Min. *Meerchaum*. Decomp. by  $\text{HCl} + \text{Aq.}$

"Magnesium silicate," is insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Magnesium potassium silicate,**

$\text{MgO}, \text{K}_2\text{O}, 3\text{SiO}_2$

Easily sol. in acids with decomp (Duboin, C. R. 1895, 120. 681)

**Magnesium silicate fluosilicate,  $\text{Mg}_2\text{Si}_2\text{O}_7, \text{Mg}_2\text{Si}_2\text{F}_{10}$ .**

Min. *Humite*, *Chondrodite*. Gelatinizes with  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq.}$

**Manganous silicate,  $Mn_2SiO_4$ .**

Min *Tephroite* Decomp. by  $HCl + Aq$  with formation of a stiff jelly.

$MnSiO_3$ . Min. *Rhodonite*, *Hermannite*

Not attacked by  $HCl + Aq$ .

$Mn_2Si_2O_7 + 2H_2O$ . Min. *Friedelite*

Easily gelatinized by  $HCl + Aq$

"Manganous silicate" is insol in ethyl

acetate. (Naumann, B. 1910, 43. 314)

**Manganous zinc silicate,  $(Mn,Zn)_2SiO_4$ .**

Min *Troostite*.

**Manganous silicate chloride,  $MnSiO_3$ ,  $MnO$ ,  $MnCl_2$ .**

Decomp by  $H_2O$  (Gorgeu)

**Nickel silicate,  $Ni_2SiO_4$ .**

Easily decomp by acids. (Bourgeois, C. R. 108. 1077.)

**Potassium silicate,  $K_2SiO_3$ .**

Completely sol in  $H_2O$ . (Ordway, Sil. Am. J. (2) 33. 34.)

Insol in methyl acetate. (Naumann, B. 1909, 42. 3790)

$K_2Si_2O_7$ . Sol in  $H_2O$ . Conc.  $K_2Si_2O_7 + Aq$  contains 28% of the salt, and has sp gr 1.25. (Fuchs)

Hygroscopic. Decomp. at once by  $H_2O$ . (Morey, J. Am. Chem. Soc. 1914, 36. 222.)

$K_2Si_2O_7$ . Partially sol in  $H_2O$  as  $K_2SiO_3$ .

$K_2Si_2O_7 + 16H_2O$  Insol. in  $H_2O$  (Forchhammer)

The K silicates are pptd. from their aqueous solution by alcohol with partial decomp., but less readily than Na silicates.

More sol. in  $H_2O$  than the corresponding Na salts (Ordway, Sil. Am. J. (2) 32. 155)

Solution can be obtained which is perfectly clear when  $4\frac{1}{2}SiO_2$  are present to 1  $K_2O$ , if there are no impurities present (Ordway)

The K silicates resemble the Na salts, which see for further data

**Potassium hydrogen silicate,  $KHSi_2O_5$ .**

Not readily affected by  $H_2O$ , even by treatment at 100° for several hours

Decomp. by heating with dil  $HCl$  (Morey, J. Am. Chem. Soc. 1914, 36. 222)

**Potassium zinc silicate.**

Sol. in  $KOH + Aq$ . (Schindler)

$K_2O$ , 8  $ZnO$ , 4  $SiO_2$ . Sol. in  $HCl + Aq$ . (Duboin, C. R. 1905, 141. 255)

8  $K_2O$ , 9  $ZnO$ , 17  $SiO_2$ . Sol. in  $HCl + Aq$ . (Duboin.)

**Potassium zirconium silicate,  $K_2O$ ,  $ZrO_2$ , 2  $SiO_2$ .**

Decomp. by  $HCl + Aq$  (Melliss.)

**Rubidium silicate,  $Rb_2SiO_3$ .**

(Kahlenberg, J. phys. Chem. 1898, 2. 82.)

**Silver silicate,  $Ag_2SiO_3$ .**

Decomp. by all acids, sol in  $NH_4OH + Aq$ . (Hawkins, Sil. Am. J. 139. 311.)

**Sodium silicate,  $Na_2SiO_3$ .**

Rapidly decomp. by  $H_2O$  (Morey, J. Am. Chem. Soc. 1914, 36. 224)

Insol in methyl acetate (Naumann, B. 1909, 42. 3790)

+5, 6, and 8  $H_2O$ . Easily sol. in  $H_2O$ .

+9  $H_2O$ . Solubility in  $\frac{1}{2}$ -N  $NaOH + Aq$ .

100 cem. of the solution contain 25.56 g.  $Na_2SiO_3 + 9H_2O$  at 17.5°

Sp gr. of the solution = 1.129 (Vesterberg, C. C. 1913. 777.)

100 cem. of a sat. solution of sodium silicate in  $\frac{1}{2}$ -N  $NaCl + Aq$  contain 3.83 g.  $Na_2SiO_3 + 9H_2O$  at 17.5°

Sp gr. of solution = 1.15

100 cem. of a sat solution of sodium silicate in sat.  $NaCl + Aq$  contain 20.64 g.  $Na_2SiO_3 + 9H_2O$  at 17.5° (Vesterberg)

$Na_2Si_2O_7$ . Sol. in  $H_2O$ .

Slowly decomp by cold  $H_2O$  (Morey, J. Am. Chem. Soc. 1914, 36. 223.)

$Na_2Si_2O_7$ .

$Na_2Si_2O_7$ .

$Na_2Si_2O_7$ . Slowly sol in  $H_2O$

+12  $H_2O$ .

Above compounds are all more or less indefinite

Water glass  $xNa_2O$ ,  $ySiO_2 + zH_2O$ . Sol. in  $H_2O$ , but solution is decomposed by all weak acids, even  $CO_2$ .

Fused water glass is but little acted on by cold  $H_2O$ , but when pure, easily dissolves in  $H_2O$  by long boiling (Ordway, Am. J. Sci. (2) 32. 337.)

When the  $SiO_2$  is present in greater proportion than in  $Na_2O$ , 3  $SiO_2$ , it is very difficult to dissolve in  $H_2O$ .

Na silicate is less easily sol in  $H_2O$  than the corresponding K compound.

Solubility of water glass in  $H_2O$  is much impaired by earthy impurities, so that traces have great effect in preventing the solubility.

$NH_4$  salts decomp. water glass solutions. A solution containing  $\frac{1}{2}\%$   $Na_2SiO_3$  is scarcely precipitated by  $NH_4Cl$ , but easily by  $NH_4NO_3$  (Fluckinger)

Precipitated by  $NH_4OH + Aq$  as  $Na_2SiO_3$ .

Many sodium and potassium salts, especially the chlorides and acetates, form precipitates in solutions of water glass; these precipitates are larger the more concentrated the solution is, and the greater amount of  $SiO_2$  it contains. Heating hastens the precipitation by chlorides, nitrates, and sulphates, but delays that by acetates.  $KOH + Aq$  does not precipitate.

Cold sat  $Na_2SO_4 + Aq$  does not precipitate even on heating, but 1 pt. anhydrous  $Na_2SO_4$ , dissolved in 2 pts.  $H_2O$  precipitates a hot solution of  $Na_2SiO_3$ .

$\text{NaNO}_3$  dissolved in 1 pt  $\text{H}_2\text{O}$  precipitate  $\text{Na}_2\text{SiO}_3 + \text{Aq}$  of 1392 sp. gr.,  $\text{NaNO}_3$  in 2 pts  $\text{H}_2\text{O}$  when mixed with a solution of  $\text{Na}_2\text{SiO}_3$ , as above, if the two are present in equal vols., causes no ppt in the cold, but solidifies when warmed to  $54^\circ$ , and redissolves on cooling rapidly, but if 2 vols.  $\text{NaNO}_3 + \text{Aq}$  are present to 1 vol.  $\text{Na}_2\text{SiO}_3 + \text{Aq}$ , the precipitate does not disappear on cooling.

If 1 pt  $\text{NH}_4\text{OH} + \text{Aq}$  (0.921 sp. gr.) is added to 10 pts.  $\text{Na}_2\text{SiO}_3 + \text{Aq}$ , no ppt. forms, but by increasing the amt. of  $\text{NH}_4\text{OH} + \text{Aq}$  to 2 pts, the greater pt. of the  $\text{Na}_2\text{SiO}_3$  is pptd., but redissolves on heating to  $90^\circ$ , separating again on cooling. When 1 pt  $\text{NH}_4\text{OH} + \text{Aq}$  is added to 6-8 pts.  $\text{Na}_2\text{SiO}_3 + \text{Aq}$  and heated to  $30^\circ$ , a clear liquid is formed which separates into two layers at ordinary temp.

The most sol. K, Na, Li, and  $\text{NH}_4$  salts separate  $\text{SiO}_2$  from conc.  $\text{Na}_2\text{SiO}_3 + \text{Aq}$ . Most of these salts lose this power by dilution, but the  $\text{NH}_4$  salts and  $\text{KNO}_3$  keep this power until the solution is very dil. This is especially the case with  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{NO}_3$ .

Bromine, chlorine, propyl amine, caesate, phenol, dissolved in glycerine, chloral hydrate, dil. albumen solution, and glue solution ppt.  $\text{SiO}_2$  from  $\text{Na}_2\text{SiO}_3 + \text{Aq}$ ; but sugar, dextrine, glycerine, urea, al. alkaline solution of urea nitrate, conine, nicotine, saponine, convolvuline, jalapine, and colophonum dissolved in  $\text{KOH} + \text{Aq}$  do not ppt.  $\text{SiO}_2$  (Flückinger, Aich Pharm (2) 144. 97.)

Alcohol ppts water glass as such from its aqueous solution, even when this is very dil., but there is some decomposition, the alcohol tending to hold in solution a portion of a silicate more alkaline than that previously dissolved in  $\text{H}_2\text{O}$ , while the ppt. formed contains more  $\text{SiO}_2$  than the original silicate.

Many neutral K or Na salts ppt. water glass as such when added to aqueous solutions. Like alcohol, these solutions exert a decomposing action, the ppt. being always more siliceous than the original silicate. Na silicate yields a larger deposit than K silicate; when a silicate of one base is pptd. by a salt of the other, both bases enter into the composition of the ppt., and the relative proportion of Na and K is very nearly the same as in the average of the liquids mixed.

Different salts have very unequal pptg. power, the acetates and chlorides being particularly efficient. Heat increases the pptg. power of the chlorides, sulphates, and nitrates, and diminishes that of the acetates. The alkali acetates are somewhat more efficient than the chlorides, but  $\text{NaC}_2\text{H}_3\text{O}_2$  gives only a slight ppt. with  $\text{Na}_2\text{O}$ ,  $2\frac{1}{2}\text{SiO}_2$ , even after some time.

$\text{NaNO}_3$  has but little effect on the more alkaline silicates.

$\text{Na}_2\text{SO}_4$  has still less power than  $\text{NaNO}_3$ .  $\text{Na}_2\text{CO}_3$  has no pptg. power, and  $\text{Na}_2\text{AsO}_4$  or  $\text{Na}_2\text{PO}_4$  have very little effect.

$\text{MHSO}_4$ ,  $\text{MHCO}_3$ ,  $\text{M}_2\text{HPO}_4$ ,  $\text{M}_2\text{HAsO}_4$ , ppt.  $\text{SiO}_2$ .  $\text{NH}_4$  salts also have that effect.

Pptd. water glass, as mentioned above, is much more sol. in  $\text{H}_2\text{O}$  than ordinary water glass, and dissolves in  $\text{H}_2\text{O}$  without decomp. For numerous further details, see articles by Ordway in Sil. Am. J. Sci. vols. 32 and 33; also Storer's Dict.

Sp. gr. of water glass solution containing 14-15%  $\text{SiO}_2$ , 13-14%  $\text{Na}_2\text{O}$ , and 70-72%  $\text{H}_2\text{O}$  is 1.30-1.35 (Hager, Comm. 1883.)

Sp. gr. of sat.  $\text{Na}_2\text{SiO}_3 + \text{Aq}$  freshly prepared at  $18^\circ$  is 1.2600, and 1 litre contains 4.5 gramme-equivalents  $\frac{1}{2}\text{Na}_2\text{SiO}_3$ .

Sp. gr. of sat. solution of  $\text{Na}_2\text{O}$ , 3.480, is 1.306, and 1 litre contains 3.7 gramme-equivalents  $\frac{1}{2}(\text{Na}_2\text{O}, 3.48\text{SiO}_2)$  (Kohl-  
ausch, Z. phys. Ch. 12. 773.)

**Sodium zirconium silicate,  $\text{Na}_2\text{O}, \text{ZrO}_2, \text{SiO}_2$ .**

Decomp. by hot  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$  (Gibbs, Pogg. 71. 559.)

$\text{Na}_2\text{O}, 8\text{ZrO}_2, \text{SiO}_2 + 11\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{SO}_4$  (Melliss.)

**Strontium silicate,  $\text{SrSiO}_3$ .**

(Stein, Z. anorg. 1907, 55. 164.)

$+ \text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Jordis and Kanter, Z. anorg. 1903, 35. 90.)

$\text{Sr}_2\text{SiO}_4$  (Stein, Z. anorg. 1907, 55. 167.)

$3\text{SrO}, \text{SiO}_2$ . Sol. in  $\text{H}_2\text{O}$  Sol. in acids.

(Vauquelin.)

**Thalious silicate,  $3\text{Ti}_2\text{O}_3, 10\text{SiO}_2$ .**

100 pts. of a solution of  $\text{Ti}_2\text{O}_3$  dissolve 4.17 pts.  $\text{SiO}_2$  by 24 hours' boiling. Sol. in  $\text{H}_2\text{O}$ . (Flemming, J. B. 1868. 251.)

**Thorium silicate,  $\text{ThO}_2, \text{SiO}_2$ .**

Insol. in acids. Attacked by  $\text{KHSO}_4$  (Troost and Ouyverd, C. R. 105. 255.)

$+ 1\frac{1}{2}\text{H}_2\text{O}$ . Min. *Thorite* Decomp. by  $\text{HCl} + \text{Aq}$ .

$\text{ThO}_2, 2\text{SiO}_2$  Insol. in acids or  $\text{KHSO}_4$  (T and O.)

**Yttrium silicate,  $\text{Y}_2\text{O}_3, \text{SiO}_2$ .**

Attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Dubou, C. R. 107. 99.)

**Zinc silicate,  $\text{ZnSiO}_3$ .**

(Stein, Z. anorg. 1907, 55. 165.)

$\text{Zn}_2\text{SiO}_4$  Min. *Willemit*. Gelatinizes with  $\text{HCl} + \text{Aq}$ ; sol. in  $\text{KOH} + \text{Aq}$ .

Decomp. by cold sat. citric acid +  $\text{Aq}$  (Bolton, C. N. 1881, 43. 34.)

$+ \text{H}_2\text{O}$  Min. *Calamine*. Sol. in  $\text{HCl} + \text{Aq}$  with separation of gelatinous  $\text{SiO}_2, x\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ , and  $\text{KOH} + \text{Aq}$ .

Insol. in  $\text{NH}_4\text{OH} + (\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Brandhorst, Zeit. angew. Ch. 1904, 17. 513.)

$\text{ZnO}, 3\text{SiO}_2$  (Bornträger, Ch. Z. 1893, 8. 186.)

Zirconium silicate,  $\text{SiO}_2, \text{ZrO}_2$ .

Min. *Zircon*. Insol. in acids, except  $\text{H}_2\text{SO}_4$ , in which it is very slowly and sl sol  $3\text{SiO}_2, 2\text{ZrO}_2$  Min. *Auerbachite*.

"Silicium oxide,"  $\text{Si}_2\text{H}_2\text{O}_6$ .

(Geuther, J. pr. 95. 430) This substance is identical with silicoformic anhydride according to Otto-Graham's Handb anorgan. Chem 7te Aufl 2. 953.

Siliciuretted hydrogen.

See Silicon hydride.

Silicobromoform,  $\text{HSiBr}_3$ .

Fumes on air, decomp by  $\text{H}_2\text{O}$ .

Silicochloroform,  $\text{HSiCl}_3$ .

Decomp by  $\text{H}_2\text{O}$  and alcohol

Completely miscible with  $\text{CS}_2, \text{CCl}_4, \text{CHCl}_3, \text{C}_6\text{H}_6, \text{SiCl}_4, \text{SnCl}_4, \text{TiCl}_4$ , and  $\text{AsCl}_3$  (Ruff, B 1905, 38. 2230)

Silicoethane.

See Silicon hydride.

Silicofluoroform,  $\text{SiHF}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Decomp. by  $\text{NaOH}$  and abs. alcohol with evolution of hydrogen. Decomp. by abs. ether. Sol. in toluene. (Ruff, B. 1905, 38. 63)

Silicoformic anhydride,



Somewhat sol. in  $\text{H}_2\text{O}$ . Acids, even conc  $\text{HNO}_3 + \text{Aq.}$  have no action, except  $\text{HF}$ , which dissolves it easily with evolution of hydrogen. Solutions of alkali hydrates, ammonium hydrate, and alkali carbonates +  $\text{Aq.}$  also dissolve with evolution of hydrogen. (Ruff and Wöhler, A. 104. 101.)

Silicolodoform,  $\text{HSiI}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{CS}_2$ . (Friedel, A. 149. 96.)

Miscible with  $\text{C}_6\text{H}_6$  and  $\text{CS}_2$ . (Ruff, B. 1908, 41. 3739)

Silicomethane,  $\text{SiH}_4$ .

See Silicon hydride.

Silicomethyl chloride,  $\text{SiH}_3\text{Cl}$ .

Decomp by  $\text{H}_2\text{O}$  and by alkalis. (Besson and Fournier, C. R. 1909, 148. 556.)

Silicomethylene chloride,  $\text{SiH}_2\text{Cl}_2$ .

Decomp. by  $\text{H}_2\text{O}$  and by alkalis. (Besson and Fournier, C. R. 1909, 148. 556.)

Silicomolybdic acid,  $\text{SiO}_2, 12\text{MoO}_3 + 26\text{H}_2\text{O}$ .

Very easily sol. in  $\text{H}_2\text{O}$  and dil acids. (Parmentier, C. R. 94. 213)

Forms a solution with a little ether, which separates into two layers by addition of  $\text{H}_2\text{O}$  or more ether. (Parmentier, C. R. 104. 686.) (Copaux, Bull Soc Min. 1906, 29. 79)

+  $32\text{H}_2\text{O}$ . Decomp. by alkali (Asch, Z. anorg 1901, 28. 293.)

+  $33\text{H}_2\text{O}$ . (Copaux, Bull Soc Min. 1906, 29. 79)

Aluminum silicomolybdate,  $2\text{Al}_2\text{O}_3, 3(\text{SiO}_2, 12\text{MoO}_3) + 93\text{H}_2\text{O}$ .

(Copaux, A. ch. 1906, (8) 7. 118.)

Aluminum sodium silicomolybdate,  $4(\text{Na}_2\text{O}, \text{Al}_2\text{O}_3, 2\text{SiO}_2), \text{Na}_2\text{MoO}_4 + 7\text{H}_2\text{O}$ .

Sol in  $\text{HCl} + \text{Aq.}$  (Thugutt, Z. anorg 1892, 2. 87.)

Ammonium silicomolybdate.

Sol. in  $\text{H}_2\text{O}$  (Parmentier, C. R. 94. 213)

Barium silicomolybdate,  $2\text{BaO}, \text{SiO}_2, 12\text{MoO}_3 + 16\text{H}_2\text{O}$ .

(Copaux, A. ch. 1906, (8) 7. 118.)

+  $22\text{H}_2\text{O}$  Sol. in 4 pts.  $\text{H}_2\text{O}$  (Copaux, Bull. Soc. Min. 1906, 29. 80.)

+  $24\text{H}_2\text{O}$ . Efflorescent Very sol. in  $\text{H}_2\text{O}$ . (Asch, Z. anorg 1901, 28. 282.)

+  $29\text{H}_2\text{O}$  Efflorescent (Copaux, A. ch. 1906, (8) 7. 118.)

Cadmium silicomolybdate,  $2\text{CdO}, \text{SiO}_2, 12\text{MoO}_3 + 22\text{H}_2\text{O}$ .

Very unusually sol. in  $\text{H}_2\text{O}$ . (Copaux, A. ch. 1906, (8) 7. 140.)

Cæsium silicomolybdate.

Sl. sol. in  $\text{H}_2\text{O}$ , insol in silicomolybdic acid +  $\text{Aq.}$

Calcium silicomolybdate,  $2\text{CaO}, \text{SiO}_2, 12\text{MoO}_3 + 24\text{H}_2\text{O}$

Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Asch, Z. anorg. 1901, 28. 282.)

+  $26\text{H}_2\text{O}$ . (Copaux, A. ch. 1906, (8) 7. 118.)

+  $31\text{H}_2\text{O}$ . (Copaux.)

Chromium silicomolybdate,  $2\text{Cr}_2\text{O}_3, 3(\text{SiO}_2, 12\text{MoO}_3) + 93\text{H}_2\text{O}$ .

(Copaux.)

Cupric silicomolybdate,  $2\text{CuO}, \text{SiO}_2, 12\text{MoO}_3 + 31\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Copaux.)

Lithium silicomolybdate,  $2\text{Li}_2\text{O}, \text{SiO}_2, 12\text{MoO}_3 + 29\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ . (Copaux)

Magnesium silicomolybdate,  $2\text{MgO}, \text{SiO}_2, 12\text{MoO}_3 + 30\text{H}_2\text{O}$ .

(Asch, Z. anorg. 1901, 28. 282.)

+  $31\text{H}_2\text{O}$  Very efflorescent and sol in  $\text{H}_2\text{O}$ . (Copaux.)

**Potassium silicomolybdate**,  $2K_2O, SiO_2, 12MoO_3 + 16H_2O$   
Efflorescent. Very sol. in  $H_2O$  (Asch, Z anorg. 1901, 28, 282.)  
1  $5K_2O, SiO_2, 12MoO_3 + 14H_2O$  (Asch.)  
Sol in  $H_2O$  with decomp (Copaux)

**Potassium silver silicomolybdate**,  $K_2O, 3Ag_2O, 2(SiO_2, 12MoO_3) + 14H_2O, + 22H_2O, + 30H_2O$   
Sol. in  $H_2O$  with decomp Sol unchanged in dil mother liquor. (Copaux, Bull. Soc. Min 1907, 30, 293.)

**Rubidium silicomolybdate.**  
Sl. sol in  $H_2O$ .

**Silver silicomolybdate**,  $1.5Ag_2O, SiO_2, 12MoO_3 + 11H_2O$   
Sol. in cold  $H_2O$ . (Asch.)  
 $2Ag_2O, SiO_2, 12MoO_3 + 12H_2O$  Decomp by boiling  $H_2O$  Sol in  $NH_4OH + Aq.$   
 $4Ag_2O, SiO_2, 12MoO_3 + 15H_2O$  (Asch.)

**Sodium silicomolybdate**,  $2Na_2O, SiO_2, 12MoO_3 + 14H_2O$ .  
(Copaux)  
 $2Na_2O, SiO_2, 12MoO_3 + 21H_2O$  Very sol in  $H_2O$ . Efflorescent. (Asch.)  
 $+ 22H_2O$ . (Copaux)  
1  $5Na_2O, SiO_2, 12MoO_3 + 17H_2O$ . (Asch.)  
3  $Na_2O, 2(SiO_2, 12MoO_3) + 17H_2O$  (Copaux.)

**Strontium silicomolybdate**,  $2SrO, SiO_2, 12MoO_3 + 26H_2O$ .  
(Copaux.)

**Zinc silicomolybdate**,  $2ZnO, SiO_2, 12MoO_3 + 31H_2O$ .  
Extremely sol. in  $H_2O$  (Copaux)

## Silicon, Si.

**Amorphous.** Insol. in  $H_2O$  Sol. before igniting in cold  $HF$ . Insol. in other mineral acids and aqua regia. Sol. in conc.  $KOH + Aq.$  When amorphous Si is ignited, it becomes insol. in  $HF$  and  $KOH + Aq.$

Amorphous Si is sol. in aqua regia and in a mixture of  $HNO_3$  and  $HF$  (Vigouroux-Moissan, C. R. 1895, 120, 367.)

Insol. in liquid  $CO_2$ . (Buchner, Z. phys. Ch. 1906, 54, 674)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20, 830)

**Graphitic.** Sol. in  $HNO_3 + HF$ . (Berzelius, A. 49, 247.)

**Crystalline** Insol. in all acids, except a mixture of  $HF$  and  $HNO_3$ . Sol. in moderately conc.  $KOH + Aq$  even when cold. (Deville)

Although it has been generally understood that crystallized Si is not attacked by  $HF$ , it is now found that this applies only to  $HF +$

$Aq.$  Gaseous  $HF$  readily attacks cryst. Si. (Newth, C. N. 1896, 72, 287)

Si cryst. from  $Ag$  is incompletely sol. in  $HF$  According to the temp. to which the  $Ag$  Si mixture has been heated, the following percentages of Si are dissolved in  $HF$ :  $970^\circ$ , 58.02%;  $1150^\circ$ , 27.66%;  $1250^\circ$ , 19%;  $1470^\circ$ , 16%. (Moissan and Siemens, C. R. 1904, 138, 657, 1300.)

Insol in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20, 830.)

## Silicon amide, $Si(NH_2)_4$ .

Unstable, decomp. by  $H_2O$  and partially decomp. by  $HNO_3$ ; sol. in most organic solvents (Lengfeld, Am. Ch. J. 1899, 21, 531.)

Decomp by  $H_2O$ ; insol in liquid  $NH_3$ . (Vigouroux, C. R. 1903, 136, 1670)

## Silicon traboride, $SiB_3$

Slowly attacked by  $HNO_3$  Decomp. by hot conc  $H_2SO_4$  or fused  $KOH$ . (Moissan, C. R. 1900, 131, 142.)

## Silicon hexaboride, $SiB_6$ .

Readily attacked by  $HNO_3$ . Slowly decomp. by hot conc  $H_2SO_4$ . Not attacked by fused  $KOH$ . (Moissan, C. R. 1900, 131, 142.)

## Silicon tribromide, $Si_2Br_6$ .

Decomp. by  $KOH + Aq$  (Friedel and Ladenburg, A. 203, 253)

$HSiBr_3$  See Silicobromoform.

## Silicon tetrabromide, $SiBr_4$ .

Rapidly decomp. by  $H_2O$ ; decomp. in several days by  $H_2SO_4$ . (Friedel and Ladenburg, A. 147, 362)

## Silicon bromide, $Si_2Br_4$ .

(Besson, C. R. 1910, 151, 1056)  
 $Si_2Br_4$ . (Besson.)

## Disilicon hydrogen pentabromide, $HSi_2Br_5$ or $Si_2Br_5$ (?)

Decomp by  $H_2O$  (Mahn, Zeit. Chem. (2) 5, 279.)

## Silicon tetrabromide ammonia, $SiBr_4, 6NH_3$ .

Decomp. by  $H_2O$ . (Lay, Dissert. 1910.)  
 $SiBr_4, 7NH_3$  Decomp. by  $H_2O$ . (Besson, C. R. 110, 240)

## Silicon bromoiodide, $SiIBr_3$

Decomp by  $H_2O$ . Sol in  $CS_2$ . (Friedel, B. 2, 60)

$SiBr_2I_2$ . As above. (F.)

$SiBrI_2$ . As above (F.)

## Silicon bromosulphide, $SiSBr_3$ .

Decomp in moist air. Violently decomp. by  $H_2O$ . Sol in  $CS_2$  and other organic solvents (Blux, B. 1903, 36, 4218.)

**Silicon carbide, SiC.**

Very stable, insol in  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ ; sol. in fused KOH at red heat (Moissan, Bull. Soc. 1894, (3) 11. 997.)

Cryst. modification. Insol. in acids; sol. in fused alkalis. (Moissan, C. R. 1893, 117. 427.)

Insol. in all acids, sol. in molten alkalis (Muhlhauser, Z. anorg. 1894, 5. 116.)

See Silundum.

**Silicon subchloride,  $\text{SiCl}_2$  (?).**

Decomp. by  $\text{H}_2\text{O}$  (Troost and Hautefeuille, A. ch. (5) 7. 463.)

**Silicon trichloride,  $\text{SiCl}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  and alkalis. (Troost and Hautefeuille, A. ch. (5) 7. 459.)

$\text{SiHCl}_3$ . See Silicochloroform.

**Silicon tetrachloride,  $\text{SiCl}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  and alcohol.

**Silicon octachloride,  $\text{Si}_2\text{Cl}_8$ .**

"Perchlorosilicopropane." Decomp. by  $\text{H}_2\text{O}$ . (Gattermann, B. 1894, 27. 1947.)

**Silicon chloride,  $\text{Si}_4\text{Cl}_{16}$ .**

(Besson, C. R. 1909, 149. 36.)

$\text{Si}_4\text{Cl}_8$ . "Perchlorosilicobutane." Decomp. by  $\text{H}_2\text{O}$ . Fumes in the air (Besson.)

$\text{Si}_2\text{Cl}_4$ . "Perchlorosilicohexane." Decomp. by  $\text{H}_2\text{O}$  (Besson, C. R. 1909, 148. 841.)

**Silicon trichloride ammonia,  $\text{Si}_3\text{Cl}_9, 5\text{NH}_3$ .**

Slowly decomp. by  $\text{H}_2\text{O}$  (Besson, C. R. 110. 515.)

**Silicon tetrachloride ammonia,  $\text{SiCl}_4, 6\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  (Persoz, A. ch. 44. 319.)

**Silicon tetrachloride hydrazine,  $\text{SiCl}_4, 4\text{N}_2\text{H}_4$ .**

Extremely hygroscopic and quickly decomp. by  $\text{H}_2\text{O}$ . (Lay, Dissert 1910.)

**Silicon chlorobromide,  $\text{SiCl}_2\text{Br}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Friedel and Ladenburg, A. 145. 187.)

$\text{SiCl}_2\text{Br}_2$ . As above (Friedel and Ladenburg.)

$\text{SiBr}_2\text{Cl}_2$ . Decomp. by  $\text{H}_2\text{O}$ . (Reynolds, Chem. Soc. 51. 590.)

**Silicon chlorobromide ammonia,  $2\text{SiCl}_2\text{Br}_2, 11\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 112. 788.)

$\text{SiCl}_2\text{Br}_2, 5\text{NH}_3$ . As above (B.)

$2\text{SiCl}_2\text{Br}_2, 11\text{NH}_3$ . As above (B.)

**Silicon chlorohydrosulphide,  $\text{SiCl}_2\text{SH}$ .**

Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Pietre, A. ch. (3) 24. 286.)

**Silicon chlorosulphide,  $\text{SiCl}_2\text{S}$ .**

Decomp. by  $\text{H}_2\text{O}$  (Besson, C. R. 112. 611.)

$\text{SiCl}_2\text{S}$ . As above. (B.)

$\text{SiCl}_2$ . As above (B.)

**Silver chlorosulphide ammonia,  $2\text{SiCl}_2\text{S}, 11\text{NH}_3$ .**

(Besson)

$\text{SiCl}_2\text{S}, 5\text{NH}_3$

**Silicon chloronitride,  $\text{Si}_4\text{N}_6\text{Cl}_3$ .**

(Schützenberger, C. R. 92. 1508.)

**Silicon chlorosulphide,  $\text{Si}_2\text{Cl}_2\text{S}_2$ .**

Decomp. violently by  $\text{H}_2\text{O}$ . Sol. in  $\text{CCl}_4$ . (Besson, C. R. 113. 1040.)

$\text{Si}_2\text{Cl}_2\text{S}_2$ . Violently decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{CS}_2$  (Blix, B. 1903, 36. 4223.)

**Silicon difluoride,  $\text{SiF}_2$  (?).**

Decomp. by  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Troost and Hautefeuille, A. ch. (5) 7. 464.)

**Silicon tetrafluoride,  $\text{SiF}_4$ .**

Abundantly absorbed by  $\text{H}_2\text{O}$  with decomp. 100 pts  $\text{H}_2\text{O}$  absorb 140.6 pts.  $\text{SiF}_4$  in 24 hours (Berzelius); 124.1 pts.  $\text{SiF}_4$  in 24 hours (Davy)

Absorbed abundantly by  $\text{HNO}_3 + \text{Aq.}$  (Kuhlmann, A. 39. 319.)

Absorbed abundantly by alcohol, without separation of silicic acid, if the alcohol contains less than 8% of water.

Sol. in conc.  $\text{HF} + \text{Aq.}$  Absorbed by ether. Sl. sol. in naphtha, and oil of turpentine.

**Silicon hydrogen fluoride,  $\text{H}_2\text{SiF}_6$ .**

See Fluosilicic acid.

**Silicon fluoride with MF.**

See Fluosilicate, M.

**Silicon fluoride ammonia,  $\text{SiF}_4, 2\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Davy.)

**Silicon hydride,  $\text{SiH}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{KOH} + \text{Aq.}$  Not changed by  $\text{NH}_4\text{OH} + \text{Aq.}$ ,  $\text{H}_2\text{SO}_4 + \text{Aq.}$ , or  $\text{HCl} + \text{Aq.}$

$\text{Si}_4\text{H}_8$ . "Silicoacetylene"

Sol. in 20%  $\text{NaOH} + \text{Aq.}$  with evolution of  $\text{H}$  (Bradley, C. N. 1900, 82. 149.)

$\text{Si}_2\text{H}_6$ . "Silicoethane" (Lebeau, C. R. 1909, 148. 44.)

Sl. sol. in  $\text{H}_2\text{O}$ . Best solvent is ethyl orthosilicate. (Moissan, Bull. Soc. 1903, (2) 29. 443.)

**Silicon nitrogen hydride,  $\text{SiHN}$ .**

Decomp. by  $\text{H}_2\text{O}$  and  $\text{NaOH}$ . (Ruff, B. 1905, 38. 2241.)

Silicon hydroxide,  $\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ .

See Silicic acid.

$\text{Si}_2\text{H}_2\text{O}_4$ . See Silicooxalic acid.

$\text{Si}_2\text{H}_2\text{O}_3$ . See Silicoformic anhydride.

$\text{Si}_4\text{H}_4\text{O}_4$ . See Silicene.

Silicon imide,  $(\text{Si}(\text{NH})_2)_n$ .

Decomp. by  $\text{H}_2\text{O}$  (Vigouroux, C. R. 1903, 136, 1671.)

Siliconhydride,  $\text{Si}(\text{NH})_3$ .

Decomp. by  $\text{H}_2\text{O}$  with evolution of much heat. (Blx, B. 1903, 36, 4224.)

Silicon imide hydrochloride,  $\text{Si}(\text{NH})_2 \cdot 2\text{HCl}$ .

Rather stable in air. (Blx, B. 1903, 36, 4225.)

Silicon dioxide,  $\text{SiO}_2$ .

Insol. in  $\text{CS}_2$ ,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ , and  $\text{SiCl}_4$ . (Friedel and Ladenburg, A. 203, 247.)

Silicon trioxide,  $\text{Si}_2\text{O}_3$ .

Decomp. with  $\text{H}_2\text{O}$  even at  $0^\circ$   
100 pts.  $\text{CS}_2$  dissolve 19 pts  $\text{Si}_2\text{O}_3$  at  $19^\circ$ ;  
20 pts.  $\text{Si}_2\text{O}_3$  at  $27^\circ$ . (Friedel and Ladenburg,  
Bull. Soc. (2) 12, 92.)  
 $\text{HSiCl}_3$ . See Silicochloroform.

Silicon tetroxide,  $\text{SiI}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . Acts on alcohol and ether.

1 pt.  $\text{CS}_2$  dissolves 2.2 pts  $\text{SiI}_4$  at  $27^\circ$  (Friedel, A. 149, 90.)

Silicon nitride,  $\text{Si}_3\text{N}_4$ .

Partially decomp. by boiling with conc  $\text{H}_2\text{SO}_4$ .

Not attacked by dil. acids with the exception of HF. Decomp. by HF.

Partially decomp. by boiling with alkalis + Aq. (Weiss, Z. anorg. 1910, 65, 89.)

$\text{Si}_3\text{N}_4$ . Partially decomp. by boiling with conc  $\text{H}_2\text{SO}_4$ .

Not attacked by dil. acids with the exception of HF. Decomp. by HF.

Partially decomp. by boiling with alkalis + Aq. (Weiss, Z. anorg. 1910, 65, 89.)

$\text{Si}_3\text{N}_4$ . Not attacked by  $\text{H}_2\text{O}$ .

Partially decomp. by boiling with conc  $\text{H}_2\text{SO}_4$ .

Not attacked by dil. acids with the exception of HF. Decomp. by HF.

Partially decomp. by boiling with alkalis + Aq. (Weiss, Z. anorg. 1910, 65, 89.)

Silicon nitride,  $\text{Si}_2\text{N}_2\text{H}_4$ .

"Silicene"

Sol. in HF, and rapidly in KOH + Aq. (Schutzenberger, C. R. 92, 1508.)

Decomp. by cold, more rapidly by hot  $\text{H}_2\text{O}$  and much more rapidly by alkalis. Sol. in HF + Aq. Not attacked by  $\text{HNO}_3$ . Decomp. by conc.  $\text{H}_2\text{SO}_4$ . (Lay, Dissert. 1910.)

Not decomposed by  $\text{H}_2\text{O}$ .

Sol. in hot alkalis + Aq with decomp. (Blx, B. 1903, 36, 4227.)

Silicon suboxide,  $\text{Si}_2\text{O}_2$ .

(Honigschmid, M. 1900, 30, 509.)

Silicon monoxide,  $\text{SiO}$ .

Much less easily sol. in HF + Aq but more easily sol. in alkalis + Aq than  $\text{SiO}_2$ . (Potter, C. C. 1907, II, 1952.)

Silicon dioxide,  $\text{SiO}_2$ .

See also Silicic acid.

(a) *Crystalline*. Min. Quartz, Tridymite. Insol. in  $\text{H}_2\text{O}$ , and acids, except HF.

Sl. sol. in boiling  $\text{K}_2\text{CO}_3$  + Aq, and KOH + Aq, see below.

Insol. in cold KOH + Aq; extremely slowly sol. in boiling KOH + Aq. (Fuchs.)

Sol. in HF with formation of  $\text{SiF}_4$  and  $\text{H}_2\text{O}$ .

Insol. in sugar + Aq, contrary to assertion of Veidel and Russler. (Petzholdt, J. pr. 60, 368.)

(b) *Amorphous*. Min. Opal, etc.

Insol. in  $\text{H}_2\text{O}$ , and acids except HF.

100 pts  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  dissolve 0.078 pt amorphous  $\text{SiO}_2$  (Maschke); 0.0136 pt (Struckmann).

100 pts. cold HCl + Aq of 1.088 sp. gr. dissolve 0.017 pt  $\text{SiO}_2$  (Struckmann.) 100 pts HCl + Aq of 1.115 sp. gr. dissolve in the cold 0.009 pt  $\text{SiO}_2$ , and 0.018 pt. on boiling 100 pts.  $\text{NH}_4\text{OH}$  + Aq (containing 10%  $\text{NH}_3$ ) dissolve 0.017 pt. quartz and 0.38 pt ignited  $\text{SiO}_2$ . (Pribian, Z. anal. 6, 119.)

Sol. in boiling  $\text{K}_2\text{CO}_3$  or  $\text{Na}_2\text{CO}_3$  + Aq, separating out on cooling as a gelatinous mass. (Piaff, Schw. J. 29, 383.) The different forms of  $\text{SiO}_2$  have different degrees of solubility in  $\text{K}_2\text{CO}_3$  + Aq. Unignited amorphous  $\text{SiO}_2$  from  $\text{SiF}_4$  dissolves most readily, then come opal, ignited amorphous  $\text{SiO}_2$ , fused  $\text{SiO}_2$ , and tridymite, quartz powder is the most difficultly soluble (Rose.)

A similar behaviour is shown to KOH + Aq.

Opal is much more sol. in KOH + Aq than quartz, and hyalite is the least sol. of the varieties of opal. (Fuchs.)

Opal is easily sol. in KOH + Aq, even after ignition. (Schaffgotsch, Pogg. 68, 147.)

Rammelsberg (Pogg. 112, 177) made the following experiments on the solubility of  $\text{SiO}_2$  in KOH + Aq. The KOH + Aq used contained 1 pt. KOH to 3 pts  $\text{H}_2\text{O}$ . 1 pt. of the powdered mineral was boiled half an hour in a silver dish with such an amount of the KOH + Aq that 20 pts KOH were present.

7.75% of milky white quartz was dissolved by repeating the above process three times.

12.8-15% of gray hornstone was dissolved by twice boiling, 2.43% of moderately finely powdered agate of 2.661 sp. gr. was dissolved by once boiling, 9.7% of unignited hyalite remained undissolved after three boiling;

21% of ignited hyalite remained undissolved after thrice boiling; 7.21% of semi-opal of 2.101 sp. gr. remained undissolved after thrice boiling; 18.5-19.2% of impure semi-opal of 2.101 sp. gr. remained undissolved after thrice boiling; 79.9% of chalcedony of 2.624 sp. gr. remained undissolved after thrice boiling; 6.12% of chalcedony of 2.567 sp. gr. remained undissolved after fourth boiling; 14.4% chrysoprass of 2.623 sp. gr. remained undissolved after once boiling; 49.41% of chrysoprass of 2.635 sp. gr. remained undissolved after thrice boiling; 6.62% of flint of 2.606 sp. gr. remained undissolved after twice boiling; 38.1% of fire-opal of 2.625 sp. gr. remained undissolved after fourth boiling; 26.6% of fire-opal of 2.625 sp. gr. remained undissolved after fifth boiling.

Insol. in liquid  $\text{CO}_2$  (Büchner, Z. phys. Ch. 1906, 54, 674.)

Insol. in acetone (Naumann, B. 1904, 37, 4329.)

The solubility of crystals of quartz on different faces in HF has been determined by Lebrun. (Belg. Acad. Bull. 1913, 953.)

#### Silicon thorium oxide.

See Silicate, thorium.

#### Silicon zirconium oxide.

See Silicate, zirconium.

#### Silicon oxychloride, $\text{Si}_2\text{OCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol. Miscible with  $\text{CS}_2$ ,  $\text{SiCl}_4$ ,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ , or ether. (Friedel and Ladenburg, A. 147, 355.)

$\text{Si}_2\text{O}_2\text{Cl}_2$ ;  $\text{Si}_4\text{O}_4\text{Cl}_4$ ;  $\text{Si}_6\text{O}_6\text{Cl}_6$ ;  $(\text{Si}_2\text{O}_2\text{Cl}_2)_n$ .  $\text{Si}_4\text{O}_4\text{Cl}_4$ . Sol. in above oxychlorides. (Troost and Hautefeuille, Bull. Soc. (2) 36, 360.)

#### Silicon oxyfluorhydride, $\text{Si}_2\text{O}_2\text{F}_2^{\text{OH}}$ .

(Landolt, A. Suppl. 4, 27.)

#### Silicon selenide, $\text{SiSe}_2$ .

Decomp. by  $\text{H}_2\text{O}$  or  $\text{KOH} + \text{Aq.}$  (Sabatier, C. R. 113, 132.)

#### Silicon sulphide, $\text{SiS}_2$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. Acts on alcohol or ether in the cold. (Fremy, A. ch. (3) 38, 314.)

$\text{SiS}$ . Decomp. by  $\text{H}_2\text{O}$ ; easily sol. in dil. alkalis. (Schützenberger, Bull. Soc. (2) 38, 58.)

#### Silicon sulphodiamide, $\text{SiS}(\text{NH}_2)_2$ .

Slowly decomp. in the air. Insol. in cold liquid  $\text{NH}_3$ . (Blix, B. 1903, 36, 4219.)

#### Silicon sulphobromide.

See Silicon bromosulphide.

#### Silicon sulphochloride.

See Silicon chlorosulphide.

#### Silicon sulphourea, $\text{SiS}(\text{NH}_2)_2$ .

Slowly decomp. in air

Decomp. by  $\text{H}_2\text{O}$

Insol. in cold liquid  $\text{NH}_3$ . (Blix, B. 1903, 36, 4219.)

#### Silicone, $\text{Si}_4\text{H}_4\text{O}_4$ .

Insol. in  $\text{H}_2\text{O}$ , but gives off hydrogen when warmed therewith. Not attacked by chlorine or nitric or sulphuric acids even on heating, but is gradually sol. in HF. Decomp. by alkalis, even by the most dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  with greatest violence and evolution of heat and hydrogen gas. Insol. in alcohol,  $\text{SiCl}_4$ ,  $\text{PCl}_3$ , or  $\text{CS}_2$ . (Wohler, A. 127, 257.)

$\text{H}_2\text{Si}_2\text{O}_5$ . Decomp. by  $\text{H}_2\text{O}$  and by dil. acids. Violently decomp. by fuming  $\text{HNO}_3$ . Not attacked by conc.  $\text{H}_2\text{SO}_4$ . Very slowly decomp. by conc.  $\text{HCl}$ , rapidly by alkalis +  $\text{Aq.}$  and by pyridine (Honigschmid, M. 1909, 30, 509.)

Insol. in  $\text{H}_2\text{O}$ , alcohol.  $\text{SiCl}_4$ ,  $\text{PCl}_3$ , and  $\text{CS}_2$ . Not attacked by acids except HF. (Donath and Liesner, C. C. 1909, II 1707.)

$\text{H}_{10}\text{Si}_{10}\text{O}_8$ . Scarcely attacked by acids, but easily decomp. by hot  $\text{H}_2\text{O}$ ,  $\text{NaOH} + \text{Aq.}$  etc. but not by  $\text{NH}_4\text{OH} + \text{Aq.}$  (Kolb, Z. anorg. 1909, 64, 353.)

$\text{H}_{10}\text{Si}_{10}\text{O}_8$  (Kolb.)

$\text{H}_7\text{Si}_7\text{O}_{12}$  As  $\text{H}_{12}\text{Si}_{12}\text{O}_{20}$ . (Kolb.)

#### Silicomesoaxalic acid, $\text{Si}(\text{OH})_2(\text{SiO.OH})_2$ .

Insol. in cold  $\text{H}_2\text{O}$ , decomp. by hot  $\text{H}_2\text{O}$  (Gattermann, B. 1899, 32, 1116.)

#### Silicooxalic acid, $\text{Si}_2\text{H}_2\text{O}_4 = \text{Si}_2\text{O}_2(\text{OH})_2$ .

Decomp. by bases with evolution of hydrogen. Takes up  $\text{HNO}_3$  to form compound, but not  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . (Troost and Hautefeuille, A. ch. (5) 7, 463.)

#### Silicophosphoric acid, $\text{SiO}_2, \text{P}_2\text{O}_5$ .

Slowly decomp. by  $\text{H}_2\text{O}$ . Unchanged by alcohol. Exists also in two modifications which are not attacked by  $\text{H}_2\text{O}$  (Hautefeuille and Margottet, C. R. 99, 789.)

$\text{SiO}_2, 2\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$ . Decomp. by moist air. Sol. in  $\text{H}_2\text{O}$  at  $0^\circ$ , but decomp. by warming to ordinary temp. (Hautefeuille and Margottet, C. R. 104, 56.)

#### Calcium silicophosphate.

See Phosphate silicate, calcium.

#### Silicostannic acid.

#### Calcium silicostannate, $\text{Ca}(\text{Si.Sn})\text{O}_4$ .

Not attacked by acids,  $\text{KHSO}_4$ , or alkalis +  $\text{Aq.}$  (Bourgeois, Bull. Soc. (2) 47, 297.)

**Silicodectungstic acid**,  $H_3W_{10}SiO_{38} + 3H_2O = 4H_2O, SiO_2, 10WO_3 + 3H_2O$ .

Sometimes sol in  $H_2O$ , but usually separates out gelatinous silica. (Maignac, A. ch. (4) 3. 55.)

See also **Silicoduodecungstic acid**.

**Ammonium silicodectungstate**,  $(NH_4)_3W_{10}SiO_{38} + 8H_2O$

Sol in 4.5 pts.  $H_2O$  at  $18^\circ$ . Very sol in hot  $H_2O$ . (Maignac, A. ch. (4) 3. 59.)  
 $(NH_4)_3W_{10}SiO_{38} + 9H_2O$ . (Maignac.)

**Ammonium potassium —**,

$(NH_4)_2K_2H_8SiW_{10}O_{41} + 15H_2O$ . (Maignac.)

**Barium —**,  $Ba_2SiW_{10}O_{38} + 22H_2O$

Precipitate. Insol in  $H_2O$ . (Maignac.)

**Potassium —**,  $K_3SiW_{10}O_{38} + 17H_2O$ .

Sol. in  $H_2O$ . (Maignac.)  
 $K_4H_8SiW_{10}O_{38} + 8H_2O$ . Sol in  $H_2O$ . (Maignac.)

**Potassium — silicotungstate (?)**,

$K_3SiW_{11}O_{39} + 14H_2O$ .  
 $K_4H_8SiW_{11}O_{39} + 10H_2O$ . (Maignac.)

**Silver —**,  $Ag_8W_{12}SiO_{42} + 3H_2O$

Not appreciably sol. in cold  $H_2O$ . (Maignac, A. ch. (4) 3. 65.)

**Silicotungstic acid or Silicoduodecungstic acid**,  $H_3SiW_{12}O_{42}$ .

( $H_3SiW_{12}O_{42}$ , according to Copaux. (Bull. Soc. 1908, (4) 3. 101.)

+20 $H_2O$  Sol in  $H_2O$ ; very sol. in alcohol; behaves with ether as the acid with 22 $H_2O$  (Maignac, A. ch. (4) 3. 10.)

+22 $H_2O$ . Solubility as acid with 29 $H_2O$ .

100 pts. deliquesce with 13 pts. ether. To this mixture 20–25 pts. of ether can be added, but a further quantity no longer mixes with, but floats above the mixture. Etheral solution is miscible with  $H_2O$ . Ether is taken up by a saturated aqueous solution with evolution of heat, until the volume has become doubled; more ether floats on the mixture. By warming the latter a liquid separates out which forms a layer between the two original layers. Alcoholic solution of the acid mixes with an equal vol of ether, but on adding more ether a conc. etheral solution separates as a syrupy layer. (Maignac, A. ch. (4) 3. 10.)

+29 $H_2O$ . Efflorescent. Sol in  $H_2O$ . Saturated solution at  $18^\circ$  contains 1 pt. crystallized acid to 0.104 pt.  $H_2O$ , and has 2.843 sp. gr. Melts in crystal  $H_2O$ . Easily sol in absolute alcohol and anhydrous ether +2 $H_2O$ . (Drechsel, B. 1887, 20. 1452.)

**Aluminum silicotungstate**,  $Al_4H_{12}(SiW_{12}O_{42})_2 + 75H_2O$ .

Not deliquescent; a very sol. in  $H_2O$ . (Maignac.)

$Al_4(SiW_{12}O_{42})_2 + 60H_2O$  (Wyruboff Chem. Soc. 1897, 72, (2) 174.)

+87 $H_2O$ . (Wyruboff)  
 +93 $H_2O$ . Very efflorescent. (Wyruboff.)

**Aluminum ammonium —**,

$Al_4(NH_4)_{12}(SiW_{12}O_{42})_2 + 75H_2O$ .  
 Sol in  $H_2O$  (Maignac.)

**Ammonium —, basic**,  $(NH_4)_2SiW_{12}O_{42}$

4 $NH_4OH$  + 14 $H_2O$   
 (Wyruboff, Chem. Soc. 1897, 72, (2) 174.)

**Ammonium —**,  $(NH_4)_2SiW_{12}O_{42} + 16H_2O$ .

Very sol. in hot  $H_2O$ . (Maignac, A. ch. (4) 3. 17.)

$(NH_4)_2H_2SiW_{12}O_{42} + 6H_2O$ . Less soluble in  $H_2O$  than the preceding salt. (Maignac.)

$(NH_4)_2SiW_{12}O_{42} + 8H_2O$ . (Wyruboff, Chem. Soc. 1897, 72, (2) 174.)

**Barium —**,  $Ba_2H_4SiW_{12}O_{42} + 14H_2O$ .

Sol in  $H_2O$ .  
 +22 $H_2O$ . Gradually efflorescent. (Maignac.)

Sol in cold  $H_2O$ , 1.07 pts. (Copaux, Bull. Soc. Min. 1906, 29. 80.)

Sol in 4 pts. cold  $H_2O$ . (Wyruboff, Bull. Soc. Min. 1896, 19. 278.)

$Ba_2SiW_{12}O_{42} + 27H_2O$  Nearly insol. in cold, sl. sol in hot  $H_2O$ . (Maignac.)

$Ba_2SiW_{12}O_{42} + 16H_2O$ . (Wyruboff.)

**Barium potassium —**,  $Ba_2K_2SiW_{12}O_{42} + 17H_2O$

(Wyruboff, Chem. Soc. 1897, 72, (2) 176.)

**Barium sodium —**,  $Na_2Ba_2SiW_{12}O_{42} + 28H_2O$ .

$H_2O$  gradually dissolves out sodium silicotungstate

**Cadmium —**,  $Cd_2SiW_{12}O_{42} + 23H_2O$ , and +27 $H_2O$

(Wyruboff.)

4 $CdO$ , 3( $SiO_2$ , 12 $WO_3$ ) + 4 $H_2O$ . (Wyruboff.)

**Cæsium —**,  $Cs_2SiW_{12}O_{42}$ .

100 pts.  $H_2O$  dissolve only 0.005 pt. at  $20^\circ$ ; 0.52 pt. at  $100^\circ$ .

Completely insol. in alcohol, and  $HCl + Aq$ . Somewhat sol. in dil.  $NH_4OH + Aq$ . (Godefroy, B. 9. 1363.)

**Cadmium hydrogen —**,  $2Cd_2SiW_{12}O_{42}$ ,  $H_2SiW_{12}O_{42} + 42H_2O$ .

(Wyruboff.)

**Calcium silicotungstate**,  $\text{Ca}_2\text{H}_2\text{SiW}_{12}\text{O}_{42} + 20\text{H}_2\text{O}$

Not deliquescent. \*Extremely easily sol. in  $\text{H}_2\text{O}$  (Marignac.)

$\text{Ca}_2\text{SiW}_{12}\text{O}_{40} + 18, 24$  and  $27\text{H}_2\text{O}$ . (Wyröuboff.)

**Calcium silicotungstate nitrate**,  $\text{Ca}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{Ca}(\text{NO}_3)_2 + 15\text{H}_2\text{O}$ .

(Wyröuboff.)

**Cerous** —,  $\text{Ce}_2\text{SiW}_{12}\text{O}_{40} + 27\text{H}_2\text{O}$ .

(Wyröuboff.)

$\text{Ce}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{CeH}_2\text{SiW}_{12}\text{O}_{40} + 34\text{H}_2\text{O}$  (Wyröuboff.)

**Chromium** —,  $\text{Cr}_4(\text{SiW}_{12}\text{O}_{40})_2 + 60, 87$  and  $93\text{H}_2\text{O}$ .

(Wyröuboff.)

**Cupric** —,  $\text{Cu}_2\text{SiW}_{12}\text{O}_{40} + 18, 27$  and  $29\text{H}_2\text{O}$ . Very efflorescent (Wyröuboff.)

**Didymium** —,  $\text{D}_{12}\text{SiW}_{12}\text{O}_{40} + 26$  and  $27\text{H}_2\text{O}$ . (Wyröuboff.)

$\text{D}_{12}\text{SiW}_{12}\text{O}_{40}$ ,  $\text{D}_{12}\text{H}_2\text{SiW}_{12}\text{O}_{40} + 34\text{H}_2\text{O}$  (Wyröuboff.)

**Gallium** —,  $\text{Ga}_4(\text{SiW}_{12}\text{O}_{40})_2 + 60, 87$ , and  $93\text{H}_2\text{O}$ .

(Wyröuboff.)

**Glucinum** —,  $\text{Gl}_4(\text{SiW}_{12}\text{O}_{40})_2 + 45, 87$  and  $93\text{H}_2\text{O}$ .

(Wyröuboff.)

**Indium** —,  $\text{In}_2\text{O}_3$ ,  $\text{H}_2\text{O}$ ,  $2(\text{SiO}_2, 12\text{WO}_3) + 40\text{H}_2\text{O}$ .

(Wyröuboff.)

$2\text{In}_2\text{O}_3$ ,  $3(\text{SiO}_2, 12\text{WO}_3) + 63$  and  $93\text{H}_2\text{O}$  (Wyröuboff.)

**Iron (ferric)** —,  $\text{Fe}_4(\text{SiW}_{12}\text{O}_{40})_2 + 60$  and  $93\text{H}_2\text{O}$ .

(Wyröuboff.)

**Lanthanum** —,  $\text{La}_2\text{SiW}_{12}\text{O}_{40} + 27\text{H}_2\text{O}$ .

Efflorescent (Wyröuboff.)

$\text{La}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{LaH}_2\text{SiW}_{12}\text{O}_{40} + 34\text{H}_2\text{O}$ . (Wyröuboff.)

**Lead** —, basic,  $\text{Pb}_2\text{SiW}_{12}\text{O}_{40}$ ,  $2\text{PbO} + 20\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Wyröuboff.)

**Lead** —,  $\text{Pb}_2\text{SiW}_{12}\text{O}_{40} + 21 \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wyröuboff.)

**Lithium** —,  $\text{Li}_2\text{O}$ ,  $\text{SiO}_2$ ,  $12\text{WO}_3 + 14$  and  $24\text{H}_2\text{O}$ .

(Wyröuboff.)

**Magnesium** —,  $\text{Mg}_2\text{H}_2\text{SiW}_{12}\text{O}_{42} + 16\text{H}_2\text{O}$ .

Stable on the air (Marignac.)

**Mercurous silicotungstate, basic**,  $\text{Hg}_2\text{SiW}_{12}\text{O}_{40}$ ,  $2\text{Hg}_2\text{O} + 5\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{HNO}_3$ . Slowly sol. in conc. warm  $\text{HNO}_3$  (Wyröuboff.)

**Mercurous** —,  $\text{Hg}_2\text{SiW}_{12}\text{O}_{42}$

Insol. in  $\text{H}_2\text{O}$ . Scarcely sol. in dil.  $\text{HNO}_3$  + Aq (Marignac, A. ch. (4) 3. 43)

**Mercuric** —,  $\text{Hg}_2\text{SiW}_{12}\text{O}_{40} + 15\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Solution decomp. on boiling (Wyröuboff.)

**Potassium** —, basic,  $\text{K}_4\text{SiW}_{12}\text{O}_{40}$ ,  $4\text{KOH} + 12\text{H}_2\text{O}$

1 pt. is sol. in 10 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Wyröuboff.)

**Potassium** —,  $\text{K}_2\text{SiW}_{12}\text{O}_{42} + 14\text{H}_2\text{O}$ .

Sol. in 10 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and less than 3 pts. at  $100^\circ$ . (Marignac.)

+  $20\text{H}_2\text{O}$ . Much less sol. in cold than hot  $\text{H}_2\text{O}$ . Extremely sol. in hot  $\text{H}_2\text{O}$ . More sol. than above comp. (Marignac.)

$\text{K}_2\text{H}_2\text{SiW}_{12}\text{O}_{42} + 7\text{H}_2\text{O}$ . Solubility as preceding salt.

$\text{K}_4\text{H}_2\text{SiW}_{12}\text{O}_{42} + 16\text{H}_2\text{O}$ . Sol. in 3 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ .

$\text{K}_4\text{H}_{16}(\text{SiW}_{12}\text{O}_{42})_2 + 25\text{H}_2\text{O}$ . Decomp. by dissolving in  $\text{H}_2\text{O}$  (Marignac.)

$\text{K}_4\text{SiW}_{12}\text{O}_{40} + 6$  and  $15\text{H}_2\text{O}$  (Wyröuboff.)

$\text{K}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{K}_2\text{H}_2\text{SiW}_{12}\text{O}_{40} + 29\text{H}_2\text{O}$  (Wyröuboff.)

**Rubidium** —,  $\text{Rb}_2\text{SiW}_{12}\text{O}_{42}$

Sol. in 145–150 pts.  $\text{H}_2\text{O}$  at  $20^\circ$  and in 19–20 pts. at  $100^\circ$ . Insol. in alcohol; difficultly sol. in  $\text{H}_2\text{O}$ . Easily in ammoniacal . . . . . 9. 1363.)

$\text{Rb}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{Rb}_2\text{H}_2\text{SiW}_{12}\text{O}_{40} + 22\text{H}_2\text{O}$  (Wyröuboff.)

**Silver** —,  $\text{Ag}_2\text{H}_2\text{SiW}_{12}\text{O}_{42} + 7\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3$  + Aq (Marignac.)

Sl. sol. in  $\text{H}_2\text{O}$  (Wyröuboff.)

**Sodium** —, basic,  $\text{Na}_4\text{SiW}_{12}\text{O}_{40}$ ,  $4\text{NaOH} + 5\text{H}_2\text{O}$ .

(Wyröuboff.)

**Sodium** —,  $\text{Na}_4\text{SiW}_{12}\text{O}_{42} + 7\text{H}_2\text{O}$

The saturated solution at  $19^\circ$  contains 0.21 pt.  $\text{H}_2\text{O}$  to 1 pt. of the salt dried at  $100^\circ$ , and has sp. gr. = 3.05 (Marignac.)

$\text{Na}_4\text{H}_2\text{SiW}_{12}\text{O}_{42} + 11\text{H}_2\text{O}$ . Stable on air. +  $18\text{H}_2\text{O}$ . Efflorescent. (Marignac.)

$\text{Na}_2\text{H}_2\text{SiW}_{12}\text{O}_{42} + 14\text{H}_2\text{O}$ . Decomp. by dissolving in  $\text{H}_2\text{O}$ .

$\text{Na}_4\text{SiW}_{12}\text{O}_{40}$  . . . . . (Wyröuboff.)

Sodium silicotungstate nitrate,  
 $3\text{Na}_4\text{H}_2\text{SiW}_{12}\text{O}_{42} \cdot 4\text{NaNO}_3 + 39\text{H}_2\text{O}$ .  
 Slightly deliquescent. (Manganese)

Strontium —,  $\text{Sr}_2\text{SiW}_{12}\text{O}_{40} + 16, 17, 23$  and  $27\text{H}_2\text{O}$ .  
 (Wyruboff)

Thallium —,  $\text{Tl}_2\text{H}_2\text{SiW}_{12}\text{O}_{40} + 9\text{H}_2\text{O}$ .  
 (Wyruboff.)

Thorium —, basic.  
 Insol. in  $\text{H}_2\text{O}$ . (Wyruboff.)

Thorium —,  $\text{Th}_2\text{SiW}_{12}\text{O}_{40} + 27\text{H}_2\text{O}$ .  
 Very sol in  $\text{H}_2\text{O}$  (Wyruboff)  
 $\text{Th}_2\text{SiW}_{12}\text{O}_{40} \cdot 2\text{H}_4\text{SiW}_{12}\text{O}_{40} + 45\text{H}_2\text{O}$ .  
 (Wyruboff.)

Uranium —.  
 Thirteen salts are described by Wyruboff.

Uranyl —.  
 Seven salts are described by Wyruboff.

Zinc —,  $\text{Zn}_2\text{SiW}_{12}\text{O}_{40} + 18, 27$  and  $29\text{H}_2\text{O}$ .  
 (Wyruboff)

#### Silicovanadiomolybdic acid.

Ammonium silicovanadiomolybdate,  
 $3(\text{NH}_4)_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 9\text{MoO}_3 + 20\text{H}_2\text{O}$ .  
 Sp. gr. of sat. solution containing 0.32016 g. salt in 1 ccm. at  $18^\circ = 1.21322$ . (Friedheim, B. 1900, 33. 1624)  
 $3(\text{NH}_4)_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 10\text{MoO}_3 + 21\text{H}_2\text{O}$ .  
 Sp. gr. of sat. solution containing 0.35026 g. of salt in 1 ccm. at  $18^\circ = 1.25275$ . (Friedheim.)  
 $3(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot \text{SiO}_2 \cdot 11\text{MoO}_3 + 27\text{H}_2\text{O}$ .  
 Sp. gr. of sat. solution containing 0.38086 g. salt in 1 ccm. at  $18^\circ = 1.29266$ . (Friedheim)  
 $3(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot \text{SiO}_2 \cdot 15\text{MoO}_3 + 24\text{H}_2\text{O}$ .  
 Sp. gr. of sat. solution containing 0.48997 g. salt in 1 ccm. at  $18^\circ = 1.43761$  (Friedheim)

Ammonium potassium —,  $(\text{NH}_4)_2\text{O} \cdot 2\text{K}_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 9\text{MoO}_3 + 20\text{H}_2\text{O}$ .  
 Sp. gr. of sat. solution containing 0.24021 g. salt in 1 ccm. at  $18^\circ = 1.17031$ . (Friedheim.)

$(\text{NH}_4)_2\text{O} \cdot 2\text{K}_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 10\text{MoO}_3 + 21\text{H}_2\text{O}$ . Sp. gr. of sat. solution containing 0.25914 g. salt in 1 ccm. at  $18^\circ = 1.19184$ . (Friedheim)  
 $(\text{NH}_4)_2\text{O} \cdot 2\text{K}_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 11\text{MoO}_3 + 12\text{H}_2\text{O}$ . Sp. gr. of sat. solution containing 0.27914 g. salt in 1 ccm. at  $18^\circ = 1.21378$ . (Friedheim.)

Ammonium zinc —,  $4(\text{NH}_4)_2\text{O} \cdot 2\text{ZnO} \cdot 2\text{SiO}_2 \cdot 3\text{V}_2\text{O}_5 \cdot 18\text{MoO}_3 + 15\text{H}_2\text{O}$ .  
 Sl sol. in  $\text{H}_2\text{O}$ . (Blum, Dissert. 1904.)

#### Silicovanadotungstic acid.

Ammonium silicovanadotungstate,  $3(\text{NH}_4)_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 9\text{WO}_3 + 24\text{H}_2\text{O}$ .  
 Can be cryst. from  $\text{H}_2\text{O}$  (Friedheim, B. 1902, 35. 3244.)  
 $(\text{NH}_4)_2\text{SiV}_2\text{W}_{12}\text{O}_{40} + 21\text{H}_2\text{O}$  1 cc. of sat. solution in  $\text{H}_2\text{O}$  at  $17.5^\circ$  contains 0.6652 g. of the hydrated salt Sp. gr. of this solution = 1.4505. Decomp. by conc. acid and alkali. (Friedheim.)

Ammonium barium potassium —,  
 $(\text{NH}_4)_2\text{K}_2\text{BaSiV}_2\text{W}_{12}\text{O}_{40} + 25\text{H}_2\text{O}$ .  
 Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by conc. acids and alkalis. (Friedheim.)

Ammonium potassium —,  
 $(\text{NH}_4)_2\text{K}_2\text{SiV}_2\text{W}_{12}\text{O}_{40} + 23\text{H}_2\text{O}$ .  
 1 ccm. of sat. solution at  $17.5^\circ$  contains 0.5072 g. of the salt Sp. gr. of the solution at  $20^\circ = 1.3462$ . Can be cryst. from  $\text{H}_2\text{O}$ . Decomp. by conc. acids and alkalis. (Friedheim.)

Barium —,  $\text{Ba}_2\text{SiV}_2\text{W}_{12}\text{O}_{40} + 28\text{H}_2\text{O}$ .  
 1 ccm. of the sat. solution in  $\text{H}_2\text{O}$  at  $17.5^\circ$  contains 0.0384 g. of the salt Sp. gr. of the solution = 1.0307. Decomp. by conc. acids and alkalis (Friedheim, B. 1902, 35. 3245)  
 $6\text{BaO} \cdot 2\text{SiO}_2 \cdot 3\text{V}_2\text{O}_5 \cdot 18\text{WO}_3 + 50\text{H}_2\text{O}$ .  
 Sl. sol. in  $\text{H}_2\text{O}$ . (Friedheim.)  
 $7\text{BaO} \cdot 2\text{SiO}_2 \cdot 3\text{V}_2\text{O}_5 \cdot 18\text{WO}_3 + 33\text{H}_2\text{O}$ .  
 Sl sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

Potassium —,  $\text{K}_2\text{SiV}_2\text{W}_{12}\text{O}_{40} + 22\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . Can be cryst. from  $\text{H}_2\text{O}$  without decomp. Decomp. by conc. acids and alkalis. (Friedheim.)  
 $6\text{K}_2\text{O} \cdot 2\text{SiO}_2 \cdot 3\text{V}_2\text{O}_5 \cdot 18\text{WO}_3 + 31\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Friedheim)  
 $7\text{K}_2\text{O} \cdot 2\text{SiO}_2 \cdot 3\text{V}_2\text{O}_5 \cdot 18\text{WO}_3 + 42\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

Sodium —,  $\text{Na}_2\text{SiV}_2\text{W}_{12}\text{O}_{40} + 29\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . Decomp. by conc. acids and alkalis (Friedheim)

#### Silundum, $\text{Si}_2\text{Cp}$ .

Not attacked by hot Cl or conc. acids. (Amberg, Z. Elektrochem. 1909, 15. 725)

#### Silver, Ag.

Not attacked by  $\text{H}_2\text{O}$ . Absolutely insol. in  $\text{HCl}$  or  $\text{HClO}_4 + \text{Aq}$ . (Lea, Sil. Am. J. 144. 444.) Easily sol. in  $\text{HNO}_3 + \text{Aq}$  on warming, if not too conc. Only a minute trace is dissolved in an hour by cold dil.  $\text{HNO}_3 + \text{Aq}$  (1 pt.  $\text{HNO}_3 + \text{Aq}$  of sp. gr. 1.40 · 10 pts.  $\text{H}_2\text{O}$ ). (Lea.) Sol. in hot conc.  $\text{H}_2\text{SO}_4$  with evolution of  $\text{SO}_2$ . Sl. sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  (1 4), but with more dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  the different forms of Ag behave differently. (Lea.)

Sol. in  $\text{HI} + \text{Aq}$  at ordinary temperature.

Sol. in KI + Aq with access of air. Sol. in hot KCN + Aq. (Christomanos, Z. anal. 7. 301.)

Sol. in chromic, iodic, chloric and bromic acids. Dil.  $H_2SO_4$  alone is incapable of dissolving finely divided Ag, and the seeming solvent action is due to the oxygen of the air, oxygen dissolved in the acid, or derived from some external source. (Hendrixson, J. Am. Chem. Soc. 1903, 25. 637.)

Boiling  $H_2SO_4$  dissolves pure Ag only when concentration equals 60° B. More dil. acid dissolves only the impure metal (Pannani, Gazz. ch. it. 1909, 39. (2) 234.)

Slowly decom. into AgCl by alkali chlorides + Aq, also by  $CuCl_2$ , etc. + Aq.

Somewhat sol. in  $NH_4OH$  + Aq in presence of O. (Lea, Sill. Am. J. 144. 444.)

Sol. in  $KMnO_4$  + dil.  $H_2SO_4$  + Aq. (Friedheim, B. 20. 2554.)

Sol. in  $Fe_2(SO_4)_3$  + Aq, especially on heating, but completely insol. in  $FeSO_4$  + Aq (Vogel.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

**Allotropic forms**—(a). Very sol. in  $H_2O$ . Solution is pptd. by saline solutions or almost any neutral substance. Alkali sulphates, nitrates, and citrates ppt. it in a sol. form, while  $MgSO_4$ ,  $CuSO_4$ ,  $FeSO_4$ ,  $NiSO_4$ ,  $K_2C_2O_7$ ,  $K_4Fe(CN)_6$ ,  $Ba(NO_3)_2$ , and even  $AgNO_3$  + Aq ppt. it in an insol. form, which, however, may be made sol. again by treatment with many substances, as  $Na_2B_4O_7$ ,  $K_2SO_4$ , or  $Na_2SO_4$  + Aq.  $NaNO_2$  + Aq ppts. the Ag from its solution in a perfectly insol. form.

(b) The ppt. from aqueous solution by salts is sol. in  $NH_4OH$  + Aq. (Lea, Sill. Am. J. 137. 476.)

Many other allotropic forms exist. (Lea.) Pure colloidal silver is also sol. in alcohol (Schneider, B. 25. 1164.)

Entirely sol. in  $H_2O$ , even when dry. (Schneider, Z. anorg. 1894, 7. 339.)

### Silver acetylde, $Ag_2C_2$ .

Sol. in KCN + Aq with evolution of  $C_2H_2$ . Decomp. by HCl + Aq. (Arth, C. R. 1897, 124. 1535.)

### Silver amide, $AgNH_2$ .

Ppt., sol. in ammonium salts + Aq and in excess of potassium amide. Sol. in liquid  $NH_3$ . Insol. in Ag salts + Aq. (Franklin, J. Am. Chem. Soc. 1905, 27. 833.)

Sol. in excess of  $KNH_2$ . (Franklin, Z. anorg. 1905, 46. 16.)

### Silver antimonide, $Ag_3Sb$ or $Ag_3Sb$

Min. *Diserazite*. Sol. in  $HNO_3$  + Aq.  $Ag_3Sb$ . Insol. in HCl + Aq; decomp. by  $HNO_3$  + Aq. (Christofle.)

### Silver azoimide, $AgN_3$ .

Insol. in hot or cold  $H_2O$  or dil. acids, sol. in conc. mineral acids. Sol. in  $NH_4OH$  + Aq. (Curtius, B. 23. 3023.)

### Silver bromide, AgBr.

Insol. in  $H_2O$ , or  $H_2O$  acidulated with  $HNO_3$ ,  $H_2SO_4$ , or  $HCl$ , between 0° and 33°. If flocculent or pulverulent, it is sensibly sol. thereon above 33°, but if granular only above 50°, and then very slightly. (Stas, A. ch. (5) 3. 289.) Ag can be detected as AgBr in 10,000,000 pts.  $H_2O$  (Stas.)

Calculated from the electrical conductivity of AgBr + Aq, AgBr is sol. in 1,971,658 pts.  $H_2O$  at 20°, and 775,400 pts. at 38°. (Holleman, Z. phys. Ch. 12. 133.)

By same method Kohlrausch and Rose calculate that 1 l.  $H_2O$  dissolves 0.4 mg. AgBr at 18° (Z. phys. Ch. 12. 240.)

Solubility in  $H_2O$  = 0.109 mg. per l. (Prudhomme, J. chim. Phys. 9. 519.)

Solubility in  $H_2O$  =  $6.6 \times 10^{-7}$  at 25°. (Goodwin, Z. phys. Ch. 1894, 13. 645.)

Solubility of AgBr in  $H_2O$  at 25° equals  $8.1 \times 10^{-7}$  g. mols. per l. (Thiel, Z. anorg. 1900, 24. 57.)

Aq. solution sat. at 21.1° contains  $0.57 \times 10^{-4}$  gr. equiv. per litre. (Kohlrausch, C. C. 1901, II. 1299.)

1 l.  $H_2O$  dissolves 0.000137 g. AgBr at 25°. (Abegg and Cox, Z. phys. Ch. 1903, 46. 11.)

$0.84 \times 10^{-4}$  g. are dissolved per liter of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903, 46. 608.)

1 l.  $H_2O$  dissolves 0.107 mg. AgBr at 21°. (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

3.7 mg. AgBr are contained in 1 liter of sat. solution at 100°. (Böttger, Z. phys. Ch. 1903, 46. 93.)

1 mg. in 1 l. of sat. solution at 21° (Kohlrausch, Z. phys. Ch. 1903, 46. 168.)

Solubility in  $H_2O$  =  $8.8 \times 10^{-7}$  g. mol. per litre at 25°. (A. E. Hill, J. Am. Chem. Soc. 1908, 30. 74.)

Boiling  $H_2O$  dissolves 0.000003502 of its weight of AgBr.  $HNO_3$  + Aq (1%  $HNO_3$ ) dissolves 0.00000543 of its weight of AgBr at 100° with sl. decomposition. The solution is pptd. by  $AgNO_3$  + Aq or HBr (or MBr) + Aq, but not completely. 1 pt. of AgBr in solution requires 3 pts. of Br as MBr (or HBr), or of Ag as  $AgNO_3$ , in order to be wholly precipitated. (Stas.)

Not attacked by boiling  $HNO_3$  + Aq; sl. sol. in conc. HBr or HCl + Aq (Löwig). Boiling conc.  $H_2SO_4$  decomposes it (Balard), hardly acts on it (Dumas), dissolves a small quantity, which is repptd. by  $H_2O$  (Berzelius.)

Very sl. sol. in dil., easily in conc.  $NH_4OH$  + Aq. 100 pts.  $NH_4OH$  + Aq (0.986 sp. gr.) dissolve 0.51 pt. AgBr (dried at 100°) at 80°, and about double that amount of freshly pptd. AgBr. (Pohl, W. A. B. 41. 267.)

1 g. freshly pptd. AgBr is sol. in 250 ccm. 10%  $NH_4OH$  + Aq, but insol. in an ammoniacal solution of AgCl (Seiner, Pharm. J. Trans. (3) 14. 1.)

1 g. AgBr dissolves in 8779.4 g. 5%  $NH_4OH$  + Aq (sp. gr. = 0.993) at 12°, and in 288.5 g.

10%  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. = 0.96) at  $12^\circ$  (Long, *Gazz. ch. it.* 13. 87.)

Solubility of  $\text{AgBr}$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ .  
G. mols. per l.

$\text{NH}_3$	$\text{AgBr}$	Sp. gr. $15.5^\circ$
1.085	0.0011	0.9932
2.365	0.0031	0.9853
3.410	0.0050	0.9793
4.590	0.0074	0.9720
5.725	0.0101	0.9655

(Bodlander, *Z. phys. Ch.* 1892, 9. 734.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $0^\circ$ .

10 cc. of the solution contain g.  $\text{NH}_3$  and mg.  $\text{AgBr}$ .

g. $\text{NH}_3$	Mg. $\text{AgBr}$	g. $\text{NH}_3$	Mg. $\text{AgBr}$
0.307	8.0	2.627	108.7
0.488	9.6	3.126	156.8
0.669	17.2	3.389	198.7
0.829	21.2	3.652	266.9
1.151	34.9	3.722	288.8
1.532	55.7	3.770	293.0
1.809	72.2	3.926	289.2
1.953	74.1	3.995	285.0

(Jarry, *A. ch.* 1899, (7) 17. 364.)

Solubility of  $\text{AgBr}$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .  
G. mols. per l.

$\text{NH}_3$	$\text{AgBr}$	$\text{NH}_3$	$\text{AgBr}$
0.1932	0.00060	1.985	0.00692
0.3849	0.00120	3.024	0.01163
0.7573	0.00223	5.244	0.02443

(Bodlander and Fittig, 1902, *Z. phys. Ch.* 39. 597.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

g. at Ag per l.	Mols. $\text{NH}_3$ per l.
0.00170	0.450
0.00159	0.497
0.000941	0.268
0.00107	0.273
0.000391	0.115
0.000386	0.118
0.000276	0.0764
0.000264	0.0777

(Whitney and Melcher, *J. Am. Chem. Soc.* 1903, 25. 79.)

Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ . Very sl. sol. in  $\text{NH}_4$  carbonate, sulphate, or succinate +  $\text{Aq}$ , and still less in nitrate. (Wittstein.) Not very easily sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  when suspended in much  $\text{H}_2\text{O}$ , and is separated out again by  $\text{KBr} + \text{Aq}$ . (Field, *C. N.* 3. 17.)

Sol. in  $\text{KCN} + \text{Aq}$ . Sl. sol. in conc.  $\text{KCl}$ ,

$\text{KBr}$ ,  $\text{NaCl}$ ,  $\text{NaBr}$ ,  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{Br} + \text{Aq}$ ; but insol. when dilute.

Traces only dissolve in alkali nitrates +  $\text{Aq}$ . (Fresenius, *Quant. Anal.*)

Abundantly sol. in  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ . 100 cc.  $\text{H}_2\text{O}$  containing 10 cc. normal  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  dissolve 0.0383 g.  $\text{AgBr}$ . (Stas.)

Solubility of  $\text{AgBr}$  in  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .  
G. mols. per l.

$\text{Hg}(\text{NO}_3)_2$ $\text{HNO}_3$	$\text{AgBr}$	$\text{Hg}(\text{NO}_3)_2$ $\text{HNO}_3$	$\text{AgBr}$
1	0.03660	0.025	0.00459
0.10	0.00873	0.0125	0.00329
0.05	0.00639	0.0100	0.00306

$\text{HNO}_3$  was present in all cases, and it was found that there was no difference in solubility of  $\text{AgBr}$  with concentrations between 0.1N and 2N  $\text{HNO}_3$ . Cryst. and amorphous  $\text{AgBr}$  showed the same solubility. (Morse, *Z. phys. Ch.* 1902, 45. 708.)

Difficultly sol. in hot conc.  $\text{AgNO}_3 + \text{Aq}$ . (Russe, *A.* 111. 39.)

100 cc. of a 3-N solution of  $\text{AgNO}_3$  dissolve 0.04 g.  $\text{AgBr}$  at  $25^\circ$ . Much less sol. in  $\text{AgNO}_3 + \text{Aq}$  than  $\text{AgI}$  (Hellwig, *Z.* anorg. 1900, 25. 176.)

Solubility in  $\text{AgNO}_3 + \text{Aq}$ .

Volumetric measurements

$\text{AgNO}_3$	N/10 $\text{KBr}$ ccm	Opalescent at	G. $\text{AgBr}$ retained per 100 g. $\text{AgNO}_3$
10 g. made up to 32 g. per 100 g. of solution	0.65	$22^\circ$	0.129
	0.72	35	0.144
	0.8	44	0.159
	0.9	62	0.178
	1.0	67	0.188
	1.1	77	0.207
	1.2	79	0.226
10 g. made up to 70 g. per 100 g. of solution	6.0	37	1.13
	8.0	53	1.50
	10.0	67	1.88
	11.25	72	2.12
	12.0	74	2.26
	12.75	79	2.40
	13.5	82	2.54
	15.5	85.5	2.92
	17.5	90	3.29

Gravimetric measurements at  $14.5^\circ$

G. $\text{AgNO}_3$	ccm $\text{H}_2\text{O}$	Strength of $\text{AgNO}_3$ %	G. $\text{AgBr}$ re- tained per 100 g. $\text{AgNO}_3$
7.326	9.32	44	0.144
8.290	7.65	52	0.185
7.255	4.84	60	0.253
7.35	3.95	65	0.365

(Lowry, *Roy. Soc. Proc.* 1914, 91. A, 65.)

100 g. KBr in conc. KBr+ $Aq$  dissolve 3019 mg. AgBr at 15°; 95 g. NaCl+10 g. KBr dissolve only 75 mg. AgBr at 15°. (Schierholz, W. A. B. 101, 2b. 4.)

### Solubility in KBr+ $Aq$ at 25°.

Mol KBr in 1 litre	G. AgBr in 1 litre
4 864	26 44
4 44	17 95
4 18	13 50
3 68	7 50
2 81	2 34
2 76	2 20

(Heilwig, Z. anorg. 1900, 25. 183.)

Sol in conc. KBr or NaBr+ $Aq$  (Lowig), but less than AgI in KI+ $Aq$  (Field).

100 g. NaCl in conc. NaCl+ $Aq$  dissolve 474 mg. AgBr at 15°; 100 g. NaCl in 21% NaCl+ $Aq$  dissolve 188 mg. AgBr at 15°. (Schierholz, W. A. B. 101, 2b. 4.)

### Solubility of AgBr in $Na_2SO_3$ + $Aq$ at 25°.

G. formula weights per l.

$SO_3$	Ag	$SO_3$	Ag
0.232	0.0025	0.466	0.0053
0.406	0.0023	0.474	0.0055
0.448	0.0023	0.675	0.0084

(Luther and Leubner, Z. anorg. 1912, 74. 393.)

### Solubility of AgBr in $Na_2SO_3$ at (?)°.

(g salts per l of solution.)

$Na_2SO_3$	AgBr	$Na_2SO_3$	AgBr
83.75	0 790	2.08	0 0159
70 75	0 570	1.13	0 0086
38 2	0 265	0 59	0 0045
17 65	0 116	0 3	0 0039
9.47	0 0526	0.17	0 0022
4 85	0 0329	0.08	0 00075

(Mees and Piper, Photog J 1912, 36. 234.)

### Solubility in $Na_2S_2O_3$ + $Aq$ at 35°.

g. $Na_2S_2O_3$ in 1 liter	g. AgBr corresponding to each g. $Na_2S_2O_3$ .
100	0 376
200	0 390
300	0 397
500	0 427

(Richards and Faber, Am. Ch. J. 1899, 21. 169.)

$(NH_4)_2S_2O_3$ + $Aq$ . dissolves AgBr more rapidly than does  $Na_2S_2O_3$ + $Aq$ . (Lumière and Seyewitz, C. C. 1908, II. 1138.)

### Solubility in salts+ $Aq$ .

Solvent	% Conc	Grams AgBr sol in 100 grams solvent
Sodium thiosulphate	1	0 35
" " "	5	1 90
" " "	10	3 50
" " "	15	4 20
" " "	20	5 80
Sodium sulphite	10	0 04
" " "	20	0 08
Ammonium sulphite	10	Traces
Potassium cyanide	5	6.55
Ammonium sulphocyanide	5	0 21
" " "	10	2.04
" " "	15	5.30
Potassium " "	10	0.73
Calcium " "	10	0 53
Barium " "	10	0 35
Aluminum " "	10	4 50
Thiocarbamide	10	1 87
Thioquinamine	1	0 08
" " "	5	0.35
" " "	10	0.72

(Valenta, M. 1894, 15. 250.)

Solubility of AgBr in salts+ $Aq$  at (?)°. (G. AgBr sol. in 1 l. of 1% solution of salts.)

$NaSCN$	2.06
$NH_4SCN$	0.03
$(NH_4)_2CO_3$	0.004
$Na_2SO_4$	0.055

(Mees and Piper, Photog J., 1912, 36. 234.)

In a solution of  $NaC_2H_3O_2$ + $Aq$ , containing 10 ccm. of sat  $NaC_2H_3O_2$ + $Aq$  at 15° and 20 ccm. normal  $HC_2H_3O_2$ + $Aq$  mixed with 970 ccm.  $H_2O$ , about double the amt. of flocculent AgBr is dissolved in the cold that is dissolved by boiling  $H_2O$  from granular AgBr. This solution required 3 pts of Ag or Br to ppt. the AgBr in solution. Pulverulent or granular AgBr are wholly insol. in dil. or conc. acetates+ $Aq$  (Stas)

Sol. in  $Hg(C_2H_3O_2)_2$ + $Aq$ . 100 ccm.  $H_2O$  containing 10% of normal  $Hg(C_2H_3O_2)_2$ + $Aq$  dissolves 0.0122 g. AgBr at 20°. (Schierholz.)

Very sol in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Solubility in 10 cc. methylamine+ $Aq$  of different concentrations at 11.5°

g. $NH_2CH_3$	4 844	4 311	3 562	3.258
mg. AgBr	289	127	73	55

g. $NH_2CH_3$	1 797	1.513	1 317	1.101
mg. AgBr	28	16	12	7

(Jarry, A. ch. 1899, (7) 17. 378.)

## Solubility in methylamine + Aq at 25°

G mol per l

CH <sub>3</sub> NH <sub>2</sub>	AgBr
0 02	0 00026
0 04	0 00034
0 074	0 000395
0 0947	0 00041
0 1950	0 00045

(Wuth, B. 1902, 35. 2416)

## Solubility of AgBr in methylamine + Aq at 25°

G mol per l

CH <sub>3</sub> NH <sub>2</sub>	AgBr	CH <sub>3</sub> NH <sub>2</sub>	AgBr
1 017	0 0025	0 102	0 00026
0 508	0 0013	0 051	0 00012
0 203	0 00049		

(Bodländer and Eberlein, B. 1903, 36. 3948)

## Solubility in ethylamine + Aq at 25°

G mol per l

C <sub>2</sub> H <sub>5</sub> NH <sub>2</sub>	AgBr
0 01272	0.0000867
0 03942	0 000137
0 05512	0 000193
0 06572	0 000258
0 10300	0 000711

(Wuth, B. 1902, 35. 2416)

At 25°, 1 l ethylamine + Aq containing 0.483 g. mol. C<sub>2</sub>H<sub>5</sub>NH<sub>2</sub> dissolves 0.00231 g. mol. AgBr; 0.200 g. mol. C<sub>2</sub>H<sub>5</sub>NH<sub>2</sub>, 0.0097 g. mol. AgBr (Bodländer and Eberlein, B. 1903, 36. 3948.)

Insol in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol in acetone. (Eidmann, C. C 1899, II, 1014.) (Naumann, B. 1904, 37. 4329.)

Sol in alcoholic thiourea. (Reynolds, Chem. Soc. 1892, 61. 251.)

Insol in methyl acetate (Rebold, Dissert. 1906); (Naumann, B. 1909, 42. 3790.) ethyl acetate (Harners, Dissert. 1906); (Naumann, B. 1910, 43. 314.)

1.49 g. AgBr is dissolved in 1 l. of 1% thiocarbamide + Aq. (Meas and Piper, Photog J. 1912, 36. 239)

Insol in warm pyridine.

Mol wt. determined in piperidine. (Wermer, Z anorg. 1897, 15. 16.)

Min Bromyrite, Bromite.

Silver bromide ammonia, AgBr, NH<sub>3</sub>

(Joannis and Crozier, C. R. 894, 118. 1150.)

AgBr, 1½NH<sub>3</sub> (Jarry, A. ch. 1899, (7) 17. 356.)

2AgBr, 3NH<sub>3</sub> (Joannis and Crozier.)

AgBr, 3NH<sub>3</sub>. Decomp by H<sub>2</sub>O. Sl. sol. in liquid NH<sub>3</sub> (Jarry)

AgBr, 5NH<sub>3</sub> (Jarry, C. R. 1898, 126. 1141.)

Silver carbide, Ag<sub>2</sub>C.

(Gay-Lussac)

Ag<sub>2</sub>C(?) Sol in HNO<sub>3</sub> + Aq with residue of C (Liebig, A. 38. 129.)

Ag<sub>2</sub>C<sub>2</sub>. Sol in HNO<sub>3</sub> + Aq with residue of C (Regnault, A. 19. 153.)

Silver subchloride, Ag<sub>2</sub>Cl<sub>2</sub>.

NH<sub>4</sub>OH + Aq dissolves the greater part, the residue (20%) being sol in HNO<sub>3</sub> + Aq. KCN dissolves the greater part; H<sub>2</sub>SO<sub>4</sub> dissolves about 2%; acetic acid and KOH are without action (Bibra, J pr. 1875, (2) 12. 52)

Argentous chloride, Ag<sub>2</sub>Cl.

Obtained in a pure state by Guntz (C. R. 112. 861). Dil. HNO<sub>3</sub> + Aq does not attack but warm conc. HNO<sub>3</sub> + Aq decomp. Easily sol in KCN + Aq (Guntz, C. R. 112. 1212.)

The following data are for a more or less impure Ag<sub>2</sub>Cl

Boiling conc. HCl + Aq, NaCl + Aq, or NH<sub>4</sub>OH + Aq dissolve out AgCl, and leave Ag (Scheele, Wetzelar, Dulk, Wöhler)

According to Berthollet, wholly sol in NH<sub>4</sub>OH + Aq. Sol for the most part in NH<sub>4</sub>OH + Aq, and the residue is sol in HNO<sub>3</sub> + Aq (= Ag + AgCl) (v Bibra, B. 7. 741)

## Silver chloride, AgCl

Nearly insol. in H<sub>2</sub>O.

When AgCl is left in contact for some hours with pure H<sub>2</sub>O at 20-22°, and especially at 75°, traces go into solution; more Cl is dissolved than Ag. When 1 pt. Ag is pptd as AgCl in presence of 1 million pts. H<sub>2</sub>O a slight bluish milkiness is observed, but in order to have a distinct ppt. 4 pts. Ag should be present.

Dil. HNO<sub>3</sub> + Aq does not increase the solubility of AgCl, but AgCl is not absolutely insol. in stronger HNO<sub>3</sub> + Aq (Mulder.)

1 pt. AgNO<sub>3</sub>, when mixed with HCl + Aq in presence of 120,000 (Pfaff), 240,000 (Harting), pts. H<sub>2</sub>O, causes an opalescence

1 pt. Ag gives a slight turbidity with HCl + Aq in presence of 200,000 pts. H<sub>2</sub>O, a scarcely opalescent cloudiness with 400,000 pts. H<sub>2</sub>O, and the same after the lapse of 15 minutes in presence of 800,000 pts. H<sub>2</sub>O (Lassaigne)

1 pt. Ag can be detected as AgCl in 1 million parts H<sub>2</sub>O at ordinary temp., but not in 2 million parts. In NaNO<sub>2</sub> + Aq containing 0.79 pt. NaNO<sub>2</sub> in 200,000 pts. H<sub>2</sub>O, 1 pt. Ag can be detected as AgCl. This dissolves at 75°, and is visible again on cooling.

If the same liquid contains 1574 pts. NaNO<sub>2</sub>, the AgCl remains in solution after cooling.

In 100 ccm  $H_2O$  containing 0.787 g.  $NaNO_3$ , 13 drops of  $NaCl$  and silver solution, each drop of which contains 0.05 mg.  $Ag$ , cause a precipitate at  $5^\circ$ , 20 drops at  $15-17^\circ$ , 60 drops at  $45-55^\circ$ .

$AgCl$  is somewhat less sol. in  $HNO_3 + Aq$  than in  $NaNO_3 + Aq$  when the amount of  $H_2O$  remains the same.

Therefore, if  $HCl$  is used instead of  $NaCl$ , about  $\frac{1}{2}$  less  $AgCl$  remains in solution.

In 100,000 pts. of  $H_2O$ , which contain  $HNO_3$  and an amount of  $HCl$  corresponding to the amount of  $Ag$  salt, 1.596 pts.  $AgCl$  dissolve at  $25^\circ$ . The solution is precipitated by either  $AgNO_3$  or  $HCl$  (Mulder, Silber Probir-methode, Leipzig, 1859. 62.)

(For further older data, see Storer's Dictionary.)

White flaky  $AgCl$  is appreciably sol. in hot  $H_2O$ , 1000 ccm. boiling  $H_2O$  dissolving about 2 mg.  $AgCl$ . Far less sol. in  $H_2O$  containing  $AgNO_3$ , being practically insol. in  $H_2O$  containing 0.1 g.  $AgNO_3$  in a litre. Solubility is also diminished one-half by addition of  $HCl$  (Cooke, Sill. Am. J. (3) 21. 220.)

Solubility in  $H_2O$  rapidly diminishes as the temp. falls. (Cooke, l. c.)

Not completely insol. in  $H_2O$ . According to Stas (C. R. 73. 998) there are four modifications: (1) gelatinous; (2) cheesy-flocculent; (3) pulverulent; (4) granular, crystalline, or fusible. (4) is almost absolutely insol. in  $H_2O$  at the ordinary temp., but the solubility increases with the temp., and is considerable at  $100^\circ$ ; (2), which is formed by the precipitation of a cold dilute  $Ag$  solution, has the greatest solubility in pure  $H_2O$ , and it changes its solubility by standing, or if made pulverulent by shaking with  $H_2O$ ; (3) is also sol. in  $H_2O$ , the solution of (2) or (3) in pure  $H_2O$ , or  $H_2O$  acidified with  $HNO_3$ , is precipitated by  $AgNO_3$  or  $NaCl + Aq$ .

In order to ppt 1 pt.  $AgCl$  in above solution 3 pts. of  $Cl$  as chloride or  $Ag$  as nitrate are necessary; the pptn. is then complete.

Solubility of granular variety in boiling  $H_2O$  is proportionately large, and pptn. is brought about by 3 pts.  $Cl$  or  $Ag$  as above, but the pptn. in this case is not complete.

The salts formed simultaneously with the  $AgCl$  have no influence on the solubility of the  $AgCl$ . Presence of  $HNO_3$  does not increase the solubility of (2), but has that effect on (3) in proportion to the amt. of  $HNO_3$  present. (Stas, C. R. 73. 998.)

Further determination by Stas are as follows:—

Between  $0^\circ$  and  $30^\circ$  granular  $AgCl$  is insol. in pure  $H_2O$ , or  $H_2O$  acidulated with  $HNO_3$ .

Between  $0^\circ$  and  $30^\circ$  the flocculent and pulverulent forms of  $AgCl$  dissolve without alteration in pure  $H_2O$ , in acidulated  $H_2O$ , in alkali acetates +  $Aq$ , and in  $Hg(C_2H_3O_2)_2 + Aq$  containing an alkali acetate. Their degree of solubility is a function of the state of the chloride, of the temp., and of the nature

and quantity of the solvent within these limits of temp. ( $0^\circ-30^\circ$ ). These solvents, if they contain either  $Ag$  in the state of an  $Ag$  salt, or  $Cl$  as chloride or  $HCl$  in an amount three times that which they can dissolve as  $AgCl$ , exercise no solvent action on any of the modifications of  $AgCl$ . And reciprocally sat.  $AgCl + Aq$  is pptd. instantly by a decinormal solution of  $AgNO_3$  or  $MCl$  (or  $HCl$ ). The  $AgCl$  is wholly pptd. when the quantity of the  $Ag$  or  $Cl$  thus added is equal to three times the quantity of the  $Ag$  or  $Cl$  dissolved as  $AgCl$ .

Between  $50^\circ$  and  $100^\circ$ , however, decinormal solutions of  $Ag$  or chlorides, which cause instant ppts in solutions sat. with any of the modifications of  $AgCl$ , do not eliminate all the dissolved  $AgCl$ . At  $100^\circ$ , they only ppt. 60% of the amt. dissolved. (Stas, A. ch. (5) 3. 323.)

Calculated from electrical conductivity of  $AgCl + Aq$ ,  $AgCl$  is sol. in 715,800 pts.  $H_2O$  at  $13^\circ$ , and 384,100 pts. at  $26.5^\circ$ . (Holleman, Z. phys. Ch. 12. 132.)

Calculated in the same way, 1 l.  $H_2O$  dissolves 0.76 mg. at  $2^\circ$ ; 0.97 mg. at  $10^\circ$ ; 1.52 mg. at  $18^\circ$ ; 2.24 mg. at  $26^\circ$ ; 3.03 mg. at  $34^\circ$ ; 4.05 mg. at  $42^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 242.)

Solubility in  $H_2O = 1.25 \times 10^{-5}$  mol./l. at  $25^\circ$ . (Goodwin, Z. phys. Ch. 1894. 13. 645.)

Solubility of  $AgCl$  in  $H_2O$  at  $25^\circ$  is  $1.41 \times 10^{-5}$  (in normality). (Thiel, Z. anorg. 1900, 24. 57.)

$2.16 \times 10^{-5}$  moles are sol. in 1 liter  $H_2O$  at  $25^\circ$ . (Noyes and Kohr, Z. phys. Ch. 1903, 42. 341.)

$1.53 \times 10^{-3}$  g. per liter are dissolved in sat. aq. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 48. 603.)

1 l.  $H_2O$  dissolves 1.6 mg.  $AgCl$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

21.8 milligrams are dissolved in 1 liter of sat. solution at  $100^\circ$ . (Böttger, Z. phys. Ch. 1906, 56. 93.)

1.34 mg. are contained in 1 l. of sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

1 l. sat. solution at  $t^\circ$  contains mg.  $AgCl$ .

$t^\circ$	mg. $AgCl$	$t^\circ$	mg. $AgCl$
1 55	0 56	17 51	1 31
4 68	0 66	25 86	1 935
9 97	0 89	34 12	2 74

(Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Solubility in  $H_2O = 1.6 \times 10^{-5}$  g.-mol. per litre at  $25^\circ$ . (A. E. Hill, J. Am. Chem. Soc. 1908, 30. 74.)

1 l.  $H_2O$  dissolves 0.00154 g.  $AgCl$  at  $21^\circ$ ; 0.0217 g. at  $100^\circ$ . (Whitby, Z. anorg. 1910, 67. 108.)

Calculated from electrical conductivity of AgCl+ $\text{Aq}$ , 1 l  $\text{H}_2\text{O}$  dissolves:

0.0105 mill-equivalents AgCl at 18°  
0.0365 " " " " 50°  
0.147 " " " " 100°.

(Malcher, J. Am. Chem. Soc. 1910, **32**, 55.)

1 l  $\text{H}_2\text{O}$  dissolves  $1.02 \times 10^{-5}$  g. equiv at 18°;  $1.429 \times 10^{-5}$  g. equiv. at 25°. (van Rossen, C. C. 1912, I 1539.)

The most probable average value for solubility of AgCl in  $\text{H}_2\text{O}$  is  $1.04 \times 10^{-5}$  g. equiv per l at 18°, and  $1.43 \times 10^{-5}$  g. equiv. per l. at 25°. (van Rossen, C. C. 1912, II, 1807.)

$1.20 \times 10^{-5}$  g. AgCl are sol in 1 l.  $\text{H}_2\text{O}$  at 18°. (Glowczynski, C. A. 1915, 741.)

More sol. in  $\text{H}_2\text{O}$  than AgSCN. (Noimand, Chem. Soc. 1912, 101, 1853.)

Sol in conc. HCl+ $\text{Aq}$ , and also when not very conc., thus the solution of 1 pt.  $\text{AgNO}_3$ + $\text{Aq}$  in 15,000 pts.  $\text{H}_2\text{O}$  is clouded by a little HCl+ $\text{Aq}$ , but clears up by the addition of more. (Reinsch, J. pr. 13, 133.)

1 pt. AgCl dissolves in 200 pts. conc. HCl+ $\text{Aq}$  and in 600 pts. HCl+ $\text{Aq}$  diluted with 2 pts.  $\text{H}_2\text{O}$ . (Pierre, J. Pharm. (3) 12, 237.)

Somewhat sol. in hot alcohol, to which HCl has been added, but is precipitated on cooling. (Erdmann, J. pr. 19, 341.)

100 pts. sat. HCl+ $\text{Aq}$  (sp. gr. 1.165) dissolve 0.2980 pt. AgCl, or AgCl is sol in 336 pts. HCl+ $\text{Aq}$  at old temp., 100 pts. HCl+ $\text{Aq}$  (sp. gr. 1.165) at b-pt dissolve 0.56 g. AgCl, or AgCl is sol. in 178 pts. HCl+ $\text{Aq}$ .

Solubility of AgCl in dil. HCl+ $\text{Aq}$ . 100 cc. HCl+ $\text{Aq}$  (sp. gr. 1.165), to which the given amt.  $\text{H}_2\text{O}$  has been added, dissolve g. AgCl

ccm. HCl	ccm. $\text{H}_2\text{O}$	g. AgCl	Pts. HCl which dissolve 1 pt. AgCl
100	10	0.056	1,785
100	20	0.018	5,555
100	30	0.0089	11,235
100	50	0.0035	18,571

(Vogel, N. Rep. Pharm. **23**, 335.)

If HCl is added to a solution in which  $\frac{1}{1,000,000}$  pt. Ag is suspended, the milkiness disappears. Solubility in HCl+ $\text{Aq}$  increases with the temp., the AgCl separating out on cooling. (Mulder.)

The amounts of AgCl which dissolve in HCl+ $\text{Aq}$  are directly proportional to the volumes of acid (of fixed concentration) used. (Bailew, J. Am. Chem. Soc. 1906, **28**, 1448.)

1 l. 1% HCl dissolves 0.0002 g. AgCl at 21°.

1 l. 5% HCl dissolves 0.0033 g. AgCl at 21°.

1 l. 10% HCl dissolves 0.0555 g. AgCl at 21°.

(Whitby, Z. anorg. 1910, **67**, 108.)

### Solubility in HCl+ $\text{Aq}$ at 25°.

HCl g-equivalents per l	Ag $\times 10^{-3}$ g-equivalents per l
0.640	0.032
1.300	0.126
1.911	0.266
2.149	0.374
2.569	0.610
2.975	0.814
3.576	1.358
4.182	2.147
4.735	3.168
5.508	4.126

(Forbes, J. Am. Chem. Soc. 1911, **33**, 1941.)

### Solubility in 20% HCl + $\text{Aq}$ .

HCl	N/10 $\text{AgNO}_3$ ccm	Opalescent at 1°	G. AgCl to 100 g. anhydrous HCl
20 g. of 20% acid	1.0		
	1.1	0 0	0.39
	2.0	29 5	0.72
	3.0	51 5	1.076
	3.75	70.0	1.346
	4.25	82.0	1.525
	4.75	90.0	1.74
	5.80	107.0	2.08

(Lowry, Roy, Soc. Proc. 1914, **91**, A. 62.)

Sol. in conc. HBr+ $\text{Aq}$  (Löwig.)

Insol. in  $\text{HNO}_3$ + $\text{Aq}$  (Wackenroder.)

Entirely unacted upon by  $\text{HNO}_3$  of 1.43 sp. gr. (Wurtz, Am. J. Sci. (2) **25**, 382.)

Solubility in dil.  $\text{HNO}_3$ + $\text{Aq}$  is the same as solubility in  $\text{H}_2\text{O}$ , i. e.  $\frac{1}{2,000,000}$  pt. of Ag cannot be detected in  $\text{H}_2\text{O}$  with or without  $\text{HNO}_3$ , but  $\frac{1}{1,000,000}$  pt. can be detected in both cases. (Mulder.)

1 pt. Ag in the form of AgCl dissolves at 25° in 83,000 pts.  $\text{H}_2\text{O}$  containing free  $\text{HNO}_3$  and 0.33 pt. of HCl (Mulder.)

100,000 pts. conc.  $\text{HNO}_3$ + $\text{Aq}$  dissolve about 2 pts. AgCl, and solubility is not sensibly affected by lower nitrogen oxides. (Thorpe, Chem. Soc. (2) **10**, 453.)

### Solubility of AgCl in $\text{HNO}_3$ + $\text{Aq}$ at 25°.

G per liter			
$\text{HNO}_3$	AgCl	$\text{HNO}_3$	AgCl
0.0315	0.001647	18.9	0.00225
0.063	0.001705	94.5	0.0245
0.630	0.00176		

(Glowczynski, Kolloidchem. Beih. 1914, **6**, 147.)

Insol. in cold conc.  $H_2SO_4$ , but on boiling is in part decomp. and in part dissolved, and does not separate on cooling.

$AgCl$  is not more sol. in dil.  $H_2SO_4$ +Aq than in dil.  $HNO_3$ +Aq.

Unacted upon by cold  $H_2SO_4$ +Aq, and but slightly decomp. on heating. (Vogel.)

Abundantly sol. in  $H_2PtCl_6$ +Aq without decomp. (Birnbaum, Z. Ch. 1867. 520.)

Insol. in cold dil. caustic alkalis+Aq but decomp. by hot conc. solutions. (Gregory)

Decomp. by  $K_2CO_3$ +Aq.

Sl. sol. in cold  $K_2CO_3$ +Aq.

Easily sol. even in dil.  $NH_4OH$ +Aq.

1 pt.  $AgCl$  dissolves in 1288 pts  $NH_4OH$ +Aq of 0.89 sp. gr. (Wallace and Lamont, Chem. Gaz. 1893. 137.)

100 pts.  $NH_4OH$ +Aq of 0.986 sp. gr. dissolve at  $80^\circ$  1.492 pts.  $AgCl$ , dried at  $100^\circ$ . (Pohl, W. A. B. 41. 627.)

1 l.  $NH_4OH$ +Aq of 0.949 sp. gr. dissolves 51.6 g.  $Ag$  as freshly precipitated  $AgCl$ , and 47.6 g. when diluted with 1 l.  $H_2O$ .

1 l.  $NH_4OH$ +Aq of 0.924 sp. gr. dissolves 58 g.  $Ag$  as freshly precipitated  $AgCl$ ; 1 l.  $NH_4OH$ +Aq of 0.899 sp. gr. dissolves 49.6 g.; 0.5 l.  $NH_4OH$ +Aq (of 0.949 sp. gr.)+0.5 l. saturated  $NaCl$ +Aq dissolves 20.8 g.; 0.5 l.  $NH_4OH$ +Aq (of 0.949 sp. gr.)+0.5 l. saturated  $KCl$ +Aq dissolves 20.4 g.; 0.5 l.  $NH_4OH$ +Aq (of 0.949 sp. gr.)+0.5 l. saturated  $NH_4Cl$ +Aq dissolves 22.4 g.  $Ag$  as freshly pptd.  $AgCl$ . (Millon and Commaille, C. R. 56. 309.)

1 g.  $AgCl$  dissolves in 428.64 g. 5%  $NH_4OH$ +Aq (sp. gr. 0.998) at  $12^\circ$ ; 1 g.  $AgCl$  dissolves in 1276 g. 10%  $NH_4OH$ +Aq (sp. gr. 0.998) at  $18^\circ$ . (Long, Gazz. ch. it. 13. 87.)

1 g. freshly pptd.  $AgCl$  is sol. in 17 ccm. 10%  $NH_4OH$ +Aq. Solubility is diminished by presence of  $AgBr$ . (Senier, Pharm. J. Trans. (3) 14. 1.)

#### Solubility in $NH_4OH$ +Aq at $0^\circ$

G. per 100 g. solution.

$NH_3$	$AgCl$	$NH_3$	$AgCl$
1.45	0.49	28.16	5.69
1.94	1.36	29.80	7.09
5.60	3.44	30.19	7.25
6.24	4.00	32.43	5.87
11.77	4.68	34.56	4.77
16.35	5.18	37.48	3.90

(Jarry, A. ch. 1899, (7) 17. 342.)

Solubility in  $NH_4OH$ +Aq increases with the temp. (Jarry.)

#### Solubility in $NH_4OH$ +Aq at $25^\circ$ .

g. at Ag per l.	Mols $NH_3$ per l.	g. at Ag per l.	Mols $NH_3$ per l.
0.151	2.042	0.0140	0.253
0.149	2.017	0.0140	0.253
0.149	2.013	0.0140	0.252
0.147	1.991	0.0139	0.252
0.0616	0.961	0.00621	0.118
0.0583	0.916	0.00621	0.118
0.0584	0.909	0.00619	0.118
0.0572	0.903	0.00625	0.118
0.0569	0.896	0.00304	0.0590
0.0555	0.873	0.00297	0.0589
0.0541	0.863	0.00300	0.0585
0.0514	0.815	0.00149	0.0288
0.0249	0.428	0.00143	0.0287
0.0240	0.416	0.00142	0.0285
0.0235	0.411	0.00141	0.0282
0.0227	0.397	...	.....

(Whitney and Melcher, J. Am. Chem. Soc. 1903, 25. 78.)

#### Solubility of $AgCl$ in $NH_4OH$ +Aq at $25^\circ$ .

$Ag$ =g. at.  $Ag$  in 1000 g.  $H_2O$ .

$NH_3$ =g. mol.  $NH_3$  in 1000 g.  $H_2O$ .

Conc.=Molecular concentration of free  $NH_3$ .

$Ag$	$NH_3$	Conc.	Solid phase
0.023	0.437	0.391	$AgCl$
0.025	0.428	0.378	"
0.1197	1.700	1.461	"
0.1308	1.688	1.426	"
0.372	3.782	3.038	"
0.378	3.945	3.181	"
0.574	5.10	3.95	"
0.600	5.33	4.11	"
0.633	5.545	4.279	"
0.745	6.26	4.77	$AgCl+2AgCl, 3NH_3$
0.754	6.27	4.76	"
0.757	6.25	4.74	"
0.760	6.25	4.73	"
0.775	6.52	4.97	$2AgCl, 3NH_3$
0.848	8.28	6.58	"
0.968	11.19	9.25	"
0.980	11.78	9.82	"
0.978	12.23	10.27	"
0.965	12.26	10.33	"
1.03	12.68	10.62	"
1.09	12.96	10.78	"
1.049	14.34	12.24	"
1.039	14.47	12.39	"

(Straub, Z. phys. Ch. 1911, 77. 332.)

Easily (Brett), difficultly (Wittstein), sol. in  $NH_4Cl$ +Aq, but not in other  $NH_4$  salts.

Solubility in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $15^\circ$ 

% $\text{NH}_4\text{Cl}$	% $\text{AgCl}$
10.0	0.0050
14.29	0.0143
17.70	0.0354
19.23	0.0577
21.98	0.110
25.31	0.228
28.45	0.340*
Sat.	0.177

\*24.5°.

(Scherholz, W. A. B., 1890, 101. 2b. 8.)

Solubility in  $\text{NH}_4\text{Cl} + \text{Aq}$  (26.31%) at  $t^\circ$ 

$t^\circ$	% $\text{AgCl}$
15	0.276
40	0.329
60	0.421
80	0.592
90	0.711
100	0.856
110	1.053

(Scherholz.)

At  $25^\circ$ , 1 l.  $\text{NH}_4\text{Cl} + \text{Aq}$  containing 0.0053 g.  $\text{NH}_4\text{Cl}$  dissolves 0.001604 g.  $\text{AgCl}$ ; 0.00530 g.  $\text{NH}_4\text{Cl}$ , 0.002379 g.  $\text{AgCl}$ . (Glowczynski, Kolloidchem. Beih. 1914, 6. 147.)

See also Forbes, page 826.

1 l.  $\text{KClO}_3 + \text{Aq}$  dissolves 1.8 mg. (Guye, J. Chim. Phys. 10. 145.)

Sl sol. in conc.  $\text{KCl} + \text{Aq}$ ,  $\text{NaCl} + \text{Aq}$ , and certain other chlorides

$\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{CaCl}_2$ ,  $\text{ZnCl}_2 + \text{Aq}$ , etc., dissolve appreciable quantities of  $\text{AgCl}$ , especially if hot and concentrated, but it separates out for the most part on cooling.

Sol. in solutions of all the metallic chlorides which are sol. in  $\text{H}_2\text{O}$ , thus  $\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{CaCl}_2$ ,  $\text{SrCl}_2$ , and  $\text{BaCl}_2 + \text{Aq}$  all dissolve  $\text{AgCl}$ , especially if hot.  $\text{MgCl}_2$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{HgCl}_2$  (least) also dissolve  $\text{AgCl}$  (Mulder)

Sol. in conc.  $\text{CaCl}_2 + \text{Aq}$ . (Wetzlar.)

Sol. in rosecobaltic chloride +  $\text{Aq}$ . (Gibbs and Genth.)

Insol. in  $\text{SnCl}_4$ ,  $\text{HgCl}_2$ ,  $\text{CuCl}_2$ ,  $\text{ZnCl}_2$ ,  $\text{CdCl}_2$ ,  $\text{NiCl}_2$ , or  $\text{CoCl}_2 + \text{Aq}$ . (Vogel)

Solubility of  $\text{AgCl}$  in sat. solutions of chlorides at ordinary temperatures

Salt	100 pts sat solution dissolve pts $\text{AgCl}$	Pts solution required to dissolve 1 pt $\text{AgCl}$
$\text{BaCl}_2$	0.0143	6.993
$\text{SrCl}_2$	0.0884	1.185
$\text{CaCl}_2$	0.0930	1.075
$\text{NaCl}$	0.0950	1.050
$\text{KCl}$	0.0475	2.122
$\text{NH}_4\text{Cl}$	0.1575	634
$\text{MgCl}_2$	0.1710	584
$\text{HCl}$	0.2980	336

(Vogel, N. Rep. Pharm. 23. 335.)

Experiments by Hahn gave different results from those of Vogel as follows:—

Solubility in various salts +  $\text{Aq}$ .

Salt	% salt	Sat. at $t^\circ$	% $\text{AgCl}$
$\text{KCl}$	24.95	19.6	0.0776
$\text{NaCl}$	25.96	"	0.1053
$\text{NH}_4\text{Cl}$	28.45	24.5	0.3397
$\text{CaCl}_2$	41.26	"	0.5713
$\text{MgCl}_2$	36.35	"	0.5313
$\text{BaCl}_2$	27.32	"	0.0570
$\text{FeCl}_2$	"	"	0.1886
$\text{FeCl}_3$	"	"	0.0058
$\text{MnCl}_2$	"	24.5	0.1996
$\text{ZnCl}_2$	"	"	0.0134
$\text{CuCl}_2$	"	24.5	0.0532
$\text{PbCl}_2$	"	"	0.0000

(Hahn, Wyandotte Silver Smelting Works, 1877.)

1 l. 4-N  $\text{KCl} + \text{Aq}$  dissolves 0.915 g.  $\text{KCl}$  at  $25^\circ$ . (Hellwig, Z. anorg. 1900, 25. 166.)

Solubility in  $\text{KCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	G equiv. per l	
	$\text{Ag} \times 10^{-3}$	$\text{KCl}$
10	1.734	3.325
25	2.415	3.083
35	2.786	2.955

(Forbes, J. Am. Chem. Soc. 1911, 33. 1937.)

Solubility in  $\text{KCl} + \text{Aq}$  at  $25^\circ$ 

G. per liter.

$\text{KCl}$	$\text{AgCl}$	$\text{KCl}$	$\text{AgCl}$
0.00236	0.00184	0.01491	0.00305
0.00471	0.00218	0.02984	0.00321

(Glowczynski, Kolloidchem. Beih. 1914, 6. 147.)

Solubility in  $\text{CaCl}_2 + \text{Aq}$ .

$t^\circ$	G equiv per l	
	$\text{Ag} \times 10^3$	$\frac{\text{CaCl}_2}{2}$
10	0.964	3.512
25	1.514	3.320
35	1.806	3.221

(Forbes, l. c.)

Sat.  $\text{CuCl}_2 + \text{Aq}$  at  $0^\circ$  dissolves 2.835 g.  $\text{AgCl}$  per l; at  $100^\circ$ , 8.147 g. Solubility in sat.  $\text{MgCl}_2 + \text{Aq}$  is still greater. (Hahn, Eng. Min. J. 65. 434.)

More sol. in  $\text{HgCl}_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Finzi, Gazz. ch. it 1902, 32, (2) 324.)

At  $15^\circ$ , 100 g.  $\text{NaCl}$  in 280 ccm.  $\text{H}_2\text{O}$  dissolve 485 mg.  $\text{AgCl}$ ; 100 g.  $\text{KCl}$  in 300 ccm.  $\text{H}_2\text{O}$  dissolve 334 mg.; 100 g.  $\text{NH}_4\text{Cl}$  in 280 ccm.  $\text{H}_2\text{O}$  dissolve 1051 mg.

The solubility decreases with dilution rapidly at first until about an equal vol. of  $\text{H}_2\text{O}$  has been added, and then much more slowly to a minimum quantity, when the dilution is 1:10 for  $\text{NaCl}$  and  $\text{KCl}$ , and 1:20 for  $\text{NH}_4\text{Cl}$ .

100 g.  $\text{NaCl}$  in 280 ccm.  $\text{H}_2\text{O}$  dissolve 2170 mg.  $\text{AgCl}$  at  $109^\circ$ , 100 g.  $\text{NH}_4\text{Cl}$  in 280 ccm.  $\text{H}_2\text{O}$  dissolve 4000 mg.  $\text{AgCl}$  at  $110^\circ$ ; 100 g.  $\text{NaCl}$  in 620 ccm.  $\text{H}_2\text{O}$  (14% solution) dissolve 15 mg.  $\text{AgCl}$  at  $15^\circ$ , and 774 mg. at  $104^\circ$  (Schierholz, W. A. B. 101, 2b. 4.)

The solubility of  $\text{AgCl}$  in  $\text{NaCl} + \text{Aq}$  decreases with diminishing concentration of  $\text{NaCl} + \text{Aq}$ . (Barlow, J. Am. Chem. Soc. 1903, 25, 1418.)

#### Solubility in $\text{NaCl} + \text{Aq}$ .

##### Gravimetric measurements, $15^\circ$

Strength of salt solution	G. $\text{AgCl}$ retained per 100 g. $\text{NaCl}$
15% $\text{NaCl}$	0.063
20% $\text{NaCl}$	0.134
28% $\text{NaCl}$	0.279

##### Volumetric measurements

$\text{NaCl}$	N/10 $\text{AgNO}_3$ ccm.	Opalescent at $5^\circ$	G. $\text{AgCl}$ retained per 100 g. $\text{NaCl}$
20 g. of 15% solution	0.25 0.4 0.7 1.0 1.25 1.7	28 40 64 78 89 102.5	0.119 0.191 0.335 0.478 0.598 0.812
20 g. of 20% solution	0.43 0.65 0.82 1.2 1.6 2.12 2.52 3.08 3.52	17.0 26.0 37.0 51.5 67.0 79.5 88.5 97.0 105.0	0.156 0.234 0.295 0.430 0.524 0.765 0.910 1.10 1.27
20 g. of 28% solution	2.25 2.75 3.5 4.5 5.5 6.5 7.75	36.5 45.0 56.0 69.0 84.0 94.0 107.5	0.675 0.704 0.896 1.153 1.411 1.664 1.958

#### Solubility in salts + $\text{Aq}$ at $25^\circ$ .

C = concentration of the salt in salt solution in g.-equivalents per litre.

Salt	C	$\text{Ag} \times 10^{-3}$ g.-equivalents per l.
$\text{NaCl}$	0.933	0.086
	1.190	0.130
	1.433	0.184
	1.617	0.245
	1.871	0.348
	2.091	0.446
	2.272	0.570
	2.449	0.684
	2.658	0.851
	2.841	1.040
	3.000	1.194
	3.270	1.583
$\text{CaCl}_2$ 2	3.471	1.897
	3.747	4.462
	3.977	2.879
	4.170	3.335
	4.363	3.810
	4.535	4.298
	5.039	6.039
	1.748	0.289
	2.201	0.501
	2.741	0.900
	3.264	1.463
	3.737	2.182
$\text{NH}_4\text{Cl}$	4.033	2.802
	4.538	4.175
	5.005	5.823
	0.513	0.042
	0.926	0.113
	1.141	0.172
	1.574	0.365
	2.143	0.842
	2.536	1.425
	2.918	2.180
	3.162	2.795
	3.510	4.029
$\text{SrCl}_2$ 2	4.363	9.353
	4.902	14.92
	5.503	24.04
	5.764	30.17
	0.550	0.083
	0.989	0.092
	1.359	0.173
	1.572	0.236
	1.698	0.284
	1.818	0.348
	2.140	0.510
	2.476	0.747
	2.992	1.252
	3.494	2.018
	4.152	3.594
	5.216	8.174
	5.775	12.04

(Lowry, Roy, Soc. Proc. 1914, 91, A, 61.)

## Solubility in salts + Aq at 25°—Continued

Salt	C	Ag $\times 10^{-3}$ g.-equivalents per l
KCl	1 111	0 141
	1 425	0 235
	1 713	0 391
	2 022.	0.616
	2 396	1 050
	2 628	1.390
	2 850	1 845
	3 081	2 435
	3 424	3 602
	3 843	5 725
BaCl <sub>2</sub> 2	1 248	0 186
	1.610	0 339
	2 076	1 274
	3 280	2 366

(Forbes, J. Am. Chem. Soc. 1911, 33, 1940)

Sol in NaNO<sub>3</sub>, KNO<sub>3</sub>, Ca(NO<sub>3</sub>)<sub>2</sub>, Mg(NO<sub>3</sub>)<sub>2</sub>, and NH<sub>4</sub>NO<sub>3</sub> + Aq, sl sol. at ord temp., but solubility is much increased by heat.

Solubility in NaNO<sub>3</sub> + Aq at 15–20°.

ccm. H <sub>2</sub> O	g NaNO <sub>3</sub>	mg AgCl dissolved
100	0 787	1 33
200	0 787	1 93
300	2 361	3 99
100	2 787	2 53

## Solubility increases with ascending temp.

Temp.	ccm H <sub>2</sub> O	g. NaNO <sub>3</sub>	mg AgCl dissolved
5°	100	0 787	0 86
15–17°	100	0 787	1.33
18°	100	0 787	1.46
30°	100	0 787	2 33
45–55°	100	0 787	3 99

(Mulder)

At 25°, 100,000 pts. H<sub>2</sub>O containing a little free HNO<sub>3</sub> and 0.787 g NaNO<sub>3</sub> dissolve 2.128 mg. AgCl. By adding 2 g. more NaNO<sub>3</sub> to above solution, 2.5269 mg. (1/3 more) AgCl are dissolved. (Mulder)

Solubility in H<sub>2</sub>O is not appreciably influenced by 1/10 N to N-KNO<sub>3</sub> or NH<sub>4</sub>NO<sub>3</sub> + Aq. (van Rossum, C. C. 1912, II 1807)

In presence of NaNO<sub>3</sub> and excess of HCl, 1 l. H<sub>2</sub>O dissolves 0.03 mg. AgCl (Richards and Wells)

Hg(NO<sub>3</sub>)<sub>2</sub> + Aq dissolves considerable quantities of AgCl, but the other nitrates do not (Mulder)

Much more sol in hot than in cold Hg(NO<sub>3</sub>)<sub>2</sub> + Aq, and much more sol. therein than in NH<sub>4</sub>NO<sub>3</sub> + Aq. NaCl ppts AgCl from this solution, much less sol. therein in

presence of NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> or NH<sub>4</sub>OH + Aq. AgCl is pptd. from above solution by NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq (Mulder.)

Sol in Hg(NO<sub>3</sub>)<sub>2</sub> + Aq (Wackenroder, A. 41. 317); in considerable amount (Laebig, A. 81. 128); and is precipitated by HCl, NH<sub>4</sub>Cl, NaCl, KC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> (Debray, C. R. 70. 849); incompletely precipitated by AgNO<sub>3</sub> and not by HNO<sub>3</sub> (Wackenroder).

Solubility of AgCl in Hg(NO<sub>3</sub>)<sub>2</sub> + Aq at 25°.

(G. mols. per l.)

Hg(NO <sub>3</sub> ) <sub>2</sub> HNO <sub>3</sub>	AgCl	Hg(NO <sub>3</sub> ) <sub>2</sub> HNO <sub>3</sub>	AgCl
0 0100	0.00432	0.050	0 00914
0.0125	0 00499	0 100	0 01395
0.025	0 00690	1.000	0 04810

HNO<sub>3</sub> was present in all cases, and it was found that there was no difference in solubility of AgCl with concentrations between 0.1N and 2N HNO<sub>3</sub>. (Morse, Z. phys. Ch. 1902, 45. 708.)

Not sol. to appreciable extent in Cu(NO<sub>3</sub>)<sub>2</sub>, Fe<sub>2</sub>(NO<sub>3</sub>)<sub>6</sub>, Mn(NO<sub>3</sub>)<sub>2</sub>, Co(NO<sub>3</sub>)<sub>2</sub>, Zn(NO<sub>3</sub>)<sub>2</sub>, or Ni(NO<sub>3</sub>)<sub>2</sub> + Aq, insol or exceedingly sl. sol in Pb(NO<sub>3</sub>)<sub>2</sub> + Aq. (Mulder.)

Imperfectly sol in AgNO<sub>3</sub> + Aq. (Wackenroder)

Conc. AgNO<sub>3</sub> + Aq dissolves AgCl perceptibly.

Less sol in AgNO<sub>3</sub> + Aq than AgBr (Risse, A. 111. 39)

Solubility in 0.02N AgNO<sub>3</sub> + Aq = 0.15  $\times 10^{-3}$  g. mols. per l. (Böttger)

100 ccm of 3-N solution of AgNO<sub>3</sub> dissolve 0.08 g AgCl at 25°. More dil. solutions dissolve very slight amounts of AgCl. (Hellwig, Z. anorg 1900, 25. 177.)

Solubility in 2-N AgNO<sub>3</sub> + Aq at ord. temp. = 0.03  $\times 10^{-3}$  g equiv. AgCl. (Forbes, J. Am. Chem. Soc 1912, 33. 1946.)

Solubility in AgNO<sub>3</sub> + Aq at t°.

(Det. by volumetric method.)

AgNO<sub>3</sub>: H<sub>2</sub>O = 2:1

G. AgNO <sub>3</sub>	n/10 NaCl ccm	t°	g AgCl re- tained per 100 g AgNO <sub>3</sub>
6	2	57	0 478
7	2	45	0.410
8	2	40	0 359
9	2	35	0 319
11	2	30	0.261
7	1	26	0.205
10	1	22	0.143
10	4	65	0 572
10	5	86	0 715

Solubility in  $\text{AgNO}_3 + \text{Aq}$  at  $t^\circ$ —Continued

$\text{AgNO}_3 \text{ H}_2\text{O} = 1:1$			
5	1	94	0.286
6	1	84	0.239
7	1	75	0.205
8	1	66	0.179
9	1	58	0.159
5.5	0.5	48	0.130
6.5	0.5	40	0.110
12	0.5	23	0.060

$\text{AgNO}_3 \text{ H}_2\text{O} = 1:2$			
6	0.5	104	0.120
7	0.5	92	0.103
8	0.5	85	0.090
10	0.5	73	0.072
12	0.5	61	0.060
8	0.25	45	0.045
12	0.25	28	0.030

(Lowry, Roy, Soc. Proc. 1914, 91. A. 58.)

Solubility in  $\text{AgNO}_3 + \text{Aq}$  at  $20^\circ$ .  
(Det. by gravimetric method.)

g $\text{AgNO}_3$	g $\text{H}_2\text{O}$	g $\text{AgCl}$ retained per 100 g $\text{AgNO}_3$
220	110	0.1372
220	165	0.1009
220	220	0.0722
220	330	0.0402
220	440	0.0294

(Lowry, Roy Soc Proc 1914, 91. A. 56.)

Insol in  $\text{Na}_2\text{SO}_4 + \text{Aq}$ .Solubility of  $\text{AgCl}$  in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .  
G. formula weights per l.

$\text{SO}_3$	Ag	$\text{SO}_3$	Ag
0.080	0.011	0.483 *	0.059 *
0.106	0.017	0.470	0.070
0.220	0.033	0.652	0.103
0.234	0.036	0.890	0.140
0.478 *	0.057 *	0.937	0.142

\* In presence of 0.05 Cl.

(Luther and Leubner, Z. anorg. 1912, 74. 393.)

Easily sol in  $\text{Na}_2\text{S}_2\text{O}_3$  or  $\text{KCN} + \text{Aq}$ When freshly pptd., very sol. in solutions of soluble thiosulphates, and especially in conc  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , which dissolves  $\text{AgCl}$  almost as readily as  $\text{H}_2\text{O}$  dissolves sugar.  $\text{K}_2\text{S}_2\text{O}_3 + \text{Aq}$ , even when very dil., also dissolves  $\text{AgCl}$ ; also  $\text{SrS}_2\text{O}_3 + \text{Aq}$ . (Herschel, 1819.)Sol. in  $\text{KAsO}_3 + \text{Aq}$ . (Reynoso.)Cold  $\text{NaHSO}_3 + \text{Aq}$  dissolves a considerable amount of  $\text{AgCl}$ . (Rosenheim and Steinhauser, Z. anorg. 1900, 25. 78.)Sol. in cold sat.  $(\text{NH}_4)_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Rosen-

heim and Steinhauser, Z. anorg. 1900, 25. 103.)

Solubility in  $\text{Na thiosulphate} + \text{Aq}$  at  $10^\circ$ .

g. $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ in 100 cc. water	g dissolved $\text{AgCl}$	
	experimental	calculated
2.08	0.29	0.80
4.16	0.64	1.60
6.24	0.88	2.40
8.35	1.26	3.21
16.70	2.54	6.42
20.83	3.28	7.99

(Abney, Z. phys. Ch 1895, 18. 65.)

A solution of  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  containing 200 g  $\text{Na}_2\text{S}_2\text{O}_3$  per liter, dissolves 0.454 g  $\text{AgCl}$  per g. of  $\text{Na}_2\text{S}_2\text{O}_3$  at  $35^\circ$  (Richards and Faber, Am. Ch. J. 1899, 21. 170.)Solubility in salts +  $\text{Aq}$ 

Solvent	% Conc.	Grams $\text{AgCl}$ sol in 100 grams solvent
Sodium thiosulphate	1	0.40
" " "	5	2.00
" " "	10	4.10
" " "	20	6.10
Ammonium thiosulphate	1	0.57
" " "	5	1.32
" " "	10	3.92
Sodium sulphite	10	0.44
" "	20	0.95
Ammonium sulphite	10	Trace
" carbonate	10	0.05
Ammonia + $\text{Aq}$	3	1.40
" "	15	7.58
Magnesium chloride	50	0.50
Potassium cyanide	5	2.75
Ammonium sulphocyanide	5	0.08
" " "	10	0.54
" " "	15	2.88
Potassium " "	10	0.11
Calcium " "	10	0.15
Barium " "	10	0.20
Aluminum " "	10	2.02
Thiocarbamide	10	0.83
Thiourea	1	0.40
" "	5	1.90
" "	10	3.90

(Valenta, M. 1894, 15. 250.)

Solubility in salts +  $\text{Aq}$ .31.71 cc. of a solution of sodium thiosulphate containing 31.869 g.  $\text{Na}_2\text{S}_2\text{O}_3$  per liter (i. e. 5 g. of the hydrate in 100 cc. of the solution) dissolve 0.6124 g.  $\text{AgCl}$ .21.88 cc. of a solution of ammonium thiosulphate containing 50 g.  $(\text{NH}_4)_2\text{S}_2\text{O}_3$  per liter dissolve 0.7024 g.  $\text{AgCl}$ .27.34 cc. of a solution of potassium cyanide containing 49.511 g.  $\text{KCN}$  per liter dissolve

14926 g. AgCl (Cohn, Z. phys. Ch. 1895, 18, 63.)

Solubility of AgCl in sodium thiosulphate and potassium cyanide solutions may be determined without inference to experimental date. (Cohn.)

Sl. sol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20, 829.)

Insol. in moderately dil  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$   
10 cem normal  $\text{Hg}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  containing 0.1 g. Hg dissolve 0.01892 g. AgCl at 15°.

(Stas)  
100 cem. of a solution of a mixture of Na and Hg acetates dissolve 0.00175 g. AgCl (Stas, A. ch. (5) 3, 145.)

Only sl. sol in liquid  $\text{NH}_3$ .

Solubility curve for AgCl, AgCl,  $3\text{NH}_3$ , AgCl,  $5\text{NH}_3$ . (Jarry, A. ch 1899, 17, 342.)

Insol in alcoholic ammonia. (Bodländer, Z. phys. Ch. 1892, 9, 731.)

Nearly insol in ether (Mylus and Huttner, B 1911, 44, 1316.)

Perceptibly sol. on warming with solution of tartaric acid, but nearly the whole is deposited on cooling.

Insol. in acetone. (Naumann, B 1904, 37, 4329); insol in acetone and in methylal. (Eidmann, C. C. 1899, II 1014.)

Insol. in methyl acetate. (Bezold, Dissert 1906; Naumann, B 1909, 42, 3790.)

Insol. in ethyl acetate. (Hamers, Dissert 1906; Naumann, B. 1910, 43, 314.)

Sol. in methylamine + Aq. (Wurtz, A. ch (3) 30, 453.)

Solubility of AgCl in methylamine at 11.5°.

% $\text{CH}_3\text{NH}_2$	% AgCl	% $\text{CH}_3\text{NH}_2$	% AgCl
1.78	0.16	13.70	3.29
4.44	0.62	18.69	5.43
5.51	0.83	36.69	9.93
7.66	1.32		

(Jarry, A. ch. 1899, (7) 17, 342.)

Solubility in methylamine + Aq at 25°.

G. mols. per l.

$\text{CH}_3\text{NH}_2$	AgCl
0.0200	0.000800
0.0400	0.000370
0.0740	0.000424
0.0947	0.000447
0.1950	0.000481

(Wurtz, B. 1902, 35, 2416.)

Solubility in methylamine + Aq at t°.

G. mols. per l.

t°	$\text{CH}_3\text{NH}_2$	Ag
18	0.93	0.0315
25	0.93	0.0338
25	0.93	0.0335

(Euler, B. 1903, 36, 2880.)

At 25°, 1 l. methylamine + Aq, containing 1.017 g. mols.  $\text{CH}_3\text{NH}_2$ , dissolves 0.0387 g. mol. AgCl; 0.508 g. mol.  $\text{CH}_3\text{NH}_2$ , 0.0178 g. mol. AgCl. (Bodländer and Eberlein, B. 1903, 36, 3943.)

Solubility in methylamine + Aq at 25°.  
G. mols. per l.

$\text{C}_2\text{H}_5\text{NH}_2$	AgCl
0.01273	0.000114
0.03942	0.000156
0.05512	0.000235
0.05572	0.000312
0.10300	0.000824

(Wurtz, B 1902, 35, 2416.)

Solubility in ethylamine + Aq at t°.  
G. mols. per l.

t°	$\text{C}_2\text{H}_5\text{NH}_2$	Ag
18	0.094	0.00458
25	0.093	0.00474
25	0.094	0.00478
18	0.236	0.0132
25	0.234	0.0136
18	0.462	0.0251

(Euler, B 1903, 36, 2880.)

At 25°, 1 l. ethylamine + Aq, containing 0.483 g. mol.  $\text{C}_2\text{H}_5\text{NH}_2$ , dissolves 0.0314 g. mols. AgCl; 0.200 g. mol.  $\text{C}_2\text{H}_5\text{NH}_2$ , 0.0115 g. mol. AgCl; 0.100 g. mol.  $\text{C}_2\text{H}_5\text{NH}_2$ , 0.0062 g. mol. AgCl. (Bodländer and Eberlein.)

Sol in alylamine + Aq, but less than in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Sol in caprylamine + Aq

Easily sol on warming in ethylene diamine + Aq (Kurnakow, Z. anorg. 1898, 17, 220.)

Easily sol in alcoholic solution of thiocetamide. (Kurnakow, J. pr 1895, (2) 51, 251.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Solubility in pyridine at t°.

t°	g AgCl sol. in 100 g pyridine	Solid phase
-52	0.70	AgCl, $2\text{C}_2\text{H}_5\text{N}$
-49	0.77	
-35	0.99	
-30	1.36	
-25	1.80	
-22	2.20	
transition point	2.75	
-20	3.71	AgCl, $\text{C}_2\text{H}_5\text{N}$
-18	3.85	
-10	4.35	
-5	5.05	
-1	5.60	

Solubility in pyridine at  $t^\circ$ .—*Continued*

$t^\circ$	g AgCl sol in 100 g pyridine	Solid phase
transition point		
0	5.35	AgCl
10	3.17	
20	1.91	
30	1.20	
40	0.80	
50	0.53	
60	0.103	
70	0.32	
80	0.25	
90	0.22	
100	0.18	
110	0.12	

(Kahlenberg, J. phys. Chem. 1900, 13, 423.)

Easily sol. in warm piperidine. (Varet, C. R. 1892, 115, 335.)

Mol. wt. determined in piperidine. (Werner, Z. anorg. 1897, 15, 16.)

Quinoline dissolves traces of AgCl. (Varet, C. R. 1893, 116, 60.)

As sol. in conine + Aq as in  $\text{NH}_4\text{OH} + \text{Aq}$  (Blyth, Chem. Soc. 1, 350.)Sol. in sinamine, and thosinamine + Aq. Min. *Cerargyre*.Silver chloride ammonia,  $\text{AgCl} \cdot 2\text{NH}_3$ .Decomp. by  $\text{H}_2\text{O}$  (Terrel, A. Phys. Beibl. 7, 149.) $2\text{AgCl} \cdot 3\text{NH}_3$ . Decomp. on air and in  $\text{H}_2\text{O}$  to AgCl. Sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ , from which it can be crystallised (Rose.)

Insol. in alcohol (Bodlander, Z. phys. Ch. 9, 730.)

 $\text{AgCl} \cdot 3\text{NH}_3$ . More easily decomp. than  $2\text{AgCl} \cdot 3\text{NH}_3$ .Sl. sol. in liquid  $\text{NH}_3$ . (Jarry, A. ch. 1899, (7) 17, 343.) $\text{AgCl} \cdot 5\text{NH}_3$ . Sl. sol. in liquid  $\text{NH}_3$ . (Jarry, A. ch. 1899, (7) 17, 336.)

Silver chlorobromoidides.

(Rodwell, Proc. Roy. Soc. 25, 202.)

Silver subfluoride (argentous fluoride),  $\text{Ag}_2\text{F}$ Decomp. by  $\text{H}_2\text{O}$  into Ag and AgF. (Guntz, C. R. 110, 1337.)Decomp. by  $\text{H}_2\text{O}$ .

Insol. in abs. alcohol, ether, acetone and xylene. (Wöhler and Rodewald, Z. anorg. 1909, 61, 63.)

Decomp. by  $\text{H}_2\text{O}$  until the solution contains 64.5% AgF, independent of temp. (Guntz, C. R. 1913, 167, 981.)

Silver fluoride, AgF.

Extremely deliquescent. (Gore.)

Sol. in 0.55 pt.  $\text{H}_2\text{O}$  at  $15.5^\circ$  with evolution of heat. Sp. gr. of sat. solution at  $15.5^\circ = 2.61$ . (Gore.)Solubility of AgF in  $\text{H}_2\text{O}$  at  $t^\circ$ .  
G. per 100 g.  $\text{H}_2\text{O}$ .

$t^\circ$	AgF	Solid phase
-14.2	60	$\text{Ice} + \text{AgF} \cdot 4\text{H}_2\text{O}$
+18.5	165	$\text{AgF} \cdot 4\text{H}_2\text{O}$
18.65	169.5	" + AgF, $2\text{H}_2\text{O}$
20	172	$\text{AgF} \cdot 2\text{H}_2\text{O}$
24	178	"
25	179.5	"
28.5	215	"
32	193	"
39.5	222	$\text{AgF} \cdot 2\text{H}_2\text{O} + \text{AgF}$
108	205	$\text{AgF}$

(Guntz, A. ch. 1914, (9) 2, 101.)

Sp. gr. AgF + Aq at  $18^\circ$ .

% AgF	Sp. gr.
7.20	1.07
29.00	1.38
49.20	1.82
56.40	2.09
66.20	2.62

(Guntz, A. ch. 1914, (9) 2, 104.)

Data on solubility of AgF in  $\text{HF} + \text{Aq}$  are given by Guntz (l. c.).Sl. sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 829.)+  $\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Guntz, A. ch. 1914, (9) 2, 101.)+  $2\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$  (Guntz)+  $4\text{H}_2\text{O}$ . Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Guntz)+  $1/3 \text{H}_2\text{O}$ . Unstable in the presence of crystals of  $\text{AgF} + 2\text{H}_2\text{O}$  (Guntz, A. ch. 1914, (9) 2, 101.)

Silver hydrogen fluoride, AgF, HF.

(Guntz.)

AgF, 3HF. Very unstable.

Sol. in HF. (Guntz, Bull. Soc. 1895, (3) 13, 114.)

Silver stannic fluoride.

See Fluostannate, silver.

Silver tungstyl fluoride.

See Fluoxtungstate, silver.

Silver, fulminating.

See Silver nitride.

Silver hydride,  $\text{AgH}$ .Not decomp. by  $\text{H}_2\text{O}$ . (Bartlett, Am. Ch. J. 1896, 19, 52.)Argentous hydroxide,  $\text{Ag}_2\text{O} \cdot \text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . Known only in solution. (Weltzein, A. 142, 105.)

Silver hydroxide, AgOH.

Decomp. into  $\text{Ag}_2\text{O}$  and  $\text{H}_2\text{O}$  above  $-40^\circ$ . See Silver oxide.

Argentous iodide,  $\text{Ag}_2\text{I}$   
(Guntz, C. R. 112. 861)

Silver imidosulphamide,  $\text{AgN}(\text{SO}_2\text{NH}_2)_2 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Decomp slowly in the air. Somewhat sol in hot, more sol in boiling  $\text{H}_2\text{O}$ , from which it crystallizes unchanged on cooling. In aqueous solution is stable toward alkali. Decomp. by acids. Difficultly sol. in dry pyridine, easily sol. in pyridine + Aq. (Hantzsch, B. 1905, 38. 1035)

$(\text{SO}_2)_2\text{N}_2\text{H}_4\text{Ag}_2 + 5\frac{1}{2}\text{H}_2\text{O}$ . Nearly insol. in hot  $\text{H}_2\text{O}$ . (Ephraim and Michel, B. 1909, 42. 3845)

$(\text{SO}_2)_2\text{N}_2\text{H}_4\text{Ag}_2 + 4\text{H}_2\text{O}$ . (Ephraim and Michel)

$(\text{SO}_2)_2\text{N}_2\text{H}_4\text{Ag}_2 + 1\frac{1}{2}$ , 11, and 28  $\text{H}_2\text{O}$   
Easily sol. in  $\text{HNO}_3$  and  $\text{NH}_4\text{OH}$  + Aq. Sol. in pyridine. Very sol. in pyridine containing pyridine nitrate and can be recryst. therefrom. (Ephraim and Michel)

$(\text{SO}_2)_2\text{N}_2\text{H}_4\text{Ag}_2 + 8\text{H}_2\text{O}$ . (Ephraim and Michel)

Silver iodide,  $\text{AgI}$ .

Insol in  $\text{H}_2\text{O}$

Calculated from electrical conductivity of  $\text{AgI}$  + Aq,  $\text{AgI}$  is sol. in 1,074,040 pts  $\text{H}_2\text{O}$  at  $25.4^\circ$ , and 420, 260 pts at  $40^\circ$  (Holleman, Z. phys. Ch. 12. 130.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.1 mg  $\text{AgI}$  at  $18^\circ$  (Kohlrausch and Rose, Z. phys. Ch. 12. 241)  
Solubility in  $\text{H}_2\text{O} = 1 \times 10^{-4}\text{N}$ . (Rolla.)

Solubility in  $\text{H}_2\text{O} = 0.97 \times 10^{-8}$  g. mols. per l. at  $25^\circ$ . (Goodwin, Z. phys. Ch. 1894, 13. 645.)

Solubility of  $\text{AgI}$  in  $\text{H}_2\text{O}$  at  $25^\circ$  is  $1.05 \times 10^{-8}$  (in normality). (Thiel, Z. anorg. 1900, 24. 57)

A sat aq solution at  $20.8^\circ$  contains 0.0020  $\times 10^{-4}$  g. equiv per l. (Kohlrausch, C. C. 1901, II. 1299.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0035 mg.  $\text{AgI}$  at  $21^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.00253 mg.  $\text{AgI}$  at  $60^\circ$ . (Semmet, Z. phys. Ch. 1905, 53. 644.)

Solubility in  $\text{H}_2\text{O} = 1.23 \times 10^{-8}$  g.-mol. per litre at  $25^\circ$ . (A. E. Hill, J. Am. Chem. Soc. 1908, 30. 74.)

0.003 mg. are contained in 1 l. of sat. solution at  $21^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Insol. in dil  $\text{HNO}_3$  + Aq or  $\text{H}_3\text{PO}_4$  + Aq  
Decomp by hot, conc.  $\text{HNO}_3$  + Aq or  $\text{H}_2\text{SO}_4$   
Easily sol in conc.  $\text{HI}$  + Aq

1 pt.  $\text{AgI}$  dissolves in 2510 pts.  $\text{NH}_4\text{OH}$  + Aq of 0.96 sp. gr (Martini, Schw. J. 56. 154); in 2483 pts. of 0.89 sp. gr. (Wallace and Lamont, Ch. Gaz. 1859. 137.)

1 g  $\text{AgI}$  dissolves in 26,300 g. 10%  $\text{NH}_4\text{OH}$  + Aq (sp. gr = 0.96) at  $12^\circ$ . Insol. in 5%  $\text{NH}_4\text{OH}$  + Aq. (Longi, Gazz. ch. it. 13. 87.)

Coefficient of solubility in  $\text{NH}_4\text{OH}$  + Aq (density, 0.926) is found lower than previously obtained and of the order of  $\frac{1}{10000}$  at  $16^\circ$ . (Baubigny, Bull. Soc. 1908, (4) 3. 772.)

According to Field, insol. in cold conc.  $\text{KCl}$  or  $\text{NaCl}$  + Aq, and only in traces on boiling, and separates out on cooling.

100 g.  $\text{NaCl}$  in conc.  $\text{NaCl}$  + Aq dissolve 0.95 mg  $\text{AgI}$  at  $15^\circ$ ; 100 g.  $\text{NH}_4\text{Cl}$  in conc.  $\text{NH}_4\text{Cl}$  + Aq dissolve 2.9 mg.  $\text{AgI}$  at  $15^\circ$ ; 95 g.  $\text{NaCl}$  + 10 g.  $\text{KBr}$  in conc. solution dissolve 1.2 mg  $\text{AgI}$  at  $15^\circ$ ; 100 g.  $\text{KBr}$  + 225 g.  $\text{H}_2\text{O}$  dissolve 430 mg  $\text{AgI}$  at  $15^\circ$ ; 100 g.  $\text{KBr}$  in conc.  $\text{KBr}$  + Aq dissolve 525 mg.  $\text{AgI}$  at  $15^\circ$ ; 100 g.  $\text{KI}$  + 69 g.  $\text{H}_2\text{O}$  dissolve 89.8 g.  $\text{AgI}$  at  $15^\circ$ ; 100 g.  $\text{KI}$  + 92 g.  $\text{H}_2\text{O}$  dissolve 54.0 g.  $\text{AgI}$  at  $15^\circ$ ; 100 g.  $\text{KI}$  + 366 g.  $\text{H}_2\text{O}$  dissolve 7.25 g.  $\text{AgI}$  at  $15^\circ$ . (Schieberholz, W. A. B. 101, 2b. 4)

Sol. in conc.  $\text{KI}$  + Aq, from which it is precipitated by  $\text{H}_2\text{O}$  (Field, C. N. 3. 17)

$\text{KI}$  gives a ppt. with  $\text{AgNO}_3$  in presence of 30,000 pts.  $\text{H}_2\text{O}$  (Harting)

#### Solubility in $\text{KI}$ + Aq at $15^\circ$

% KI	% AgI	% KI	% AgI
59.16	53.13	33.3	7.33
57.15	40	25.0	2.75
50.0	25.0	21.74	1.576
40.0	13.0	20	0.80

(Schieberholz, W. A. B. 1890, 101. 2b. 10.)

#### Solubility in $\text{KI}$ + Aq at $25^\circ$

Mol KI per l.	g AgI per l.
1.937	46.42
1.6304	24.01
1.482	15.46
1.406	12.55
1.018	3.47
1.008	3.32
0.734	1.092
0.586	0.512
0.335	0.0853

Hellwig, Z. anorg 1900, 25. 180.)

#### Solubility in $\text{KI}$ + Aq.

$t = 50^\circ$		
% AgI	% KI	Solid phase
2.5	24.8	$\text{AgI}$
16.0	33.8	"
28.0	36.7	"
39.0	38.1	"
51.8	36.2	"
53.5	36.5	"
53.5	36.6	$\text{AgI}$ + $\text{AgI}$ , $\text{KI}$
53.5	37.1	$\text{AgI}$ , $\text{KI}$
53.4	37.6	$\text{KI}$ + $\text{AgI}$ , $\text{KI}$
50.4	40.2	"
45.0	43.2	"
38.0	47.1	"
22.8	55.5	"
10.7	59.1	"

t = 30°		
% AgI	% KI	Solid phase
0.1	10.2	AgI
10.0	31.4	"
29.4	37.6	"
42.8	38.8	"
49.7	38.6	AgI + AgI, 2KI
49.6	39.5	AgI, 2KI
47.7	40.9	"
46.3	41.4	"
44.1	43.2	AgI, 2KI + KI
42.8	43.0	KI
35.8	46.9	"
16.0	55.5	"
0	60.35	"

t = 0°		
% AgI	% KI	Solid phase
0.2	0.8	AgI
1.5	20.5	"
6.5	26.1	"
26.6	34.6	"
28.1	36.4	"
38.0	41.3	AgI + AgI, KI
37.9	42.0	AgI, KI
37.6	42.7	"
37.9	44.0	AgI, KI + KI
31.3	46.6	KI
21.7	50.5	"
18.0	51.2	"
9.0	53.0	"
0	56.1	"
27.5	48.7	AgI, 2KI + KI
21.0	50.3	AgI, 2KI

(Van Dam and Donk, Chem Weekbl 1911, 8, 848.)

Very sol. in KI + Aq (Muth, Dissert. 1895)  
 Very sol. in H<sub>2</sub>O in presence of NaI (Kurnakow, Ch. Z. 1900, 24, 60.)

#### Solubility in KI + Aq at 15°.

Composition of the sat. solution in mols. per 1000 mols. H <sub>2</sub> O		Solid phase
Mols. Na <sub>2</sub> I <sub>2</sub>	Mols. AgI <sub>2</sub>	
35.63	8.14	AgI
40.54	10.94	"
61.55	25.15	"
80.55	38.19	"
94.25	47.79	"
107.52	57.52	AgI + AgI, NaI, 3 1/2 H <sub>2</sub> O
117.96	51.70	AgI, NaI, 3 1/2 H <sub>2</sub> O
124.40	46.82	"
135.83	46.36	AgI, NaI, 3 1/2 H <sub>2</sub> O + NaI
133.81	43.03	NaI
129.02	34.85	"
122.56	22.82	"
117.11	11.93	"
111.52	...	"

(Krym, J. Russ. Phys. Chem. Soc 1909, 41, 382.)

Traces are dissolved by alkali nitrates + Aq. Easily sol. in hot KOH + Aq, from which it is pptd. by H<sub>2</sub>O or alcohol. Not decomp. by boiling KOH + Aq. (Vogel, N. Rep. Pharm. 20, 129.)

100 pts. of AgNO<sub>3</sub> + Aq sat. at 11° dissolve 2.3 pts. AgI in the cold, and 12.3 pts. on boiling (Schnauss.)

#### Solubility of AgI in AgNO<sub>3</sub> + Aq at 25°.

Mol AgNO <sub>3</sub> in 1 l.	g AgI in 1 l.	Solid phase
0.20	0.0680	AgI
0.25	0.080	
0.30	0.090	
0.35	0.125	
0.40	0.167	
0.45	0.224	
0.50	0.299	
0.55	0.400	
0.60	0.528	
0.65	0.672	
0.70	0.850	
1.215	3.08	Ag <sub>2</sub> INO <sub>3</sub>
1.63	6.26	
2.04	10.90	
2.54	16.1	Ag <sub>2</sub> I(NO <sub>3</sub> ) <sub>2</sub>
3.115	22.7	
3.75	33.2	
4.055	40.0	
4.69	53.2	
5.90	85.0	

(Heliwig, Z. anorg 1900, 25, 171.)

Solubility of AgI in 25% AgNO<sub>3</sub> + Aq reaches a maximum at about 60° and at the point of maximum solubility the quantity dissolved amounts to about 5 g. AgI per 100 g. AgNO<sub>3</sub>. (Lowry, Roy. Soc. Proc. 1914, 91, A, 66.)

Sol. in hot Hg(NO<sub>3</sub>)<sub>2</sub> + Aq, from which it crystallizes on cooling.

#### Solubility of AgI in Hg(NO<sub>3</sub>)<sub>2</sub> + Aq at 25°.

Mols Hg(NO <sub>3</sub> ) <sub>2</sub> per l.	g AgI per l.	Mols Hg(NO <sub>3</sub> ) <sub>2</sub> per l.	g AgI per l.
0.010	0.800	0.050	1.737
0.0125	0.841	0.100	2.730
0.025	1.118	1.000	25.160

Solubility is not affected by presence of 0.1 to 2N HNO<sub>3</sub>.

(Morse, Z. phys. Ch. 1902, 41, 708.)

Sol. in KCN + Aq.

Sl. sol. in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq when suspended in much H<sub>2</sub>O, but separates again on addition of KI + Aq. (Field.)

Insol. in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq. (Fogh, C. R. 1890, 110, 711.)

## Solubility in salts + Aq

Solvent	% Conc	grams AgI sol in 100 grams solvent
Sodium thiosulphate	1	0.03
" " "	5	0.15
" " "	10	0.30
" " "	15	0.40
" " "	20	0.60
Sodium sulphate	10	0.01
" " "	20	0.02
Ammonium sulphate	10	Traces
Potassium cyanide	5	8.23
Ammonium sulphocyanide	5	0.02
" " "	10	0.08
" " "	15	0.13
Potassium " " "	10	0.03
Calcium " " "	10	0.02
Barium " " "	10	0.02
Aluminium " " "	10	0.79
Thiocarbamide	1	0.008
Thioacetamide	5	0.05
" " "	10	0.09

(Valenta, M 1894, 15, 250.)

Very sol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20, 829; Jarry, A. ch. 1899, (7) 17, 370.)

Easily sol. in liquid  $\text{NH}_3$ . (Ruff and Giesel, B. 1905, 38, 2862.)

Insol. in acetone (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37, 4329.)

Insol. in methyl acetate. (Bezold, Dissert. 1906; Naumann, B. 1909, 42, 3790.)

Insol. in  $\text{CS}_2$  (Aicowski, Z. anorg. 1894, 6, 287.)

Much less sol. in hot alcoholic thiourea than  $\text{AgCl}$  and  $\text{AgBr}$  (Reynolds, Chem Soc 1892, 61, 253.)

Insol. in benzonitrile (Naumann, B. 1914, 47, 1370.)

Slowly sol. in piperidine at  $100^\circ$  (Varet, C. R. 1892, 115, 336.)

0.10 pts. is sol. in 100 pts. pyridine at  $10^\circ$ . 8.60 pts. are sol. in 100 pts. pyridine at  $121^\circ$ . (Laszczyński, B. 1894, 27, 2288.)

Mol. wt determined in piperidine (Werner, Z. anorg. 1897, 15, 16.)

Min Iodhydrate.

Silver hydrogen iodide,  $3\text{AgI}, \text{HI} + 7\text{H}_2\text{O}$ .

(Berthelot, C. R. 91, 1024.)

Silver sodium iodide,  $2\text{AgI}, \text{NaI}$ .

Very sol. in acetone. (Marsh, Chem. Soc 1913, 103, 784.)

$\text{AgI}, \text{NaI} + 3\frac{1}{2}\text{H}_2\text{O}$ . (Krym, J. Russ. Phys. Chem. Soc. 1909, 41, 382.)

See  $\text{AgI} + \text{NaI}$  under  $\text{AgI}$ .

Silver iodide ammonia,  $\text{AgI}, \text{NH}_3$ .

Sol. in liquid  $\text{NH}_3$ . (Jarry, A. ch. 1899, (7) 17, 371.)

$2\text{AgI}, \text{NH}_3$ . (Rammelsberg, Pogg. 48, 170.)

Composition as  $\text{AgI}, \text{NH}_3$ . (Longi, Gazz. ch. it. 13, 86.)

Sol. in liquid  $\text{NH}_3$ . (Jarry, A. ch. 1899, (7) 17, 371.)

$\text{AgI}, 2\text{NH}_3$ . (Terreil, C. R. 98, 1279.)

Silver nitride,  $\text{Ag}_3\text{N}$

Berthollet's "knallsilber." Very explosive.

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{KCN} + \text{Aq}$ . Slowly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Raschig, A. 233, 93.)

(Angeh, Chem Soc 1894, 66, (2) 93.)

Argentous oxide,  $\text{Ag}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids into argentic oxide and silver. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  or  $\text{HC}_2\text{H}_3\text{O}_2$ . (v. der Pfordten, B. 20, 1458.)

Contains  $\text{H}_2$  and is a hydroxide  $\text{Ag}_4\text{H}_2\text{O}$ . (v. der Pfordten, B. 21, 2288.)

The above substance is a mixture, according to Friedheim (B. 20, 2557.)

Silver oxide,  $\text{Ag}_2\text{O}$ .

Somewhat sol. in  $\text{H}_2\text{O}$  (Bucholz.)

Sol. in 3000 pts  $\text{H}_2\text{O}$  (Bineau, C. R. 41, 600); sol. in 90 pts.  $\text{H}_2\text{O}$  (Albi)

Sol. in 15,360 pts.  $\text{H}_2\text{O}$ . (Levi, Gazz. ch. it. 1901, 31, (1) 1.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 2.16 \times 10^{-4}$  mols.  $\text{AgOH}$  per litre (Noyes, J. Am. Chem. Soc. 1902, 24, 1147.)

1 liter sat. aqueous solution at  $19.99^\circ$  contains  $2.14 \times 10^{-2}$  g.; at  $24.94^\circ$  contains  $2.5 \times 10^{-2}$  g.  $\text{Ag}_2\text{O}$ . (Böttger, Z. phys. Ch. 1903, 46, 603.)

1 l.  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves  $1.8 \times 10^{-4}$  gram-atoms of silver. Determined from its solubility in  $\text{NH}_3$ . (Abegg and Cox, Z. phys. Ch. 1903, 46, 11.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0215 g.  $\text{Ag}_2\text{O}$  at  $20^\circ$ . (Whitby, Z. anorg. 1910, 67, 108.)

The solubility of  $\text{Ag}_2\text{O}$  in  $\text{H}_2\text{O}$  varies with the method of preparation.

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of  $\text{NaOH}$ , freshly prepared by the solution of  $\text{Na}$  in  $\text{H}_2\text{O}$ , on a dil. solution of  $\text{AgNO}_3$ ) =  $2.16 \times 10^{-4}$  g.-mol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ ;  $2.97 \times 10^{-4}$  g.-mol. at  $50^\circ$

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of aqueous barium hydroxide on  $\text{AgNO}_3$ ) =  $2.23 \times 10^{-4}$  g.-mol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ ;  $3.09 \times 10^{-4}$  g.-mol. in 1 l.  $\text{H}_2\text{O}$  at  $50^\circ$ .

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of conc.  $\text{NaOH} + \text{Aq}$  on moist, freshly pptd.  $\text{AgCl}$ ) =  $2.32 \times 10^{-4}$  g.-mol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ ;  $3.55 \times 10^{-4}$  g.-mol. at  $50^\circ$ .

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of conc.  $\text{NaOH} + \text{Aq}$  on moist, freshly pptd.  $\text{Ag}_2\text{CO}_3$ ) =  $2.95 \times 10^{-4}$  g.-mol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ ;  $3.89 \times 10^{-4}$  g.-mol. at  $50^\circ$  (Rebière, Bull. Soc 1915, (4) 7, 311.)

Sol. in acids,  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Decomp. by alkali chlorides, bromides,

and iodides + Aq. Sol. in alkali cyanides, and thiosulphates + Aq. Sl. sol. in nitrates + Aq; insol. in sulphates + Aq. When freshly pptd., sol. in  $\text{NH}_4\text{SCN}$  + Aq. Sl. sol. in  $\text{NH}_4\text{NO}_3$  + Aq. Abundantly sol. in  $\text{Ba}(\text{NO}_3)_2$  + Aq without pptn of  $\text{BaO}_2\text{H}_2$ . Sol. in boiling  $\text{Mn}(\text{NO}_3)_2$ ,  $\text{Ni}(\text{NO}_3)_2$ ,  $\text{Co}(\text{NO}_3)_2$ ,  $\text{Cu}(\text{NO}_3)_2$ , and  $\text{Ca}_2(\text{NO}_3)_6$  + Aq with pptn of oxides. (Persoz.)

Insol. in KOH, and NaOH + Aq. Sl. sol. in  $\text{BaO}_2\text{H}_2$  + Aq. (Berzelius (?)).

Solubility in  $\text{NH}_4\text{OH}$  + Aq at 25°.

G at. Ag per l	Mol $\text{NH}_3$ per l
0.0654	0.214
0.0658	0.220
0.134	0.458
0.140	0.469
0.205	0.671
0.205	0.684
0.225	0.720
0.224	0.733
0.251	0.811
0.248	0.827
0.242	0.830
0.257	0.876
0.278	0.899
0.276	0.915
0.299	0.999
0.343	1.147
0.454	1.498
0.470	1.522

(Whitney and Melcher, J. Am. Chem. Soc. 1903, 25. 78.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. ch. J. 1898, 20. 829.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014); (Naumann, B. 1904, 37. 4329.)

Insol. in ethyl acetate. (Hamers, Dissert. 1906; Naumann, B. 1910, 43. 314.)

Sl. sol. in amylamine + Aq, easily in methylamine + Aq (Wurtz, A. ch. 30. 453); also in ethylamine, and thioaniline + Aq.

Solubility in methylamine + Aq. at 18°.

G. mols. per l.

$\text{CH}_3\text{NH}_2$	Ag
0.1	0.0221
0.5	0.118
1.0	0.228

(Euler, B. 1903, 36. 2879)

Solubility in ethylamine + Aq at 18°.

G. mols. per l.

$\text{C}_2\text{H}_5\text{NH}_2$	Ag
0.1	0.0322
0.5 (interpolated)	0.160
1.0	0.314
0.561	0.180
0.927	0.291

(Euler.)

Silver peroxide,  $\text{Ag}_2\text{O}_2$

Sol. in conc.  $\text{H}_2\text{SO}_4$  (Rose), and in pure  $\text{HNO}_3$  + Aq without decomp. Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Schonbein, J. pr. 41. 321.)

Sol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  with decomp. (Mulder, R. t. c. 1898, 17. 151.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

Silver oxide ammonia.

See Silver nitride.

Silver oxybromide,  $\text{Ag}_2\text{OBr}_7$ .

Insol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HNO}_3$ . Sol. in hot ammonia and in  $\text{NaOCl}$  + Aq. (Seyewetz, C. R. 1912, 154. 357.)

Silver oxyfluoride,  $\text{AgF}$ ,  $\text{AgOH}$ .

Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{Ag}_2\text{O}$ . (Pfaundler.)

Silver peroxyfluoride,  $2\text{Ag}_2\text{O}_4$ ,  $\text{AgF}$ .

(Tanatar, Z. anorg. 1901, 28. 335.)

$4\text{Ag}_2\text{O}_4$ ,  $3\text{AgF}$  (Tanatar, Z. anorg. 1901, 28. 335.)

Silver oxyiodide,  $\text{Ag}_2\text{O}$ ,  $\text{AgI}$ .

(Seyewitz, Bull. Soc. 1894, (3) 11. 452.)

Silver phosphide,  $\text{Ag}_3\text{P}_2$ .

Sol. in  $\text{HNO}_3$ . Attacked by aqua regia. (Granger, C. R. 1897, 124. 897.)

$\text{Ag}_3\text{P}_2$ . Insol. in  $\text{HCl}$  + Aq; easily sol. in  $\text{HNO}_3$  + Aq. (Schrotter, J. B. 1849. 247.)

$\text{Ag}_3\text{P}_2$ . (Hackspall, C. R. 1913, 157. 720.)

$\text{Ag}_3\text{P}$  (?). (Fresenius and Neubauer, Z. anal. 1. 340.)

Silver phosphoselenide,  $\text{Ag}_3\text{Se}$ ,  $\text{P}_2\text{Se}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl}$  + Aq. Sol. in  $\text{HNO}_3$  + Aq. Insol. in cold, decomp. by hot alkalies + Aq. (Hahn, J. pr. 93. 436.)

$2\text{Ag}_3\text{Se}$ ,  $\text{P}_2\text{Se}_3$ . Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{HNO}_3$  + Aq; slowly sol. in red fuming  $\text{HNO}_3$ . (Hahn, J. pr. 93. 440.)

$2\text{Ag}_3\text{Se}$ ,  $\text{P}_2\text{Se}_4$ . Sol. only in fuming  $\text{HNO}_3$ . (Hahn.)

Silver phosphosulphide,  $2\text{Ag}_2\text{S}$ ,  $\text{P}_2\text{S}$ .

$\text{Ag}_2\text{S}$ ,  $\text{P}_2\text{S}$  (Berzelius, A. 46. 254.)

$2\text{Ag}_2\text{S}$ ,  $\text{P}_2\text{S}_3$ . Easily sol. in  $\text{HNO}_3$  + Aq without separation of P. (Berzelius.)

$\text{Ag}_2\text{P}_2\text{S}_7$ . (Berzelius.)

$\text{Ag}_2\text{P}_2\text{S}_7$ . Easily attacked by hot conc.  $\text{HCl}$ . Sl. decomp. Insol. in hot  $\text{HNO}_3$ . Decomp. by aqua regia. (Ferrand, A. ch. 1899, (7) 17. 413.)

Silver selenide,  $\text{Ag}_2\text{Se}$ .

Sol. in boiling  $\text{HNO}_3$  + Aq as  $\text{Ag}_2\text{SeO}_3$ , which separates out by dilution with  $\text{H}_2\text{O}$ . (Berzelius.)

Insol. in  $\text{Hg}_2(\text{NO}_3)_2$  + Aq. (Wackenroder, A. 41. 327.)

Min *Naumannite*. Insol. in dil., but sol. in conc.  $\text{HNO}_3 + \text{Aq.}$

Silver sulphamide (silver thionyl amide),  $\text{SO}_2(\text{NHAg})_2$

Insol. in pyridine (Hantzsch and Holl, B. 1901, 34, 3436)  
+  $\text{H}_2\text{O}$ . (Ephraim and Gurevitch, B. 1910, 43, 146.)

Argentous sulphide,  $\text{Ag}_2\text{S}$

Easily sol. in warm dil.  $\text{HNO}_3 + \text{Aq.}$  and in conc.  $\text{H}_2\text{SO}_4$  without separation of S. Sol. in conc.  $\text{KCN} + \text{Aq.}$  (v der Pfordten, B. 20, 1453, Guntz, C. R. 112, 861.)

Silver sulphide,  $\text{Ag}_2\text{S}$ .

Less sol. in  $\text{H}_2\text{O}$  than  $\text{AgI}$ . (Lucas, Z. anorg. 1904, 41, 210)

1 l.  $\text{H}_2\text{O}$  dissolves about  $4 \times 10^{-11}$  g. at  $\text{Ag}_2\text{S}$  at  $18^\circ$ . (Bernfeld, Z. phys. Ch. 1898, 25, 72.)

1 l.  $\text{H}_2\text{O}$  dissolves  $0.8 \times 10^{-6}$  g. mols at  $16-18^\circ$ . (Biltz, Z. phys. Ch. 1907, 58, 291.)

1 l.  $\text{H}_2\text{O}$  dissolves  $0.552 \times 10^{-6}$  g. mols.  $\text{Ag}_2\text{S}$  at  $18^\circ$  (Weigel, Z. phys. Ch. 1907, 58, 294)

Sol. in conc.  $\text{HNO}_3 + \text{Aq.}$  with separation of S. Sol. in hot conc.  $\text{HCl} + \text{Aq.}$  Not decomp. by  $\text{CuCl}_2 + \text{Aq.}$  but by  $\text{CuCl}_2 + \text{NaCl} + \text{Aq.}$  Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Insol. in  $\text{H}_2\text{SO}_4 + \text{Aq.}$  or in  $\text{Hg}(\text{NO}_3)_2 + \text{Aq.}$

Insol. in  $\text{H}_2\text{O}$ , dil. acids, alkalies, and alkali sulphides +  $\text{Aq.}$  (Fresenius)

Sol. in  $\text{HCN} + \text{Aq.}$  (Hahn, C. C. 1870, 240)

Pptd.  $\text{Ag}_2\text{S}$  is very sol. in  $\text{HNO}_3$  containing more than 5%  $\text{HNO}_3$ . (Gruener, J. Am. Chem. Soc. 1910, 32, 1032)

Only very sl. sol. in  $\text{AgNO}_3 + \text{Aq.}$  even at  $100^\circ$ . (Lowry, Roy. Soc. Proc. 1914, 91, A 70)

Sol. in  $\text{KCN} + \text{Aq.}$  (Hahn, C. C. 1870, 240)

Difficultly sol. in  $\text{KCN} + \text{Aq.}$ ; less difficultly if  $\text{Ag}_2\text{S}$  is pptd. from a very dil. solution. Amt. of  $\text{KCN}$  present also has influence on the solubility.  $\text{Ag}_2\text{S}$  dissolved in conc.  $\text{KCN} + \text{Aq.}$  separates out on dilution. (Béchamp, J. pr. 60, 64.)

Insol. in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Brett.)

Min *Argentite*. *Acanthite*. Sol. in conc.  $\text{HNO}_3 + \text{Aq.}$  with separation of S

Sol. in citric acid +  $\text{Aq.}$  with addition of  $\text{KNO}_3$ . (Bolton, C. N. 37, 48)

Silver disulphide,  $\text{Ag}_2\text{S}_2$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.; also sol. with decomp. in  $\text{HCl}$ ,  $\text{HNO}_3$ .  $\text{CS}_2$  does not dissolve out S. (Hantzsch, Z. anorg. 1898, 19, 105.)

Silver sodium sulphide,  $3\text{Ag}_2\text{S}, \text{Na}_2\text{S} + 2\text{H}_2\text{O}$ .

Sol. in conc.  $\text{Na}_2\text{S} + \text{Aq.}$  with decomp.; sol. in  $\text{H}_2\text{O}$  with decomp. (Ditte, C. R. 1895, 120, 93.)

Silver zinc sulphide,  $\text{Ag}_2\text{S}, 3\text{ZnS}$ .

(Schneider, J. pr. (2) 3, 29)

Silver sulphimide (silver thionyl imide),  $\text{SO}_2\text{NAg}$ .

Very sl. sol. in cold, more sol. in hot  $\text{H}_2\text{O}$   
Very sol. in dil.  $\text{HNO}_3$  (Traube, B. 1892, 25, 2474.)

Silver sulphophosphide.

See Silver phosphosulphide.

Silver telluride,  $\text{Ag}_2\text{Te}$ .

Min *Hessite*. Sol. in warm  $\text{HNO}_3 + \text{Aq.}$

Sodammonium,  $\text{Na}_2(\text{NH}_4)_2$ .

100 g. liq.  $\text{NH}_3$  dissolve 60.5 g. at  $-23^\circ$ ; 56.4 g. at  $0^\circ$ ; 53 g. at  $+5^\circ$ ; 55 g. at  $9^\circ$ . (Joannis A. ch. 1906, (8) 7, 41.)

Sodium,  $\text{Na}$ .

Violently decomposes  $\text{H}_2\text{O}$ , alcohol, etc. Insol. in hydrocarbons. Easily sol. in acids with violent action

Solubility in fused  $\text{NaOH}$ .

G sol. in 100 g fused  $\text{NaOH}$  at temp.

$t^\circ$	G per 100 g $\text{NaOH}$
480	25 3
600	10 1
610	9 9
670	9 5
760	7 9
800	6 9

(Hevesy, Z. Elektrochem. 1909, 15, 531.)

Insol. in liquid  $\text{CO}_2$ . (Buchner, Z. phys. Ch. 1906, 54, 674)

Sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 829.)

1 gram atom dissolves.—

at  $+22^\circ$  in 6 l. 4 mol. liquid  $\text{NH}_3$ .

"  $0^\circ$  " 5.87 " " "

"  $-30^\circ$  " 5.52 " " "

"  $-50^\circ$  " 5.39 " " "

"  $-70^\circ$  " 5.20 " " "

"  $-105^\circ$  " 4.98 " " "

(Ruff, B. 1906, 39, 830.)

$\frac{1}{2}$  com. oleic acid dissolves 0.0449 g Na in 6 days (Gates, J. phys. Chem. 1911, 15, 143.)

Insol. in ethylamine and in secondary and tertiary amines (Kraus, J. Am. Chem. Soc. 1907, 29, 1561)

Sodium acetylde acetylene,  $\text{Na}_2\text{C}_2, \text{C}_2\text{H}_2$ .

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$  and by absolute alcohol. Insol. in ether, ligroin, etc. (Moussan, C. R. 1898, 127, 915.)

**Sodium amalgam.**

$\text{NaHg}_6$ . Stable in contact with the liquid amalgam from  $0^\circ$ – $40.5^\circ$ . Can be cryst from Hg without decomp. at any temp between these limits

$\text{NaHg}_8$ . Stable in contact with the liquid amalgam from  $40.5^\circ$ – $150^\circ$ . Can be cryst from Hg without decomp. at any temp between these limits (Kerp, Z. anorg. 1900, 25. 68)

**Sodium amide,  $\text{NaNH}_2$** 

Decomp. by  $\text{H}_2\text{O}$  and alcohol.

**Sodium amidochloride,  $\text{Na}_2\text{NH}_2\text{Cl}$ .**

Sol in  $\text{H}_2\text{O}$  with decomp (Joannis, C. R. 112. 392)

**Sodium arsenide,  $\text{Na}_3\text{As}$** 

Decomp.  $\text{H}_2\text{O}$ . (Lebeau, C. R. 1900, 130. 504.)

**Sodium arsenide ammonia,  $\text{Na}_3\text{As}, \text{NH}_3$ .**

Easily sol. in liquid  $\text{NH}_3$  (Lebeau, C. R. 1900, 130. 502.)

Sl. sol. in liquid  $\text{NH}_3$  (Hugot, C. R. 1898, 127. 554.)

**Sodium azoimide,  $\text{NaN}_3$** 

Not hygroscopic. Sol in  $\text{H}_2\text{O}$ . Insol in alcohol and ether. (Curtius, B. 24. 3344)

40.16 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ .

40.7 " " " " 100 "  $\text{H}_2\text{O}$  " 15.2

41.7 " " " " 100 "  $\text{H}_2\text{O}$  " 17.0

0.3153 pt. is sol in 100 pts abs alcohol at  $16^\circ$ .

Insol in pure ether. (Curtius, J pr 1898, (2) 58. 279.)

**Sodium bromide,  $\text{NaBr}$ , and  $+2\text{H}_2\text{O}$** 

Not deliquescent. Solubility in  $\text{H}_2\text{O}$  differs according as  $\text{NaBr}$  or  $\text{NaBr}+2\text{H}_2\text{O}$  is used. The following data for anhydrous  $\text{NaBr}$  were found

Pts.  $\text{NaBr}$  dissolved by 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts NaBr	$t^\circ$	Pts NaBr	$t^\circ$	Pts NaBr
44.1	115.6	74.5	118.4	97.2	119.9
51.5	116.2	80.5	118.6	100.3	120.6
55.1	116.8	86.0	118.8	110.6	122.7
60.3	117.0	90.5	119.7	114.3	124.0
64.5	117.3	.	.	.	.

Solubility is represented by a straight line of the formula  $S = 110.34 + 0.1075t$ .

Below  $50^\circ$  the salt usually crystallizes with

$2\text{H}_2\text{O}$ , of which the solubility in 100 pts  $\text{H}_2\text{O}$  was found to be as follows.

$t^\circ$	Pts NaBr	$t^\circ$	Pts. NaBr	$t^\circ$	Pts NaBr
-21	71.1	+5	82.0	30	97.3
-20	71.4	10	84.5	35	101.3
-15	73.1	15	87.3	40	105.8
-10	75.1	20	90.3	45	110.6
-5	77.1	25	93.8	50	116.0
0	79.5				

(Coppet, A. ch. (5) 30. 420.)

If solubility  $S$  = pts.  $\text{NaBr}$  in 100 pts. solution,  $S = 40.0 + 0.1746t$  from  $-20^\circ$  to  $+40^\circ$ ;  $S = 52.3 + 0.0125t$  from  $50^\circ$  to  $150^\circ$ . (Etard, C. R. 98. 1432)

100 pts.  $\text{H}_2\text{O}$  dissolve at  $0^\circ$ , 77.5 pts  $\text{NaBr}$ , at  $20^\circ$ , 88.4 pts; at  $40^\circ$ , 104.2 pts, at  $60^\circ$ , 111.1 pts; at  $80^\circ$ , 112.4 pts; at  $100^\circ$ , 114.9 pts. (Kremers)

Sat solution boils at  $121^\circ$ . (Kremers, Pogg. 97. 14)

Sat  $\text{NaBr} + \text{Aq}$  contains at

-22°	-10°	+140°	163°
40.1	42.5	56.5	57.5% $\text{NaBr}$ ,

180°	180°	210°	212°	230°
59.5	59.0	60.9	61.0	62.0% $\text{NaBr}$ .

(Etard, A. ch. 1894, (7) 2. 539.)

100 g. sat  $\text{NaBr} + \text{Aq}$  at  $16.4^\circ$  contain 47 g.  $\text{NaBr}$ . (Greenish, Pharm. J. 1900, 65. 190.)

Solubility of  $\text{NaBr} + 2\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $30^\circ = 65.5\%$  anhydrous  $\text{NaBr}$  (Cocheret, Dissert. 1911.)

Sp. gr. of  $\text{NaBr} + \text{Aq}$  at  $19.5^\circ$  containing.

5	10	15	20	25 % $\text{NaBr}$ ,
1.040	1.080	1.125	1.174	1.226

30	35	40	45	50 % $\text{NaBr}$ .
1.281	1.334	1.410	1.483	1.565

(Gerlach, Z. anal. 8. 285)

$\text{NaBr} + \text{Aq}$  containing 17.15%  $\text{NaBr}$  has sp. gr.  $20^\circ/20^\circ = 1.1473$

$\text{NaBr} + \text{Aq}$  containing 22.72%  $\text{NaBr}$  has sp. gr.  $20^\circ/20^\circ = 1.2060$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 278.)

Sp. gr of  $\text{NaBr} + \text{Aq}$  at  $20.5^\circ$ .

Normality of $\text{NaBr} + \text{Aq}$	g $\text{NaBr}$ in 100 g. of solution	Sp gr $20.5^\circ/4^\circ$
4.33	33.57	1.3284
3.00	25.10	1.2284
1.99	17.77	1.1526
0.98	9.41	1.0750

(Oppenheimer, Z. phys. Ch. 1898, 27. 452.)

Sp. gr at 20° of NaBr+AQ containing  
M g mols NaBr per liter.

M	0.01	0.025	0.05	0.075
Sp. gr	1.000732	1.002177	1.004074	1.005972

M	0.10	0.25	0.50	0.75
Sp. gr.	1.00788	1.01964	1.03908	1.05811

M	1.0	1.5	2.0
Sp. gr.	1.07632	1.11963	1.15240

(Jones and Pearce, Am. Ch. J. 1907, 38, 728.)

Sol in H<sub>2</sub>SO<sub>4</sub> (Walden, Z. anorg. 1902, 29, 384.)

100 pts NaBr+AQ sat at 18-19° contain 46.06 pts NaBr; 100 pts NaBr+NaCl+AQ sat at 18-19° contain 46.59 pts of the two salts, 100 pts NaBr+NaI+AQ sat at 18-19° contain 63.15 pts of the two salts; 100 pts NaBr+NaCl+NaI+AQ sat at 18-19° contain 63.20 pts. of the three salts (v. Hauer, J. pr. 98, 137.)

Solubility of NaBr in NaOH+AQ at 17°.

(G. per 100 g H<sub>2</sub>O)

NaOH	NaBr	NaOH	NaBr
0 0	91 38	22 35	59 60
3 26	79 86	24 74	55 03
9 24	68 85	28 43	48 00
13 43	64 90	36 61	38 41
17 17	63 06	46 98	29 37
19 12	62 51	54 52	24 76

(Ditte, C R 1897, 124, 30)

Easily sol in liquid HF (Franklin, Z. anorg. 1905, 46, 2)

Very sl. sol. in alcohol.

NaBr+2H<sub>2</sub>O is sol. in 1.10 pts. H<sub>2</sub>O at 15°; in 159 pts absolute alcohol at 15°; in 1200 pts. absolute ether at 15°. (Eder, Dingl. 321, 89.)

NaBr+2H<sub>2</sub>O is sol in 2.25 pts. 60% alcohol, and 7 pts. 90% alcohol. NaBr is sol in 3 pts 60% alcohol, and 10 pts. 90% alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 17.35 pts. at 19.5°. (de Bruyn, Z. phys. Ch. 10, 783.)

100 g. NaBr+CH<sub>3</sub>OH contain 0.9 g NaBr at the critical temp (Centnerszwer, Z. phys. Ch 1910, 72, 437.)

At room temp, 1 pt. NaBr by weight is sol. in:

4 6	pts. methyl alcohol	D <sub>15</sub> 0.7990.
14 0	" ethyl "	D <sub>15</sub> 0.8100.
49 7	" propyl "	D <sub>15</sub> 0.8160.

(Rohland, Z. anorg. 1898, 18, 325.)

Solubility in ethyl alcohol at 30°.

Wt. %		Solid phase
Alcohol	NaBr	
0	59.4	NaBr, 2H <sub>2</sub> O
11.79	42 90	"
31.78	32 12	"
43.22	26 79	"
54 59	20.83	"
65 51	16.08	"
72 36	13 41	"
76 92	12 03	NaBr, 2H <sub>2</sub> O+NaBr
87 35	7 44	NaBr
97 08	3 01	"

(Cocheret, Dissert. 1911.)

Solubility in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the solvent  
G = g. NaBr in 10 cc. of the solution.  
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0 00	0 293	0.8189
4.37	0.305	0.8265
10 40	0.404	0.8273
41 02	0.724	0.8593
80 69	1 251	0.9079
84.77	1 286	0.9104
91 25	1 432	0.9235
100 00	1 440	0.9238

(Hers and Kuhn, Z. anorg. 1908, 60, 155.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = g. NaBr in 10 cc. of the solution  
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	1 440	0.9238
11 11	1 243	0.9048
23 8	1 063	0.8887
65 2	0.442	0.8390
91 8	0 147	0.8153
93 75	0 126	0.8144
100	0 074	0.8093

(Hers and Kuhn, Z. anorg. 1908, 60, 156.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = g. NaBr in 10 ccm. of the solution.  
S = Sp. gr. of the sat solution.

P	G	S 25°/4°
0	0 293	0 8189
8 1	0 249	0 8147
17 85	0 247	0 8145
56.6	0 190	0 8107
88.6	0 111	0 8116
91.2	0.083	0.8083
95 2	0 082	0 8090
100	0 074	0 8093

(Herz and Kuhn, Z. anorg. 1908, 60, 159.)

2 05 g are sol. in 100 g propyl alcohol (Schlamp, Z. phys. Ch. 1894, 14, 276)

Sl. sol in acetone. (Krug and M'Elroy, J Anal Ch 6, 184.)

100 g. 95% formic acid dissolve 22.3 g. NaBr at 18.5°. (Aschan, Ch. Ztg. 1913, 37, 1117.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790); ethyl acetate (Naumann, B. 1910, 43, 314); benzonitrile. (Naumann, B. 1914, 47, 1370.)

The composition of the hydrates formed by NaBr at different dilutions is calculated from determinations of the lowering of the frpt. produced by NaBr and of the conductivity and sp gr of NaBr+Ag. (Jones, Am. Ch. J. 1905, 84, 303.)

Sodium stannic bromide.

See Bromostannate, sodium.

Sodium uranous bromide,  $\text{Na}_2\text{UBr}_6$

As K salt. (Aloy, Bull. Soc 1899, (3) 21, 264.)

Sodium zinc bromide,  $\text{NaBr}$ ,  $\text{ZnBr}_2 + \text{H}_2\text{O}$ .

Hygroscopic. (Ephraim, Z. anorg. 1908, 59, 63.)

$2\text{NaBr}$ ,  $\text{ZnBr}_2 + 5\text{H}_2\text{O}$ . Hygroscopic. (Ephraim)

Sodium carbide,  $\text{Na}_2\text{C}_2$ .

Insol. in all neutral solvents; decomp. on heating and by  $\text{H}_2\text{O}$ . (Matignon, C. R. 1897, 125, 1634.)

Sodium carbonyl,  $\text{Na}_2\text{C}_2\text{O}_2$ .

Decomp. by  $\text{H}_2\text{O}$  with explosion. (Joannis, C. R. 116, 1518.)

Sodium subchloride,  $\text{Na}_2\text{Cl}_2$ .

Decomp. by  $\text{H}_2\text{O}$  into  $\text{NaCl}$  and  $\text{NaOH} + \text{Aq}$ . (Kreutz, B. 1897, 30, 403.)

Sodium chloride,  $\text{NaCl}$ .

Sol. in  $\text{H}_2\text{O}$ .

100 pts  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts  $\text{NaCl}$

$t^\circ$	Pts. NaCl	Authority
0	More than at 13 89°	Gay-Lussac, A ch (2) 11, 310
13 89	35 91	
16 00	35 88	
50 93	37 14	
109 73	40 38	
12	35 91	Fehling, A. 77, 382
100	39 02	
18 75	37 731	Bischof.
10-15	35 42	Bergmann.
106+	42 86	Griffiths, 1825.
20	35 9	Schiff, A. 109, 320
All temps	37	Fuchs and Reichenbach 1826.
25	35 7	Kopp, A. 34, 202
18 75	36 53	C J B Karsten, 1840
1	36 121	
18 75	36 724	G. Karsten
100	41 076	
1 25	36 119	
Boiling	39 324	Unger, J. pr 8, 285.
18 75	35 40	Karsten (?), cited by
100	36 95	Unger, <i>loc</i>
15 56	34 2-35 42	
100	36 16	Ure's Diet
15	35 837	Michel and Kraft

1 pt.  $\text{NaCl}$  is sol. in 2 789 pts.  $\text{H}_2\text{O}$  at 15° (Gerlach), in 3 pts  $\text{H}_2\text{O}$  at 18.75° (Abt), in 2 8285 pts  $\text{H}_2\text{O}$  at ord. temp (Bergmann), in 2 7647 pts boiling  $\text{H}_2\text{O}$  (Bergmann), in 2 857 pts hot or cold  $\text{H}_2\text{O}$  (Fourcroy)

Not deposited from boiling aqueous solution unless the vessel containing it is open to the air (Unger, *loc*)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. NaCl	$t^\circ$	Pts. NaCl
1 5	33 6	70	38.1
13 75	35 8	108 5	39 4

(Nordenfjöld, Pogg 136, 315)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts. NaCl	$t^\circ$	Pts. NaCl
13 89	35 8	59 93	37 1
16.90	35 9	109 73	40 4

(Gay-Lussac, A ch 11, 296.)

Solubility of  $\text{NaCl}$  at various pressures. The figures represent pts.  $\text{NaCl}$  in 100 pts sat  $\text{NaCl} + \text{Aq}$  at  $t^\circ$  and A pressure in atmospheres

A	0°	9°	12°	15°	20°	25°	30°
1	26 25	26 32	26 35	26 30	26 35	26 37	26 47
20	26 35	26 35		26 39	26 37	26 47	26 53
40	26 44			26 40	..		

(Müller, Pogg 117, 386)

100 pts. H<sub>2</sub>O dissolve at t°.

t°	Pts. NaCl	t°	Pts. NaCl
-15	32 73	40	36 64
-10	33 49	50	36 98
-5	34 22	60	37 25
0	35 52	70	37 88
5	35 63	80	38 22
9	35 74	90	38 87
14	35 87	100	39 61
25	36 13	109 7	40 35

(Poggiale, A. ch. (3) 8. 649)

100 pts. H<sub>2</sub>O dissolve at:

0°	9°	12°	15°
35.59	35 72	35 77	35 68 pts. NaCl,

20° 25° 30°  
35.77 35.81 36 00 pts. NaCl.

(Muller, Pogg. 122. 337.)

100 pts. H<sub>2</sub>O dissolve 35.76-36.26 pts. NaCl at 15.6°, and the sp. gr. of sat. solution = 1.204. (Page and Keightley, Chem. Soc. (2) 10. 566.)

100 pts. NaCl + Aq sat. at 18-19° contain 26.47 pts. NaCl. (v. Hauer, J. pr. 98. 137.)

Solubility of NaCl in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. NaCl	t°	Pts. NaCl	t°	Pts. NaCl
0	35 7	30	36 3	60	37 3
1	35 7	31	36 3	61	37 3
2	35 7	32	36 3	62	37 4
3	35 7	33	36 4	63	37 4
4	35 7	34	36 4	64	37 5
5	35 7	35	36 4	65	37 5
6	35 7	36	36 5	66	37 6
7	35 7	37	36 5	67	37 7
8	35 7	38	36 5	68	37 7
9	35 7	39	36 6	69	37 8
10	35 8	40	36 6	70	37 9
11	35 8	41	36 6	71	37 9
12	35 8	42	36 7	72	38 0
13	35 8	43	36 7	73	38 0
14	35 8	44	36 8	74	38 1
15	35 9	45	36 8	75	38 2
16	35 9	46	36 8	76	38 2
17	35 9	47	36 9	77	38 2
18	35 9	48	36 9	78	38 2
19	36 0	49	36 9	79	38 3
20	36 0	50	37 0	80	38 4
21	36 0	51	37 0	81	38 4
22	36 0	52	37 0	82	38 5
23	36 1	53	37 1	83	38 6
24	36 1	54	37 1	84	38 6
25	36 1	55	37 1	85	38 7
26	36 1	56	37 2	86	38 7
27	36 2	57	37 2	87	38 8
28	36 2	58	37 2	88	38 9
29	36 2	59	37 3	89	39 0

Solubility of NaCl in 100 pts. H<sub>2</sub>O at t°.—  
*Continued.*

t°	Pts. NaCl	t°	Pts. NaCl	t°	Pts. NaCl
90	39.1	97	39 5	104	40 0
91	39 1	98	39 6	105	40 1
92	39 2	99	39 7	106	40 1
93	39 3	100	39 8	107	40 2
94	39 3	101	39 8	108	40 3
95	39 4	102	39 9	109	40 3
96	39 4	103	40 0	109 7	40 4

(Calculated by Mulder from his own and other observations, Scheik. Verhandel. 1864. 37)

Solubility in 100 pts. H<sub>2</sub>O at:

0-4°	20°	40°	60°	80°
35 630	35 825	36 32	37 06	38 00

(Andrae, J. pr. (2) 28. 456.)

Solubility in 100 pts. H<sub>2</sub>O from most careful experiments.

0°	20°	60°	80°
35 571	35 853	37 091	38 046

(Raupenstrauch, M. Ch. 6. 563.)

Solubility of NaCl in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. NaCl	t°	Pts. NaCl
-14 0	32 5	44 75	36 64
-13 8	32 15	52 5	37 04
-6 25	34 22	55 0	36 99
-5 95	34 15	59 75	37 31
0	35 7	71 3	37 96
3 6	35 79	74 45	37 96
5 3	35 8	82 05	38 41
14 45	35 94	86 7	38 47
20 85	35 63	93 65	38 90
25 45	35 90	101 7	40 76
38 55	36 52		..

Solubility above 20° is represented by the formula  $S = 34.359 + 0.0527t$ . (Coppet, A. ch. (5) 30. 426.)

Solubility of NaCl in 100 pts H<sub>2</sub>O at high temp.

t°	Pts. NaCl	t°	Pts. NaCl
118	39 8	160	43 6
140	42 1	180	44 9

(Tilden and Shenstone, Phil Trans 1884. 23.)

Sat NaCl + Aq contains % NaCl at t°.

t°	% NaCl	t°	% NaCl
-21	23.7	77	28.0
-21	23.4	90	28.2
-18	23.5	115	29.1
-17	23.3	135	28.9
-7	25.5	140	28.8
0	25.8	150	29.6
+15	26.7	180	30.2
55	26.8	215	31.6

(Étard, A. ch. 1894, (7) 2. 532.)

100 g. H<sub>2</sub>O dissolve 0.616 gram-equivalent NaCl at 25° (Van't Hoff and Meyerhoffer, Z. phys. Ch. 1904, 49. 315.)

Solubility of NaCl in H<sub>2</sub>O at t°.

Most careful experiments.

t°	g NaCl per 100 g H <sub>2</sub> O	Sp. gr.	t°	g NaCl per 100 g H <sub>2</sub> O	Sp. gr.
0.35	35.75	1.2090	81.70	37.28	1.1823
15.20	35.84	1.2020	75.65	37.82	1.1764
30.05	36.20	1.1956	90.50	38.53	1.1701
45.40	36.60	1.1891	107	39.65	1.1631

(Berkeley, Phil. Trans. Roy Soc. 1904, 203. A. 189.)

Sat. NaCl + Aq. at 25° contains 26.5% NaCl. (Foote, Am. Ch. J. 1906, 35. 239.)

100 g. H<sub>2</sub>O dissolve 35.80 g. NaCl at 25°. (Cameron, Bell and Robinson, J. phys. Ch. 1907, 11. 396.)

100 g. NaCl + Aq. sat. at 15° contains 26.3 g. NaCl; at 30°, 26.47 g. (Schreinemakers, Arch. neér. Sc. 1910, (2) 15. 81.)

5.456 g. mol. are contained in 1 l. NaCl + Aq sat. at 25°. (Herz, Z. anorg. 1911, 73. 274.)

5.40 g. mol. are contained in 1 l. NaCl + Aq sat. at 30°. (Masson, Chem. Soc. 1911, 99. 1136.)

26.47 g. NaCl are contained in 100 g. NaCl + Aq. sat. at 30°. (Cocheret, Dissert. 1911.)

35.79 g. NaCl are sol. in 100 g. H<sub>2</sub>O at room temp. (Frankforter, J. Am. Chem. Soc. 1914, 36. 1103.)

100 mol. H<sub>2</sub>O dissolve at:

19.3° 29.7° 40.1° 54.5°

11.04 11.06 11.15 11.35 mol. NaCl.

(Sudhaus, Miner. Jahrb. Beil. Bd. 1914, 37. 18.)

Solubility of NaCl in H<sub>2</sub>O at 24.5° at varying pressures

S = g NaCl in 100 g solvent.

P = pressure in atmospheres.

P	S	100 g. of solution contains g. NaCl
1	35.90	26.42
250	36.25	26.61
500	36.55	26.77
1000	37.02	27.02
1500	37.36	27.20

(Cohen, Inouye and Euwen, Z. phys. Ch. 1910, 75. 257.)

Sp. gr of NaCl + Aq containing 15% NaCl is 1.109 at 15° (Francœur), 1.116 at 15° (Soubeiran); 1.1107 at 15° (Coulmer), 1.111 at 15° (Baudin, C. R. 66. 932.)

Sp. gr. of NaCl + Aq saturated at 15° is 1.20715 (Michel and Kraft); at 17.5° is 1.2046 (Kursten), at 8° is 1.205 (Anthon).

Sp. gr of NaCl + Aq.

% NaCl	Sp. gr.	% NaCl	Sp. gr.	% NaCl	Sp. gr.
5	1.037	15	1.112	25	1.192
10	1.074	20	1.154	26.43	1.204

(Dahlmann, J. B. 7. 321.)

Sp. gr of NaCl + Aq at 20°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
1	1.0068	15	1.1090
2	1.0133	16	1.1168
3	1.0201	17	1.1247
4	1.0270	18	1.1327
5	1.0340	19	1.1408
6	1.0411	20	1.1490
7	1.0483	21	1.1572
8	1.0556	22	1.1655
9	1.0630	23	1.1738
10	1.0705	24	1.1822
11	1.0781	25	1.1906
12	1.0857	26	1.1990
13	1.0934	27	1.2075
14	1.1012		

(Schiff, A. 110. 76.)

Sp. gr. of NaCl + Aq at 19.5°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
6.402	1.0460	22.631	1.1712
12.265	1.0895	26.530	1.2036
17.533	1.1303		...

(Kremers, Pogg. 95. 120.)

Sp. gr. of NaCl+Aq at 15°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
1	1.00725	15	1.11146
2	1.01450	16	1.11938
3	1.02174	17	1.12730
4	1.02899	18	1.13523
5	1.03624	19	1.14315
6	1.04366	20	1.15107
7	1.05108	21	1.15931
8	1.05851	22	1.16755
9	1.06593	23	1.17580
10	1.07335	24	1.18404
11	1.08097	25	1.19228
12	1.08859	26	1.20053
13	1.09622	26.395	1.20433
14	1.10384	.	.

(Gerlach, Z anal 8. 279.)

Sp. gr. of NaCl+Aq at 18°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
5	1.0345	25	1.1898
10	1.0707	26	1.1982
15	1.1087	26.4	1.2014
20	1.1477	.	..

(Kohlrausch, W. Ann 1879. 1)

Sp. gr. of NaCl+Aq at 20°, containing  
n mols H<sub>2</sub>O to 1 mol. NaCl

n	Sp. gr.	n	Sp. gr.
12.5	1.15292	100	1.02069
25	1.08207	200	1.00965
50	1.04227	..	.

(Marignac, J B. 1870. 110.)

Sp. gr. of NaCl+Aq at 0°. NaCl=g NaCl  
to 100 g. H<sub>2</sub>O, d°=sp. gr. at 0°; d°=  
maximum sp. gr.; T=temp. of maximum

G. NaCl	d°	d°	T
0	1.00000	1.000130	+ 4°
0.5	1.003925	1.003988	+ 3
1	1.007634	1.007666	+ 1.77
2	1.015366	1.015367	- 0.58
3	1.023530	1.023583	- 3.24
4	1.030669	1.030890	- 5.63
6	1.045975	1.046952	-11.07

(Rosetti, A. ch (4) 17. 382)

Sp. gr. of NaCl+Aq at 20°.  $\tau$ =mols. NaCl  
to 100 mols H<sub>2</sub>O.

$\tau$	Sp. gr.	$\tau$	Sp. gr.
0.5	1.01145	4.0	1.08408
1.0	1.02255	5.0	1.10276
2.0	1.01393	.	..

(Nicol, Phil. Mag. (5) 16. 122)

Sp. gr. of NaCl+Aq at 0°. S=weight of salt  
in 100 g. of solution of the given sp. gr.,  
S<sub>1</sub>=No. mols. of salt contained in 100  
mols. of the solution.

S	S <sub>1</sub>	Sp. gr.
23.0821	8.627	1.1821
19.1932	6.769	1.1502
14.3415	4.898	1.1111
9.4120	3.097	1.0722
5.1536	1.644	1.0394

(Charpy, A. ch. (6) 29. 23.)

Sp. gr. of NaCl+Aq.

G-equivalents NaCl per liter	$\tau^{\circ}$	Sp. gr. $\tau^{\circ}/\tau^{\circ}$
0.005028	18.549	1.0002119
0.01005	18.550	1.0004258
0.02005	18.538	1.000848
0.04983	18.509	1.002101
0.09873	18.525	1.004143
0.19388	18.542	1.008093
0.28990	18.550	1.012053
0.47574	18.558	1.019627
0.49860	18.06	1.02054
4.9860	17.85	1.18783
0.00259	14.07	1.0001108
0.005178	14.076	1.0002210
0.010318	14.097	1.0004401
0.02580	14.097	1.005315
0.25019	14.076	1.010505

(Kohlrausch, W. Ann 1894, 53. 26.)

Sp. gr. of NaCl+Aq at 18°/18°

g-equivalents of NaCl in 1 liter of solution	Sp. gr.
0.005	1.0002104
0.010	1.0004206
0.020	1.0008476
0.050	1.002109
0.100	1.004205

(Tammann, Z. phys. Ch 1895, 16. 93)

Sp. gr. of NaCl+Aq sat. 18°, when p=percent strength of solution; d=observed density; and w=volume conc. in grams per cc.  $\left(\frac{pd}{100}=w.\right)$

p	d	w
25.37	1.1928	0.30263
21.25	1.1592	0.24637
17.35	1.1277	0.19503
13.25	1.0958	0.14518
9.34	1.0665	0.09960
4.810	1.0332	0.04969
2.991	1.0202	0.03052
2.593	1.0173	0.2638
1.746	1.0111	0.01765

(Barnea, J. Phys. Chem. 1898, 2, 544.)

Sp. gr. of NaCl+Aq at 20.5°.

Normality of NaCl+Aq	G. NaCl in 100 g. of solution	Sp. gr. 20.5°/4°
3.97	20.22	1.1489
2.96	15.56	1.1124
2.01	10.90	1.0775
0.97	5.49	1.0373

(Oppenheimer, Z. phys. Ch. 1898, 27, 451.)

Sp. gr. of NaCl+Aq at 15°.

Per cent NaCl	Sp. gr.
0	1.00000
5	1.03624
10	1.07335
15	1.11146
20	1.15107
25	1.19228
Sat. at 15°	1.20433

(H. C. Hahn, J. Am. Chem. Soc. 1898, 20, 622.)

Sp. gr. of NaCl+Aq at 18°/4°.

g. NaCl in 100 g. of solution	Sp. gr.
0.19560	1.0001
0.097952	0.9994
0.065410	0.99918
0.048977	0.99905

(Jahn, Z. phys. Ch. 1900, 33, 572.)

Sp. gr. 20°/4° of a normal solution of NaCl = 1.03886. (Haigh, J. Am. Chem. Soc. 1912, 34, 1151.)

Sp. gr. of sat. NaCl+Aq at t°.

t°	g. NaCl sol. in 100 g. H <sub>2</sub> O	Sp. gr.
-10°	32.90	1.200
0	35.63	1.210
10	35.69	1.205
20	35.82	1.202
30	36.03	1.198
40	36.32	1.193
50	36.67	1.189
60	37.06	1.184
70	37.51	1.178

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, 44, 1565.)

Sp. gr. of dil. NaCl+Aq at 20.004°.  
Conc. = g. equiv. NaCl per l. at 20.004°  
Sp. gr. compared with H<sub>2</sub>O at 20.004° = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,004,2
0.0002	1.000,008,5
0.0005	1.000,021,3
0.0010	1.000,042,7
0.0020	1.000,085,1
0.0040	1.000,169,6
0.0050	1.000,211,7
0.0100	1.000,423,3

(Lamb and Lee, J. Am. Chem. Soc. 1913, 35, 1686.)

The saturated solution boils at 109° (Kremsa.)

NaCl+Aq containing 42.9 pts. NaCl to 100 pts. H<sub>2</sub>O boils at 108.8° (Griffiths); containing 41.2 pts. NaCl to 100 pts. H<sub>2</sub>O boils at 108.2° (Legrand); containing 40.38 pts. NaCl to 100 pts. H<sub>2</sub>O boils at 109.78° (Gay-Lussac); containing 38.7 pts. NaCl to 100 pts. H<sub>2</sub>O forms a crust at 108.3°; highest point observed, 108.8° (Gerlach, Z. anal. 26, 426.)

Boiling-point of NaCl+Aq.

% NaCl	B-pt according to	
	Buchol	G. Karsten
5	101.50°	101.10°
10	103.93	102.38
15	104.63	103.83
20	106.26	105.46
25	107.93	107.27
29.4	107.9-108.99	..

% NaCl	B-pt according to	
	Legrand	Gerlach
5	100.80°	100.9°
10	101.75	101.9
15	103.00	103.3
20	104.60	105.3
25	106.60	107.6

B-pt. of NaCl+Aq containing pts. NaCl to 100 pts H<sub>2</sub>O G=according to Gerlach (Z anal 26, 438; L=according to Le-grand (A ch (2) 59, 431).

B-pt	G	L	B-pt.	G	L
100 5°	3 4	4 4	105 5°	27 5	29 8
101	6 6	7 7	106	29 5	31 8
101 5	9 6	10 8	106.5	31 5	33 9
102	12 4	13 4	107	33 5	35 8
102 5	14 9	15 9	107 5	35 5	37 7
103	17 2	18 3	108	37 5	39 7
103 5	19 4	20 7	108 4	.	41 2
104	21 5	23 1	108 5	39 5	.
104 5	23 5	25 5	108 8	40 7	.
105	25 5	27 7	.	.	.

B-pt of NaCl+Aq containing g. NaCl in 100 g. H<sub>2</sub>O.

g. NaCl	7 6	11 0	14 9	16 1	18 8
B-pt	102 2°	108	104 2	104 8	106 1

g. NaCl 22 3 24 0 26 0 28 7  
B-pt. 107 1 107 7 108 7 109 5

(Richmond, Analyst, 1893, 18, 142)

If NaCl is dissolved in 15 pts. H<sub>2</sub>O, heat is absorbed if the temp. is 15°, but much less if temp. is 86°; at 100° there is neither absorption nor evolution of heat. (Berthelot, C. R. 78, 1722.)

86 pts. NaCl mixed with 100 pts. H<sub>2</sub>O at 12.6° lower the temp. 2.6°. (Rüdorff, B. 2, 68.)

88 pts NaCl with 100 pts. snow at -1° give a temp. of -21.3°. (Rüdorff, Pogg. 122, 387.)

The freezing-point of NaCl+Aq is lowered 0.60° for every gram NaCl up to 10 g. When more conc the freezing-point sinks proportional to NaCl, 2H<sub>2</sub>O, 0.342° for every gram of that salt. (Rüdorff, Pogg 113, 163.)

Insol in conc. HCl+Aq.

Solubility of NaCl in HCl+Aq at 0°. NaCl = mols. NaCl (in milligrams) dissolved in 10 cem. of liquid, HCl = mols. HCl (in milligrams) dissolved in 10 cem. of liquid.

NaCl	HCl	Sum of mols.	Sp. gr
53.5	1	54 5	1.2045
52.2	1 85	54 05	1.2025
48 5	5 1	53 6	1.196
44 0	9.275	53.275	1.185
37.95	15.05	53 00	1.1725
23.5	30 75	54 95	1.141
6.1	56 35	62 45	1.1159

(Engel, Bull. Soc (2) 45, 654.)

Solubility in HCl+Aq at 10-10.5°

g. per 100 cc		G. per 100 cc.	
HCl	NaCl	HCl	NaCl
0 0	35 77	26 06	30 89
9 84	33 76	94.77	20 01
12 76	33 19	102 1	19.04
15.68	32 71	120 6	16 03
20 78	31 77		

(Enklaar, R. t. c. 1901, 20, 183.)

Solubility in HCl+Aq at 30°

Composition of the solution	
% by wt HCl	% by wt NaCl
0	26 47
6 93	16 16
12 50	9 35
17 35	4 52
35 60	0 11

(Schreinemakers, Z. phys. Ch. 1909, 68, 85.)

Solubility in HCl+Aq.

Conc = concentration of HCl. g. mol. per 1,000 g. H<sub>2</sub>O  
NaCl = wt NaCl dissolved in 1,000 g. H<sub>2</sub>O.

t°	Conc	NaCl	Molecular solubility
0	0	357 75	6 13
	0 25	341 70	5 85
	0 50	324 45	5 56
	1 00	291 20	4 99
25	0	360 80	6 18
	0 25	344 50	5 90
	0 50	329 05	5 64
	1 00	298 10	5 10

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) 84, 127)

Solubility in HCl+Aq at 30°.

G. mols. per l.

HCl	NaCl	Sp. gr. 30°	HCl	NaCl	Sp. gr 30°
0.0	5 400	1.2018	3.052	2 463	1.1427
0.4575	4 932	1.1906	4 152	1.628	1.1289
0.989	4 386	1.1801	5.950	0.630	1.1188
1.786	3 589	1.1633	7 205	0.268	1.1258
2.412	2 412	1.1512			

(Masson, Chem. Soc. 1911, 99, 1132.)

Solubility in HCl + Aq at 25°	
Millimols HCl in 10 ccm.	Millimols NaCl in 10 ccm
6.07	54.56
10.32	48.50
15.90	44.67
21.17	37.82
32.83	32.97
	23.43

(Herz, Z. anorg. 1912, 73, 274.)

Moderately dil.  $H_2SO_4$  or  $HNO_3$  + Aq precipitate NaCl from NaCl + Aq (Karsten.)

Sol. in  $H_2SO_4$  (Walden, Z. anorg. 1902, 29, 384.)

Solubility of NaCl in  $NH_4OH$  + Aq at 30°.

(G. in 1 l sat. solution.)

Sp. gr.	$NH_3$	NaCl	Sp. gr.	$NH_3$	NaCl
1.1735	29.535	293.38	1.1406	72.07	283.38
1.1656	40.655	292.5	1.1395	72.715	283.06
1.160	47.26	289.7	1.1301	81.855	277.49
1.1494	60.78	286.5	1.205	97.49	270.57

(Hempel and Tedesco, Z. anorg. 1911, 24, 2467.)

Solubility of NaCl in  $NH_4Cl$  + Aq at  $t^\circ$ .

$t^\circ$	G per 100 g. $H_2O$		Sp. gr.
	$NH_4Cl$	NaCl	
0	0 146.1	356.3 286.4	1.185
15	0 57.3 118.9 186.4 198.8	357.6 326.4 300 271.6 266.8	1.200 1.191 1.183 1.176 1.175
30	0 255.4	360.3 249	1.166
45	0 327.1	365 233.9	...

(Fedotieff, Z. phys. Ch. 1904, 49, 168.)

See also under  $NH_4Cl$ .

Solubility in NaOH + Aq at 0°. NaCl = mols. NaCl (in milligrams) in 10 ccm. solution;  $Na_2O$  = mols.  $Na_2O$  (in milligrams) in 10 ccm. solution

NaCl	$Na_2O$	$Na_2O$ + NaCl	Sp. gr.
54.7	0	54.7	1.207
49.375	4.8	54.175	1.221
47.212	6.725	53.937	1.225
42.375	10.406	52.781	1.236
39.55	14.78	54.33	1.249
24.95	30.5	55.45	1.295
19.3	37.875	57.175	1.314
9.408	53.25	62.66	1.362

(Engel, C. R. 112, 1130.)

Solubility in NaOH + Aq at 20°.

G NaOH in 1 liter	G NaCl in 1 liter	Sp. gr.	deg. Baumé
10	308	1.200	23.5
20	308	1.210	24.0
30	306	1.215	25.5
40	302	1.225	26.4
50	297	1.230	26.9
60	286	1.235	27.4
70	277	1.240	27.9
80	269	1.245	28.4
90	261	1.250	28.8
100	253	1.250	28.8
110	244	1.252	29.0
120	236	1.252	29.0
130	229	1.260	29.7
140	221	1.265	30.2
150	213	1.270	30.6
160	205	1.275	31.1
170	197	1.275	31.1
180	189	1.280	31.5
190	181	1.285	32.0
200	173	1.290	32.4
210	165	1.295	32.8
220	159	1.295	32.8
230	152	1.300	33.3
240	146	1.303	33.5
250	139	1.305	33.7
260	134	1.310	34.2
270	129	1.315	34.6
280	124	1.320	35.0
290	118	1.325	35.4
300	112	1.330	35.8
310	107	1.333	36.0
320	101	1.335	36.2
330	96	1.340	36.6
340	90	1.345	37.0
350	85	1.350	37.4
360	80	1.355	37.8
370	76	1.360	38.2
380	71	1.365	38.6
390	66	1.370	39.0
400	61	1.375	39.4
410	56	1.380	40.0
420	52	1.385	40.2
430	48	1.390	40.6

## Solubility in NaOH + Aq at 20°.—Continued

G NaOH in 1 liter	G NaCl in 1 liter	Sp. gr	deg Baumé
440	45	1.395	41.0
450	42	1.400	41.5
460	39	1.405	41.9
470	37	1.410	42.0
480	34	1.415	42.3
490	32	1.420	42.6
500	30	1.425	43.0
510	28	1.430	43.5
520	27	1.435	43.7
530	27	1.440	44.0
540	26	1.445	44.3
550	26	1.450	44.6
560	25	1.450	44.6
570	24	1.455	45.0
580	23	1.460	45.5
590	23	1.465	45.9
600	22	1.470	46.2
610	21	1.475	46.5
620	20	1.480	46.8
630	19	1.485	47.0
640	18	1.490	47.5

(Winteler, Z. Elektrochem., 1900, 7, 380.)

Solubility in Na<sub>2</sub>O + Aq at 30°

Composition of the solution		Solid phase
% by wt. Na <sub>2</sub> O	% by wt. NaCl	
0	26.47	NaCl
4.47	21.49	"
12.22	13.62	"
24.48	4.36	"
29.31	2.40	"
37.85	1.12	"
41.42	0.97	NaCl + NaOH, H <sub>2</sub> O
42	0	NaOH, H <sub>2</sub> O

(Schreinemakers, Z. phys. Ch., 1909, 68, 85.)

The presence of other salts increases the solubility of NaCl in H<sub>2</sub>O.

Sol. in sat. NH<sub>4</sub>Cl + Aq with pptn of NH<sub>4</sub>Cl. When the reaction is complete, the solution has sp. gr. 1.1788, and contains 32.82% mixed salts, or 100 pts. H<sub>2</sub>O dissolve 48.42 pts mixed salts, viz., 26.36 pts NaCl and 22.06 pts NH<sub>4</sub>Cl (Karsten.) (See under NH<sub>4</sub>Cl.)

Sol. in sat. BaCl<sub>2</sub> + Aq with pptn of BaCl<sub>2</sub> until a state of equilibrium is reached, when 100 pts H<sub>2</sub>O at 17° dissolve 38.6 pts. of mixed salts, of which 4.1 pts. are BaCl<sub>2</sub>. (Karsten.) (See under BaCl<sub>2</sub>.)

Insol. in sat. CaCl<sub>2</sub> + Aq. (Vauquelin, Ann. de Chim., 13, 95.)

Much more sol. in hot than in cold H<sub>2</sub>O containing MgCl<sub>2</sub> or CaCl<sub>2</sub>, but NaCl is pptd. from sat. NaCl + Aq when that solution is mixed with MgCl<sub>2</sub> or CaCl<sub>2</sub> + Aq. (Fuehs and G. Reichenbach, 1826.) (See under MgCl<sub>2</sub>.)

Less sol. in conc. CaCl<sub>2</sub> + Aq than in H<sub>2</sub>O. (Hermann.)

Solubility of NaCl + CaCl<sub>2</sub> in H<sub>2</sub>O at 25°.  
G. per 100 g. H<sub>2</sub>O.

NaCl	CaCl <sub>2</sub>	Sp. gr. 25°/25°	Solid phase
0	84	1.4441	CaCl <sub>2</sub> , 6H <sub>2</sub> O
1.846	78.49	1.4441	+ NaCl
1.637	68.48	1.3651	NaCl
1.799	53.47	1.3463	"
7.77	36.80	1.2831	"
10.70	30.08	1.2653	"
18.85	19.53	1.2367	"
32.48	3.92	1.2080	"
35.80	0	1.2030	"

(Cameron, Bell and Robinson, J. phys. Chem., 1907, 11, 396.)

Solubility of NaCl in NaHCO<sub>3</sub> sat. with CO<sub>2</sub> at t°.

t°	G. per 1000 g. H <sub>2</sub> O	
	NaHCO <sub>3</sub>	NaCl
0	6.0	358.3
"	7.7	350.1
15	0.0	357.6
"	10.0	354.6
30	0.0	360.3
"	13.9	358.1
45	0.0	356.0
"	0.23	361.5

(Fodotseff, Z. phys. Ch., 1904, 49, 170.)

Sol. in sat. KClO<sub>3</sub> + Aq; the solution can then dissolve more KClO<sub>3</sub>. (Margueritte, C. R. 38, 305.)

In solution containing Na, K, Cl and NO<sub>3</sub> ions, the solubility—relations between the four salts NaCl, KCl, NaNO<sub>3</sub> and KNO<sub>3</sub> have been studied (Uyeda, Z. anorg. 1911, 71, 2.)

Sol. in sat. NH<sub>4</sub>NO<sub>3</sub> + Aq, without causing pptn. (Karsten.)

Sol. in sat. NH<sub>4</sub>NO<sub>3</sub> + Aq, from which solution it is not pptd. by salts which would cause its pptn. in aqueous solution (Margueritte, C. R. 38, 307.)

Sol. in sat. Ba(NO<sub>3</sub>)<sub>2</sub> + Aq without causing pptn.

Insol. in Ca(NO<sub>3</sub>)<sub>2</sub> + Aq.

Sol. in Mg(NO<sub>3</sub>)<sub>2</sub> + Aq with pptn. of small portion of Mg(NO<sub>3</sub>)<sub>2</sub>.

Sol. in sat. KNO<sub>3</sub> + Aq, the mixed solution having the power to dissolve more KNO<sub>3</sub>, and the solubility of the KNO<sub>3</sub> apparently increasing in the same ratio as the amount of NaCl present (Foureroy and Vauquelin, Ann. de Chim. 11, 130.)

Sol. in sat. KNO<sub>3</sub> + Aq; the solution thus

obtained at 18-13° contains 40.34% of the mixed salts, or 100 pts. H<sub>2</sub>O dissolve 67.72 pts. of the mixed salts, viz., 38.25 pts. NaCl and 29.45 pts. KNO<sub>3</sub> (Karsten.)

Solubility of NaCl in KNO<sub>3</sub>+Aq at 25°.  
KNO<sub>3</sub>=g. KNO<sub>3</sub> in 100 cc. of solution.  
NaCl=g. mol. per l

KNO <sub>3</sub>	NaCl	KNO <sub>3</sub>	NaCl
0	5.44	12	5.28
4	5.52	16	5.21
8	5.45	20	5.15

(Ritzel, Z. Krist. 1911, 49. 152)  
(See also under KNO<sub>3</sub>.)

Solubility of NaCl in NaNO<sub>3</sub>+Aq at 15.5°.

Sp. gr.	g. per 100 cc. sat. solution		
	NaNO <sub>3</sub>	NaCl	H <sub>2</sub> O
1.2025	0	31.78	88.47
1.2305	7.53	27.89	87.63
1.2580	13.24	26.31	86.25
1.2810	21.58	23.98	82.66
1.3000	28.18	22.30	80.42
1.3345	33.80	20.40	79.25
1.3465	37.88*	19.40*	77.37
1.3465	37.64*	19.67*	77.34

\*Solutions sat. with both salts.

(Bodländer, Z. phys. Ch. 1891, 1. 361)

Sol. in sat. NaNO<sub>3</sub>+Aq with pptn. of NaNO<sub>3</sub>.

Solubility of NaCl in NaNO<sub>3</sub>+Aq.

Conc.=concentration of NaNO<sub>3</sub> in g. mol. per 1,000 g. H<sub>2</sub>O.

NaCl=g. NaCl dissolved in 1,000 g. H<sub>2</sub>O.

t°	Conc.	NaCl	Molecular solubility
0	0	350.65	6.16
	0.25	355.90	6.09
	0.50	351.20	6.02
	1	342.15	5.86
25	0	362.95	6.20
	0.25	356.65	6.11
	0.50	352.30	6.03
	1	343.65	5.88
	2	325.50	5.58

(Armstrong and Eyre, Proc. R. Soc. 1910, A. 84. 127.)

(See also under NaNO<sub>3</sub>.)

Sol. in sat. KCl+Aq with elevation of temp. (Vauquelin.)

100 g. H<sub>2</sub>O sat. with KCl dissolve 0.494 gram-equivalent NaCl at 25°. (Fuler, Z. phys. Ch. 1904, 49. 315.)

Solubility in KCl+Aq at t°.

t°	Sat. solution contains	
	% NaCl	% KCl
-20	21.3	5.7
-10	21.3	6.7
0	21.3	7.7
+10	21.3	8.6
20	21.3	9.6
30	21.3	10.6
40	21.3	11.5
50	21.3	12.5
60	21.3	13.5
70	21.3	14.4
80	20.7	15.8
90	19.9	17.8
100	18.8	19.8
110	17.2	22.4
120	16.5	24.1
130	16.4	25.1
140	16.4	26.1
150	16.4	27.1
160	16.4	28.0
170	16.4	29.0
180	16.4	30.0

(Etard A. ch. 1894, (7) 3. 277)

(See under KCl)

100 pts. NaCl+NaI+Aq sat. at 18-19° contain 62.33 pts. of the two salts. (v. Hauer.)

Sol. in sat. Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+Aq with no pptn. (Vauquelin.)

Sol. in sat. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq with pptn. of considerable amt. of (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq. (Vauquelin.)

Sol. in sat. CuSO<sub>4</sub>+Aq.

100 pts. H<sub>2</sub>O dissolve 36.71 pts. NaCl and 7.19 pts. K<sub>2</sub>SO<sub>4</sub> at 15°, and solution has sp. gr. 1.24. (Page and Keightley.)

NaCl is sol. in K<sub>2</sub>SO<sub>4</sub>+Aq, and vice versa, without separation of a salt.

100 pts. H<sub>2</sub>O dissolve 7.03 pts. K<sub>2</sub>SO<sub>4</sub> and 37.80 pts. NaCl, when warmed and cooled to 14°. (Rudorff.)

Solubility of NaCl and K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O at t°  
100 pts. H<sub>2</sub>O contain pts. NaCl, K<sub>2</sub>SO<sub>4</sub>, and KCl.

t°	Pts. NaCl	Pts. K <sub>2</sub> SO <sub>4</sub>	Pts. KCl
10	33.43	8.10	3.18
20	34.01	8.90	3.06
30	34.56	9.56	2.95
40	35.16	10.38	2.81
50	35.77	11.07	2.84
60	36.40	11.93	2.72
70	36.84	12.82	3.20
80	36.04	12.26	5.06
90	35.86	12.42	6.98
100	35.63	12.56	8.79

(Precht and Wittgen, B. 15. 1666.)

Sol. in cold sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at first without pptn., afterwards  $\text{Na}_2\text{SO}_4$  separates out. (Karsten)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 7.45 g.  $\text{Na}_2\text{SO}_4$  in 100 g. of the solution.

t°	g NaCl in 100 g. of the solution
14 80	23 30
17 90	23 33
24 85	23 45
25 60	23.485
27.75	23 525
32 18	23.55
34 28	23.68

(Marie and Marquis, C. R. 1903, 136, 684.)  
See also under  $\text{Na}_2\text{SO}_4$ .

Sol. in sat.  $\text{ZnSO}_4 + \text{Aq}$  with separation of  $\text{Na}_2\text{SO}_4$ ,  $\text{ZnSO}_4$ . (Karsten)  
Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54, 674.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 820.)

12.2 pts. NaCl are sol. in 1 pt. hydrazine at 12.5-13°. (de Bruyn, R. t. c. 1899, 18, 297.)

100 g. hydroxylamine dissolve 14.7 g. NaCl at 17.5°. (de Bruyn, Z. phys. Ch. 1892, 10, 782.)

100 g. 95% formic acid dissolve 5.8 g. at 19.7°. (Aschan, Ch. Ztg. 1913, 37, 1117.)  
Solubility in alcohol.

100 pts. alcohol of 0.900 sp. gr. dissolve 5.8 pts. NaCl; of 0.872 sp. gr. dissolve 3.67 pts. NaCl, of 0.834 sp. gr. dissolve 0.5 pts. NaCl. (Kirwan.)

100 pts. alcohol containing given % by weight of absolute alcohol dissolve pts. NaCl at 25°.

% alcohol	Pts. NaCl	% alcohol	Pts. NaCl	% alcohol	Pts. NaCl
0 0	35 70	33 4	16 08	66 9	5 95
8 4	30 49	41 8	13 28	75 2	3 75
16 7	24 84	50 2	11 28	83 6	1 69
25 1	19 80	58 5	7 90	.	..

(Kopp, A. 40 206)

100 pts. alcohol of 75% by weight dissolve at

14°	15.2°	38°	71.6°
0.091	0.700	0.736	1.038 pts. NaCl

100 pts. alcohol of 85.5% by weight dissolve at:

16°	77.2°
0.174	0.171 pts. NaCl

(Wagner, A. 64, 293.)

100 pts. alcohol containing % alcohol by weight dissolve pts. NaCl at 15°, or 100 pts. solution contain % NaCl.

10	20	30	40	% alcohol,
28.53	22.55	17.51	13.25	pts. NaCl,
22.2	18.4	14.9	11.7	% NaCl,
50	60	80	% alcohol,	
9.77	5.93	1.22	pts. NaCl,	
8.9	5.6	1.2	% NaCl.	

(Schiff, A. 118, 365.)

Solubility of NaCl in alcohol increases with the temperature.

100 pts (by weight) of alcohol of 0.9282 sp. gr. (50.5% by weight) dissolve at:

4°	10°	13°	23°	32°
10.9	11.1	11.43	11.9	12.3 pts. NaCl,

33°	44°	51°	60°	.
12.5	13.1	13.8	14.1	pts. NaCl.

(Gerardin, A. ch. (4) 5, 146.)

Solubility in alcohol at 13°

Sp. gr.	100 ccm. contain in g		
	Alcohol	Water	Salt
1 2030	0	88.70	31 60
1 1348	11.81	78.41	23 26
1 1144	15.99	74.64	20 81
1 0970	19 39	71.45	18 86
1 0698	24 95	65 50	16.23
1.0295	32 33	57 96	12.66
0.9880	40 33	49 34	9.13
0.9445	49 28	38 54	5 93
0 9075	57 91	29 37	3 47
0 8700	63 86	21 62	1 52
0 8400	72.26	11 24	0 50

(Bodländer, Z. phys. Ch. 7, 317)

Solubility in ethyl alcohol + Aq at 30°.

wt. % alcohol	g NaCl per 100 g		wt. % alcohol	g NaCl per 100 g	
	solution	H <sub>2</sub> O		solution	H <sub>2</sub> O
0	26 50	36.05	50	9 34	20.60
5	24.59	34.29	60	6 36	16 98
10	22.56	32 57	70	3.36	12 75
20	19.05	29 40	80	1 56	7 95
30	15.67	26 53	90	0 43	4 30
40	12.45	23 70	.	.	.

(Taylor, J. phys. Ch. 1897, 1, 723.)

Solubility in ethyl alcohol + Aq at 40°.

wt. % alcohol	g. NaCl per 100 g		wt. % alcohol	g NaCl + 100 g.	
	solution	H <sub>2</sub> O		solution	H <sub>2</sub> O
0	26 68	36.38	50	9.67	21 42
5	24.79	34 69	60	6.65	17 82
10	22 90	33 00	70	3.87	13.10
20	19 46	30 20	80	1 69	8 68
30	16.02	27.25	90	0 50	5 10
40	12.75	24 37	.	.	.

(Taylor, l. c.)

Solubility of NaCl in ethyl alcohol + Aq at 28°.

$\frac{\%}{\text{C}_2\text{H}_5\text{OH}}$	$\% \text{H}_2\text{O}$	$\frac{\%}{\text{NaCl}}$	$\frac{\%}{\text{C}_2\text{H}_5\text{OH}}$	$\% \text{H}_2\text{O}$	$\frac{\%}{\text{NaCl}}$
0	73.53	26.47	45.35	45.35	9.3
3.8	71.6	24.6	56.2	37.5	6.3
7.7	69.7	22.6	67.4	28.9	3.7
16.1	64.6	19.3	78.8	19.7	1.5
25.3	58.9	15.8	89.6	10	0.4
35.0	52.5	12.5			

(Fonten, Z. phys. Ch. 1904, 73. 212.)

Solubility of NaCl in ethyl alcohol + Aq at 25°.

Conc. = concentration of alcohol in g. mol. per 1,000 g. H<sub>2</sub>O.  
NaCl = g. in 1,000 g. H<sub>2</sub>O.

Conc.	NaCl	Molecular solubility
0	359.65	6.16
0.25	355.15	6.08
0.50	349.65	5.98
1	337.80	5.79
3	301.60	5.16

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) 84. 127.)

100 pts. absolute methyl alcohol dissolve 1.41 pts. at 18.5°; 100 pts. absolute ethyl alcohol dissolve 0.035 pt. at 18.5°. (de Bruyn, Z. phys. Ch. 10. 782.)

100 pts. wood-spirit of 40% (by weight) dissolve 13.0 pts. NaCl. (Schiff, A 118. 365.)

100 g. NaCl + CH<sub>3</sub>OH contain 0.1 g. NaCl at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, 72. 437.)

Solubility of NaCl in methyl alcohol + Aq. at 25°.

Conc. = concentration of alcohol in g. mol. per 1,000 g. H<sub>2</sub>O.  
NaCl = g. in 1,000 g. H<sub>2</sub>O.

t°	Conc.	NaCl	Molecular solubility
0°	0	357.75	6.13
	0.25	355.20	6.08
	0.50	353.10	6.05
	1	347.45	5.95
25°	0	362.95	6.20
	0.25	359.40	6.14
	0.50	357.60	6.11
	1	353.20	6.04
	3	336.25	5.75

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) 84. 127.)

Traces dissolve in propyl alcohol. (Schlamp Z. phys. Ch. 1894, 14. 276.)

Solubility of NaCl in propyl alcohol + Aq. at 25°.

Conc. = concentration of alcohol in g. mol. per 1,000 g. H<sub>2</sub>O.  
NaCl = g. NaCl in 1,000 g. H<sub>2</sub>O.

t°	Conc.	NaCl	Molecular solubility
0	0	357.75	6.13
	0.25	351.20	6.01
	0.50	345.55	5.91
25	0	362.95	6.20
	0.25	355.75	6.10
	0.50	350.20	6.00

(Armstrong and Eyre, Proc. R. Soc. 1910, A. 84. 127.)

Solubility of NaCl in propyl alcohol + Aq at 23-25°.

$\frac{\%}{\text{NaCl}}$	$\frac{\%}{\text{C}_3\text{H}_7\text{OH}}$	$\frac{\%}{\text{H}_2\text{O}}$	$\frac{\%}{\text{NaCl}}$	$\frac{\%}{\text{C}_3\text{H}_7\text{OH}}$	$\frac{\%}{\text{H}_2\text{O}}$
0.55	87.7	11.75	14.38	5.39	80.23
2.23	51.57	46.20	15.42	5.11	79.47
3.55	18.99	77.46	16.38	4.47	79.14
3.90	14.78	81.32	18.08	3.83	78.09
5.27	12.77	81.96	20.12	3.27	76.61
8.04	9.49	82.47	22.35	2.64	75.01
10.49	7.79	81.72	24.50	2.13	75.37
12.20	6.57	81.23	24.90	2.3	72.80

(Frankforter and Frary, J. phys. Ch. 1913, 17. 402.)

100 g. sat. solution of NaCl in 99.6% propyl alcohol contain 0.04 g. NaCl at 25°. (Frankforter and Frary.)

Insol. in fusel oil. (Gooch, Am. Ch. J. 9. 53.)

Solubility of NaCl in amyl alcohol + Aq. Liquid phases conjugated at 28°.

Upper layer			Lower layer		
NaCl	amyl alcohol	H <sub>2</sub> O	NaCl	amyl alcohol	H <sub>2</sub> O
0.05	95.45	4.5	26.36	0.22	73.42
"	94.1	5.9	19	0.4	80.4
"	92.9	7.1	12.7	0.8	86.5
"	91.6	8.4	6.2	1.5	92.3
0	90.2	9.8	0	2.3	97.7

(Fonten, Z. phys. Ch. 1910, 73. 226.)

At room temp. 1 pt. by weight is sol. in:

75 pts. methyl alcohol D<sub>15</sub> 0.7990.

566 " ethyl " D<sub>15</sub> 0.8100.

3000 " propyl " D<sub>15</sub> 0.8160.

(Rohland, Z. anorg. 1898, 18. 325.)

100 g. methyl alcohol dissolve 1.31 g. NaCl at 25°.

100 g. ethyl alcohol dissolve 0.065 g. NaCl at 25°  
 100 g. propyl alcohol dissolve 0.012 g. NaCl at 25°  
 100 g. isoamyl alcohol dissolve 0.002 g. NaCl at 25°.  
 (Turner and Bissett, Chem. Soc. 1913, 103, 1909.)

Solubility of NaCl in ethyl+amyl alcohol at 25°.

Upper layer			Lower layer		
% NaCl	% amyl alcohol	% ethyl alcohol	% NaCl	% amyl alcohol	% ethyl alcohol
0.05	95.45	0	26.35	0.22	0
0.10	89.6	9.5	25.30	0.25	1.9
0.25	75.4	19.1	24.02	0.3	9.5
0.58	59.9	30.9	22.64	0.4	6.9
1.23	47.0	38.7	21.19	0.5	10.3
2.81	31.6	44.8	19.25	1.3	16.2
6.56	17.7	41.5	15.81	3.69	22.1

Critical solution. amyl alcohol, 10%; ethyl alcohol, 32.5%; NaCl, 11%; H<sub>2</sub>O, 46.5%.

(Fonten, Z. phys. Ch. 1910, 73, 244.)

Ether ppts NaCl from NaCl+Aq. (Gmelin.)

Very sl. sol. in a mixture of equal pts. of absolute alcohol and ether. (Berzelius.)

500 mg. NaCl treated with above mixture yielded only 0.5 mg. to the liquid. (Lawrence Smith, Am. J. Sci. (2) 16, 57.)

100 pts. of a mixture of 1 pt. 96% alcohol and 1 pt. 98% ether dissolve 0.11 pt. NaCl. (Mayer, A. 98, 205.)

Insol in acetone (Krug and M'Elroy, J. Anal. Ch. 6, 184, Eidmann, C. C. 1899, II 1014.)

Solubility in acetone+Aq at 20°.

A = cem acetone in 100 cem. of the solvent.  
 NaCl = millimols NaCl in 100 cem. of the solution.

A	NaCl
0	537.9
10	464.6
20	394.8
30	330.1
32	lower layer 308.5
to	
87	upper layer 7.7
88	7.3
89	5.6
90	4.3
100	

(Herz and Knoch, Z. anorg. 1904, 41, 318.)

Solubility in acetone+Aq at 20°

% NaCl	% H <sub>2</sub> O	% acetone
25.9	73.06	1.04
24.19	71.18	4.03
25.06	72.00	2.94
20.85	66.78	12.37
20.17	66.01	13.82
18.32	63.16	18.52
20.44	66.19	13.37
17.89	62.21	19.90
0.32	13.92	85.76
0.19	10.82	88.99
0.15	9.62	90.23
0.12	8.94	90.94

(Frankforter and Cohen, J. Am. Chem. Soc. 1914, 36, 1127.)

Solubility in glycol at 14.8° = 31.7% (de Coninck, Belg. Acad. Bull. 1905, 275.)  
 Sol. in glycerine (Pelouze.)

Solubility of NaCl in glycerine+Aq at 25°.

G = g. glycerine in 100 g. glycerine+Aq  
 NaCl = millimols NaCl in 100 cc. of the solution.

G	NaCl	Sp. gr.
0	545.6	1.1960
13.28	501.1	1.2048
25.98	448.4	1.2133
45.36	370.2	1.2283
54.23	333.9	1.2381
83.84	220.8	1.2696
100	167.1	1.2964

(Herz and Knoch, Z. anorg. 1905, 45, 267.)

Insol in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Insol in methyl acetate (Naumann, B. 1909, 42, 3790), ethyl acetate (Naumann, B. 1904, 37, 3802.)

Solubility of NaCl in solutions of HgCl<sub>2</sub> in ethyl acetate.

100 mols. ethyl acetate dissolve			
Mols. HgCl <sub>2</sub>	Mols. NaCl	Mols. HgCl <sub>2</sub>	Mols. NaCl
40.0	20.0	18.0	5.1
38.1	19.6	16.4	4.3
36.0	19.2	14.1	3.8
34.9	18.5	13.2	2.9
34.8	18.3	12.4	2.3
32.1	13.8	12.0	1.6
28.0	9.1	12.2	1.3
22.8	7.0	12.9	0.8
22.9	7.0	..	..

(Lanebarger, Am. Ch. J. 1894, 16, 215.)

## Solubility of NaCl in urea + Aq at 25°.

% urea	% NaCl	% urea	% NaCl
0	31.80	18	27.65
5	30.63	23	27.24
9.6	29.05	28	26.56
13	28.46		

(Ritzel, Z. Kryst. Min. 1911, 49. 152.)

## Solubility of NaCl in urea + Aq at (?)°.

g = g. urea in 100 cc. of solution

sol. = increase of solubility of NaCl in g. per 100 cc. of the solution.

g.	sol.	g.	sol.
5	0.044	30	0.709
10	0.124	35	0.910
15	0.234	40	1.134
20	0.372	45	1.370
25	0.529	50	1.602

(Fastert, N. Jahrb. Min. Beil. Bd. 1912, 23. 286.)

## Solubility of NaCl in formamide + Aq at 25°.

% HCONH <sub>2</sub>	% NaCl	% HCONH <sub>2</sub>	% NaCl
0	31.80	11	29.11
2.3	30.98	15	28.52
5.3	30.86	18.8	27.76
8	30.40		...

(Ritzel, Z. Kryst. Min. 1911, 49. 152.)

Insol. in anhydrous and in 97% pyridine  
 Very sl. sol. in 95% pyridine + Aq. Sl. sol. in 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

Insol. in oil of turpentine (T. S. Hunt, Am. J. Sci. (2) 19. 417.)

100 g. H<sub>2</sub>O dissolve 236.3 g. sugar + 42.3 g. NaCl at 31.25°, or 100 g. sat. aq. solution contain 62.17 g. sugar + 11.13 g. NaCl. (Köhler, Z. Ver. Zuckerind., 1897, 47. 447.)

## Solubility of NaCl in glucose + Aq at 25°.

Conc. = concentration of glucose + Aq in g. mol. per 1,000 g. H<sub>2</sub>O.

Sol. = Solubility in 1,000 g. H<sub>2</sub>O.

Conc.	Sol.	Molecular solubility
0	361.40	6.18
0.25	364.15	6.22
0.50	364.30	6.23
1.0	369.90	6.32

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) 84. 127.)

## Min. Halide.

+2H<sub>2</sub>O. Efflorescent below 0°, sl. deliquescent at temps. above 0°. (Fuchs, 1836.)

The solubility in H<sub>2</sub>O at -12.25° corresponds to 32.9 pts. of NaCl per 100 pts. H<sub>2</sub>O. (Matignon, C. R. 1909, 148. 551.)

Sodium stannic chloride, 2NaCl, SnCl<sub>4</sub> + 6H<sub>2</sub>O.

See Chlorostannate, sodium.

Sodium thallic chloride, 3NaCl, TlCl<sub>3</sub> + 12H<sub>2</sub>O.

Very sol. in H<sub>2</sub>O. (Pratt, Am. J. Sci. 1895, (3) 49. 404.)

Sodium uranium chloride, 2NaCl, UCl<sub>4</sub>.

Non volatile and not hygroscopic. (Moissan, C. R. 1899, 122. 1089.)

Sol. in H<sub>2</sub>O. (Colani, A. ch. 1907, (8) 12. 59.)

Sodium uranyl chloride, Na<sub>2</sub>(UO<sub>2</sub>)Cl<sub>4</sub>.

As K salt. (Aloy, Bull. Soc. 1899, (3) 21. 264.)

Sodium zinc chloride, 2NaCl, ZnCl<sub>2</sub> + 3H<sub>2</sub>O.

Deliquescent. Easily sol. in H<sub>2</sub>O. (Schindler, Mag. Pharm. 38. 48.)

Sodium zirconium chloride, 2NaCl, ZrCl<sub>4</sub>.

(Paykull.)

Sodium chloriodide, NaCl<sub>2</sub>I + 2H<sub>2</sub>O.

Easily decomp. by alcohol or ether. (Wells and Wheeler, Sill. Am. J. 143. 42.)

Sodium fluoride, NaF.

Very sl. sol. in cold, and not more abundantly in boiling H<sub>2</sub>O. (Roos.)

100 pts. H<sub>2</sub>O dissolve 4.78 pts. at 16°. (Berzelius.)

100 pts. H<sub>2</sub>O dissolve 4 pts. at 15°. (Fremy, A. ch. (3) 47. 32.)

Sp. gr. of aqueous solutions containing in 100 pts. H<sub>2</sub>O.

1.1081    2.2162    3.3243 pts. NaF.

1.0110    1.0221    1.0333

Sat. solution has sp. gr. 1.0486. (Gerlach, Z. anal. 27. 277.)

Sp. gr. of solution sat. at 18° = 1.044, containing 4.3% NaF. (Mylius and Funk, B. 1897, 30. 1718.)

## Solubility of NaF in HF + Aq at 21°.

g. per 1000 g. H <sub>2</sub> O		g. per 1000 g. H <sub>2</sub> O	
HF	NaF	HF	NaF
0.0	41.7	83.8	22.9
10.0	41.4	120.7	23.8
45.8	22.5	596.4	48.8
56.5	22.7	777.4	81.7

(Ditte, C. R. 1896, 123. 1282.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, 46. 2.)

Sl. sol. in conc. KC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (Stromeyer.)

Almost insol. in alcohol. (Berzelius, Pogg. 1. 13.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Sodium hydrogen fluoride,  $\text{NaHF}_2$ 

Rather difficultly sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 1. 13)

## Sodium tantalum fluoride.

See Fluotantalate, sodium.

Sodium tin (stannous) fluoride,  $2\text{NaF}$ ,  $3\text{SnF}_2$ .

Sol. in  $\text{H}_2\text{O}$  (Wagner, B. 19. 896.)

## Sodium tin (stannic) fluoride.

See Fluostannate, sodium.

## Sodium tantalum fluoride.

See Fluotantalate, sodium.

Sodium tellurium fluoride,  $\text{NaF}$ ,  $\text{TeF}_4$ .

Decomp. by  $\text{H}_2\text{O}$  (Berzelius)

## Sodium titanium fluoride.

See Fluotitanate, sodium.

## Sodium tungstic fluoride.

See Fluoxytungstate, sodium.

Sodium uranium fluoride,  $\text{NaF}$ ,  $\text{UF}_4$  (?)

Somewhat soluble in  $\text{H}_2\text{O}$ . (Bolton.)

## Sodium uranyl fluoride.

See Fluoxurionate, sodium.

## Sodium vanadium sesquifluoride.

See Fluovanadate, sodium.

Sodium zinc fluoride,  $\text{NaF}$ ,  $\text{ZnF}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (R. Wagner)

Sodium zirconium fluoride,  $5\text{NaF}$ ,  $2\text{ZrF}_4$ .

See Fluozirconate, sodium.

## Sodium fluoride vanadium pentoxide.

See Fluoxovanadate, sodium.

Sodium hydrazide,  $\text{NH}_2$ ,  $\text{NHNa}$ .

Decomp. by  $\text{H}_2\text{O}$  with explosive violence.  
Decomp. by alcohol (Schlenk, B. 1915. 48. 870.)

Sodium hydride,  $\text{NaH}$ .

Decomp. by  $\text{H}_2\text{O}$  and by acids.

Sol. in fused  $\text{Na}$  or  $\text{Na}$  amalgam. Insol. in liquid  $\text{NH}_3$ . Insol. in  $\text{CS}_2$ ,  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_6$  and terebenthene. (Moissan, C. R. 1902. 134. 73)

$\text{Na}_2\text{H}_4$  Decomp. violently by  $\text{H}_2\text{O}$ .

Sodium hydrosulphide,  $\text{NaSH}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol +  $3\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ . (Damoiseau, C. C. 1885. 36.)

Sodium hydroxide,  $\text{NaOH}$ .

Very deliquescent. 100 pts.  $\text{NaOH}$  under a bell jar with  $\text{H}_2\text{O}$  at  $16-20^\circ$  absorb 552 pts. in 56 days. (Mulder.)  
Very sol. in  $\text{H}_2\text{O}$  with evolution of much heat. Sol. in 0.47 pt  $\text{H}_2\text{O}$ . (Bureau, C. R. 41. 509.)

Solubility of  $\text{NaOH}$  in  $\text{H}_2\text{O}$ .

$t^\circ$	g. per 100 g		Solid phase
	Solu- tion	$\text{H}_2\text{O}$	
-7 8	8.0	8.7	Ice
-20	16.0	19.1	"
-28	19.0	23.5	Ice + $\text{NaOH}$ $7\text{H}_2\text{O}$
-24	22.2	28.5	$\text{NaOH}$ $7\text{H}_2\text{O}$ + $\text{NaOH}$ $5\text{H}_2\text{O}$
-17 7	24.5	32.5	$\text{NaOH}$ $5\text{H}_2\text{O}$ + $\text{NaOH}$ $4\text{H}_2\text{O}$
0	29.6	42.0	$\text{NaOH}$ $4\text{H}_2\text{O}$
+5	32.2	47.5	$\text{NaOH}$ $4\text{H}_2\text{O}$ + $\text{NaOH}$ $3\frac{1}{2}\text{H}_2\text{O}$
10	34.0	51.5	$\text{NaOH}$ $3\frac{1}{2}\text{H}_2\text{O}$
15	38.9	63.53	" f. pt
5	45.5	83.5	$\text{NaOH}$ $3\frac{1}{2}\text{H}_2\text{O}$ + $\text{NaOH}$ $2\text{H}_2\text{O}$
12	50.7	103.0	$\text{NaOH}$ $2\text{H}_2\text{O}$ + $\text{NaOH}$ $\text{H}_2\text{O}$
20	52.2	109	$\text{NaOH}$ $\text{H}_2\text{O}$
30	54.3	119	"
40	56.3	129	"
50	59.2	145	"
60	63.5	174	"
64	3.69	0.222 3	" f. pt
61	8.74	2.288	$\text{NaOH}$ $\text{H}_2\text{O}$ + $\text{NaOH}$
80	75	8.313	$\text{NaOH}$ (?)
110	78	5.365	"
192	83	0.521	"

(Pickering, Chem. Soc. 1893. 83. 890; Mylius and Funk, W. A. B. 1900. 3. 450. Calc. by Seidell, Solubilities, 2d Edition, p. 653.)

100 g. sat.  $\text{NaOH}$  +  $\text{Aq}$  at  $15^\circ$  contain 46.86 g.  $\text{NaOH}$ . (de Forcrand, C. R. 149. 1344.)

Sp. gr. and b.-pt. of  $\text{NaOH}$  +  $\text{Aq}$ .

% $\text{Na}_2\text{O}$	Sp. gr.	B.-pt.	% $\text{Na}_2\text{O}$	Sp. gr.	B.-pt.
4.7	1.06	100.56°	31.0	1.44	120.00°
9.0	1.12	101.11	34.0	1.47	123.89
13.0	1.18	102.78	36.8	1.50	129.44
16.0	1.23	104.44	41.2	1.56	137.75
19.0	1.29	106.95	46.6	1.63	145.69
23.0	1.32	108.89	53.8	1.72	204.44
26.0	1.36	112.78	63.6	1.85	315.60
29.0	1.40	116.06	77.8	2.00	red heat

(Dalton)

Sp. gr. of  $\text{NaOH}$  +  $\text{Aq}$  at  $15^\circ$ .

% $\text{Na}_2\text{O}$	Sp. gr.	% $\text{Na}_2\text{O}$	Sp. gr.	% $\text{Na}_2\text{O}$	Sp. gr.
0.302	1.0040	10.879	1.1630	21.154	1.3063
0.601	1.0081	11.494	1.1734	21.758	1.3125
1.209	1.0183	12.088	1.1841	21.894	1.3143
1.813	1.0246	12.692	1.1948	22.263	1.3198
2.418	1.0330	13.207	1.2058	22.967	1.3273
3.022	1.0416	13.901	1.2178	23.572	1.3340
3.620	1.0500	14.506	1.2280	24.170	1.3429
4.231	1.0587	15.110	1.2392	24.780	1.3505
4.835	1.0675	15.714	1.2453	25.385	1.3588
5.440	1.0764	16.319	1.2515	26.989	1.3695
6.044	1.0855	16.923	1.2578	27.594	1.3751
6.648	1.0948	17.528	1.2642	27.200	1.3830
7.253	1.1042	18.132	1.2708	27.802	1.3923
7.857	1.1137	18.730	1.2775	28.407	1.4011
8.462	1.1233	19.341	1.2843	29.011	1.4101
9.066	1.1330	19.954	1.2912	29.616	1.4193
9.670	1.1428	20.560	1.2982	30.220	1.4285
10.275	1.1528				

(Tünnerman, N. J. Pharm. 18. 2)

Sp gr of NaOH + Aq					
% Na <sub>2</sub> O	Sp. gr.	% Na <sub>2</sub> O	Sp. gr.	% Na <sub>2</sub> O	Sp. gr.
2.07	1.02	11.73	1.16	28.16	1.30
1.02	1.04	16.73	1.18	29.96	1.32
5.89	1.06	18.71	1.20	31.67	1.34
7.69	1.08	20.66	1.22	32.40	1.35
9.43	1.10	22.58	1.24	33.08	1.36
11.10	1.12	24.47	1.26	34.41	1.38
12.81	1.14	26.33	1.28		

(Richter)

Sp. gr. of NaOH + Aq at 15°.

%	Sp. gr. if % Na <sub>2</sub> O	Sp. gr. if % NaOH	%	Sp. gr. if % Na <sub>2</sub> O	Sp. gr. if % NaOH
1	1.015	1.012	32	1.450	1.351
2	1.020	1.023	33	1.462	1.363
3	1.043	1.035	34	1.475	1.374
4	1.058	1.046	35	1.488	1.384
5	1.074	1.059	36	1.500	1.395
6	1.089	1.070	37	1.515	1.405
7	1.104	1.081	38	1.530	1.415
8	1.119	1.092	39	1.543	1.426
9	1.132	1.103	40	1.558	1.437
10	1.145	1.115	41	1.570	1.447
11	1.160	1.126	42	1.583	1.456
12	1.175	1.137	43	1.597	1.468
13	1.190	1.148	44	1.610	1.478
14	1.203	1.159	45	1.623	1.488
15	1.219	1.170	46	1.637	1.499
16	1.233	1.181	47	1.650	1.508
17	1.245	1.192	48	1.663	1.519
18	1.258	1.202	49	1.678	1.529
19	1.270	1.213	50	1.690	1.540
20	1.285	1.225	51	1.705	1.550
21	1.300	1.236	52	1.719	1.560
22	1.315	1.247	53	1.730	1.570
23	1.329	1.258	54	1.745	1.580
24	1.341	1.269	55	1.760	1.591
25	1.355	1.279	56	1.770	1.601
26	1.369	1.290	57	1.785	1.611
27	1.381	1.300	58	1.800	1.622
28	1.395	1.310	59	1.815	1.633
29	1.410	1.321	60	1.830	1.643
30	1.422	1.332	70		1.748
31	1.438	1.343			

(Gerlach, Z anal. 8. 279, calculated from Schuff, A. 107. 300)

Sp. gr. of NaOH + Aq at 15°.

% NaOH	Sp. gr.	% NaOH	Sp. gr.
0.61	1.0070	4.0	1.0435
0.9	1.0105	4.32	1.0473
1.0	1.0107	4.64	1.0511
1.2	1.0141	4.96	1.0549
1.6	1.0177	5.29	1.0588
2.0	1.0213	5.58	1.0627
2.36	1.0249	5.87	1.0667
2.71	1.0286	6.21	1.0706
3.0	1.0318	6.55	1.0746
3.35	1.0360	6.76	1.0787
3.67	1.0397	7.31	1.0827

Sp. gr. of NaOH + Aq at 15°—Continued

% NaOH	Sp. gr.	% NaOH	Sp. gr.
7.66	1.0868	24.81	1.2748
8.0	1.0909	25.3	1.2800
8.34	1.0951	25.8	1.2857
8.68	1.0992	26.31	1.2905
9.0	1.1030	26.83	1.2973
9.42	1.1077	27.31	1.3032
9.74	1.1120	27.8	1.3091
10.0	1.1158	28.31	1.3151
10.5	1.1195	28.83	1.3211
10.97	1.1250	29.38	1.3272
11.42	1.1294	30.0	1.3339
11.84	1.1339	30.57	1.3395
12.24	1.1383	31.22	1.3458
12.64	1.1423	31.85	1.3521
13.0	1.1474	32.47	1.3585
13.55	1.1520	33.0	1.3642
13.86	1.1566	33.69	1.3714
14.5	1.1631	34.38	1.3780
14.75	1.1662	35.0	1.3858
15.0	1.1697	35.65	1.3913
15.5	1.1755	36.25	1.3981
15.91	1.1803	36.86	1.4049
16.38	1.1852	37.47	1.4118
16.77	1.1901	38.13	1.4187
17.22	1.1950	38.8	1.4267
17.67	1.2000	39.39	1.4328
17.12	1.2050	40.0	1.4410
18.58	1.2101	40.75	1.4472
19.0	1.2148	41.41	1.4545
19.58	1.2202	42.12	1.4619
20.0	1.2250	42.83	1.4694
20.59	1.2308	43.66	1.4769
21.0	1.2361	44.38	1.4845
21.42	1.2414	45.27	1.4922
22.0	1.2462	46.15	1.5000
22.64	1.2522	46.87	1.5079
23.15	1.2576	47.60	1.5158
23.67	1.2632	48.31	1.5238
24.24	1.2687	49.02	1.531

Hager, Comm. 1883.)

The sp. gr. increases or diminishes for each degree as follows.

% NaOH	Corr.
40-50	0.00045
30-39	0.0004
20-29	0.0003
10-19	0.0002

Hager, Comm. 1883.)

Sp. gr. of NaOH + Aq at 15°.

% NaOH	Sp. gr.	% NaOH	Sp. gr.
2.5	1.0280	20	1.2262
5	1.0568	25	1.2823
10	1.1131	30	1.3374
15	1.1790		

(Kohlrausch, W. Ann. 1879.)

Sp. gr. of NaOH+Aq at 20° containing 2 mols NaOH to 100 mols H<sub>2</sub>O = 1.04712 (Nicol, Phil. Mag. (5) 16, 122.)

Sp. gr. of NaOH+Aq at 15°.

% Na <sub>2</sub> O	Sp. gr.	% NaOH	Sp. gr.
5	1.069	25	1.353
10	1.139	30	1.426
15	1.210	35	1.500
20	1.281		

(Hager, Adjumenta Varia, Leipsic, 1876.)

Sp. gr. of NaOH+Aq at 15°.

% NaOH	Sp. gr.	% NaOH	Sp. gr.	% NaOH	Sp. gr.
0	0.909180	17	1.188707	34	1.373453
1	1.010611	18	1.199783	35	1.383815
2	1.021920	19	1.210861	36	1.394092
3	1.033109	20	1.221933	37	1.404279
4	1.044317	21	1.233062	38	1.414363
5	1.055463	22	1.244110	39	1.424353
6	1.066602	23	1.255134	40	1.434299
7	1.077733	24	1.266092	41	1.444161
8	1.088856	25	1.277063	42	1.453929
9	1.099969	26	1.287990	43	1.463623
10	1.111069	27	1.298877	44	1.473249
11	1.122165	28	1.309708	45	1.482850
12	1.133250	29	1.320496	46	1.492406
13	1.144335	30	1.331213	47	1.501927
14	1.155450	31	1.341879	48	1.511412
15	1.166538	32	1.352472	49	1.520868
16	1.177619	33	1.362991	50	1.530282

(Pickering, Phil. Mag. 1894, (5) 37, 373.)

Sp. gr. of a N solution of NaOH+Aq at 18°/18° = 1.0418. (Loomis, W. Ann. 1896, 60, 550.)

Sp. gr. of NaOH+Aq  
% NaOH 8.73 3.67 3.82  
Sp. gr. 20°/20° 1.0968 1.0416 1.0464  
(Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 272.)

Sp. gr. of NaOH+Aq at t°. H<sub>2</sub>O at 4° = 1.  
The solutions contained a small amount of Na<sub>2</sub>CO<sub>3</sub>.

t°	% NaOH	% Na <sub>2</sub> CO <sub>3</sub>	Sp. gr.
60	22.57	0.61	1.2312
	20.04	0.48	1.2026
	17.04	0.35	1.1892
	14.16	0.38	1.1374
	10.02	0.36	1.1020
80	22.81	0.55	1.2207
	14.01	0.42	1.1232

(Wegscheider and Walter, M. 1905, 26, 691.)

Sat. NaOH+Aq boils at 215.5° (Griffiths.)

Sat. NaOH+Aq boils at 310°. (Gerlach, Z. anal. 26, 427.)

NaOH+Aq of 1.500 sp. gr. contains 36.8% NaOH and boils at 130°.

B.-pt. of NaOH+Aq containing pts. NaOH to 100 pts. H<sub>2</sub>O

B.-pt.	Pts. NaOH	B.-pt.	Pts. NaOH
105°	17	210°	425.5
110	30	215	475.5
115	41	220	526.3
120	51	225	583.3
125	60.1	230	645.2
130	70.1	235	714.3
135	81.1	240	800
140	93.5	245	888.8
145	106.5	250	1000
150	120.4	255	1142.8
155	134.5	260	1333.3
160	150.8	265	1534
165	168.8	270	1739.1
170	187	275	2000
175	208.3	280	2353
180	230	285	2857
185	254.5	290	3671.4
190	281.7	300	4651.1
195	312.3	305	6451.6
200	345	310	10526.3
205	380.9	314	22222.2

(Gerlach, Z. anal. 26, 463.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20, 829.)

Sp. gr. of Na<sub>2</sub>CO<sub>3</sub>+NaOH+Aq at 11.5°  
H<sub>2</sub>O at 4° = 1.

% Na <sub>2</sub> CO <sub>3</sub>	% NaOH	Sp. gr.
3.845	14.10	1.196
3.171	13.03	1.182
2.204	12.51	1.164
1.642	10.17	1.136
0.2686	16.64	1.186

(Wegscheider and Walter, M. 1905, 26, 693.)

Sp. gr. of Na<sub>2</sub>CO<sub>3</sub>+NaOH+Aq at t°. H<sub>2</sub>O at 4° = 1.

t°	% Na <sub>2</sub> CO <sub>3</sub>	% NaOH	Sp. gr.
60°	15.38	10.63	1.2621
	13.79	9.52	1.2302
	12.10	8.29	1.1952
	9.965	6.86	1.1694
	9.47	6.70	1.1521
	7.69	5.22	1.1158
80°	15.26	11.14	1.2510
	9.48	6.93	1.1417

(Wegscheider and Walter, M. 1905, 26, 692.)

Solubility of NaOH+Na<sub>2</sub>SbS<sub>4</sub> at 30°.

% NaOH	% NaSbS <sub>4</sub>	Solid phase
0	27.1	Na <sub>2</sub> SbS <sub>4</sub> ·9H <sub>2</sub> O
9.9	13.	"
24.8	5.9	"
32.9	10.5	"
42.6	16.4	"
47.2	17.7	" + NaOH, H <sub>2</sub> O
49.5	9.1	NaOH, H <sub>2</sub> O
54.3	0	"

(Donk, Chem. Weekbl. 1908, 5. 539, 629, 767.)

Easily sol. in alcohol or wood spirit; sol in fusel-oil. Sol. in an aqueous solution of mannite (Favre, A. ch. (3) 11. 76.)

Easily sol in glycerine.

Sol to a certain extent in ether

Insol. in acetone. (Eidmann, C C 1899, II 1014, Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate (Naumann, B. 1904, 37. 3602); benzonitrile (Naumann, B. 1914, 47. 1370)

+H<sub>2</sub>O. 100 g solution in H<sub>2</sub>O sat at 25° contain 42 g. Na<sub>2</sub>O. (Schreinemakers, Arch Néer. Sc 1910, (2) 15. 81)

Mpt 64.2°. (See above.)

+1 $\frac{1}{2}$ H<sub>2</sub>O. (Cripps, Pharm J. Trans. (3) 14. 833.)

+2H<sub>2</sub>O. See above.

+3 $\frac{1}{2}$ H<sub>2</sub>O. Deliquescent Sol. in H<sub>2</sub>O with absorption of much heat Melts at 6° (Hermes.)

Mpt 15.5°. (See above.)

+4.5 and 7H<sub>2</sub>O. (See above)

The composition of the hydrates formed by NaOH at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by NaOH and of the conductivity and sp. gr. of NaOH+Aq (Jones, Am. Ch. J 1905, 34. 336.)

Sodium perhydroxide, NaO<sub>2</sub>H.

"Natrly hydroxide"

Decomp by H<sub>2</sub>O. Sol. in cold alcohol or acetic acid (Tafel, B. 1894, 27. 2300.)

Sodium iodide, NaI, and +2H<sub>2</sub>O.

Solubility of NaI and of NaI+2H<sub>2</sub>O in H<sub>2</sub>O differ. Below 65°, NaI+2H<sub>2</sub>O usually separates out, and above that temp. NaI separates.

Solubility of NaI in 100 pts H<sub>2</sub>C at t°.

t°	Pts NaI	t°	Pts NaI	t°	Pts NaI
71.3	294.4	92.4	300.2	124.7	317.5
74.1	295.3	97.1	300.3	132.5	317.3
81.6	296.8	101.7	302.5	138.1	319.2
86.4	298.3	110.7	306.2	..	..

Solubility is represented by a straight line of the formula  $S = 264.19 + 0.3978t$ .

Solubility of NaI+2H<sub>2</sub>O in 100 pts at t°.

t°	Pts NaI	t°	Pts NaI	t°	Pts NaI
-17	149.4	15	173.7	45	215.6
-15	150.3	20	178.7	50	227.8
-5	155.4	25	184.2	55	241.2
0	158.7	30	190.3	60	256.8
5	163.6	35	197.0	65	278.4
10	168.6	40	205.1		

(Coppet, A. ch. (5) 50. 424.)

If solubility  $S$  = pts. NaI in 100 pts solution,  $S = 61.3 + 0.1712t$  from 0° to 80°,  $S = 75 + 0.0258t$  from 80° to 160°. (Etard, C. R. 98. 1432.)

NaI+2H<sub>2</sub>O is sol in 0.55 pt H<sub>2</sub>O at 15°. (Eder, Dingl. 221. 89.)

100 pts. NaI+Aq at 18-19° contain 62.98 pts. NaI (v. Hauer, J. pi 98. 137.)

100 pts. H<sub>2</sub>O dissolve at.

0°	20°	40°	60°
158.7	178.6	208.4	256.4 pts. NaI,
80°	100°	120°	140°
303	312.5	322.5	333.3 pts. NaI.

(Kiemers, Pogg. 97. 14.)

Transition pt. for NaI+2H<sub>2</sub>O to NaI is 64.3°, and sat. solution containing 74.4% NaI. (Panfiloff, J. Russ. Phys. Chem. Soc. 1893, 25. 162)

100 g. H<sub>2</sub>O dissolve 172.4 g NaI at 15°, and sp. gr of sat. solution = 1.8937 (Greenish, Pharm J. 1900, 65. 190.)

100 g. solution of NaI+2H<sub>2</sub>O sat. at 30° contains 65.5 g anhyd. NaI. (Cocherot, Dissert. 1910.)

Sp gr. of NaI+Aq at 19.6° containing:

5	10	15	20	25	30 % NaI,
1.040	1.082	1.128	1.179	1.234	1.294

35 40 45 50 55 60 % NaI.  
1.360 1.432 1.510 1.60 1.70 1.81

(Gerlach, Z. anal. 8. 285)

Sat solution boils at 141°

Sol in liquid SO<sub>2</sub>. (Walden, B. 1899, 32. 2864); POCl<sub>3</sub>. (Walden, Z. anorg 1900, 26. 212.)

Very easily sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 829)

Sol in 12.0 pts absolute alcohol; in 360 pts. ether (Eder, Dingl. 221. 89.)

Sol. in 3 pts 90% alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 77.7 pts NaI at 22.5°; ethyl alcohol, 43.1 pts. (de Bruyn, Z. phys. Ch. 10. 783.)

Very sol. in abs. methyl alcohol and is not pptd. therefrom on the addition of a large volume of abs. ether, while wet ether produces immediate separation. (Loeb, J. Am. Chem. Soc. 1906, 27. 1020.)

Solubility of NaI in ethyl alcohol  
(g NaI in 100 g. alcohol.)

t°	NaI	t°	NaI
10	43.77	200	42.3
30	44.25	220	38.5
50	44.50	230	36.2
80	45.0	240	32.7
100	45.1	250	26.2
120	45.2	255	21.0
160	45.0	260	10.8
180	44.3	261.5*	8.6

\*Critical temp. of solution.

(Tyrer, Chem. Soc. 1910, 97. 626.)

100 g. sat. solution of NaI in ethyl alcohol at 30° contains 30.9 g. (Cocheret, Dissert, 1910.)

Solubility in ethyl alcohol+Aq at 30°

% NaI	% alcohol	Solid phase
65.52	0	NaI, 2H <sub>2</sub> O
64	3.40	"
54.2	18.5	"
54	18.8	"
48.8	28.5	"
42.35	41.7	"
38.5	53.2	"
37.91	54.7	"
37.49	55.37	NaI, 2H <sub>2</sub> O+NaI
35.65	59.24	NaI
33.24	61.78	"
30.90	68.70	"

(Cocheret, Dissert. 1911.)

At room temp 1 pt by weight is sol in:

1.2 pts. methyl alcohol D<sup>16</sup> 0.7990  
1.7 " ethyl " D<sup>16</sup> 0.8100  
3.8 " propyl " D<sup>16</sup> 0.8160.

(Rohland, Z. anorg. 1898, 18. 325.)

100 g. methyl alcohol dissolve 90.35 g. NaI at 25°

100 g. ethyl alcohol dissolve 46.02 g. NaI at 25°.

100 g. propyl alcohol dissolve 28.22 g. NaI at 25°.

100 g. isomyl alcohol dissolve 16.30 g. NaI at 25°.

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

Solubility in methyl alcohol+ethyl alcohol at 25°.

P = % methyl alcohol in the solvent  
G = g NaI in 10 ccm. of the solution  
S = Sp gr of the sat. solution at 25°

P	G	S 25°/4°
0.00	3.515	1.0806
4.37	3.768	1.1020
10.40	3.971	1.1123
41.02	4.598	1.1742
80.69	5.744	1.2741
84.77	5.892	1.2886
91.25	6.110	1.3056
100.00	6.322	1.3250

(Herz and Kuhn, Z. anorg. 1908, 60. 154.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = g. NaI in 10 ccm. of the solution  
S = Sp gr of the sat. solution.

P	G	S 25°/4°
0	6.322	1.3250
11.11	5.845	1.2853
23.8	5.464	1.2528
65.2	4.071	1.138
91.8	2.914	1.0420
93.75	2.649	1.0178
100.00	2.411	0.9968

(Herz and Kuhn, Z. anorg. 1908, 60. 156.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = g NaI in 10 ccm. of the solution.  
S = Sp gr. of the sat. solution

P	G	S 25°/4°
0	3.515	1.0806
8.1	3.460	1.0732
17.85	3.405	1.0720
56.6	2.841	1.0276
88.6	2.613	1.0130
91.2	2.588	1.0104
95.2	2.474	1.0020
100	2.411	0.9968

(Herz and Kuhn, Z. anorg. 1908, 60. 159.)

Sol. in normal propyl alcohol. (Loeb, J. Am. Chem. Soc. 1905, 27. 1020.)

28.74 g. are sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, 14. 276.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

Sol. in ethyl acetate. (Casasaca, C. R. 30. 821.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sl. sol. in benzonitrile (Naumann, B 1914, 47. 1369.)

Solubility in organic solvents at t°.

C = pts by wt. of NaI in 100 ccm of the sat. solution.

L = no. of liters which at the saturation temp hold in solution 1 mol NaI.

Solvent	t°	C	L
Furfural	25	25 10	0.597
Acetonitrile	25	18 43	0.813
"	0	22 09	0 679
Propionitrile	25	6 230	2 406
"	0	9.091	1 649
Nitromethane	25	0.478	31.36
"	0	0.339	44.27

(Walden, Z. phys. Ch. 1906, 55. 718.)

Very sol. in acetone. (Walden.)  
+5H<sub>2</sub>O. Transition point of NaI+5H<sub>2</sub>O to NaI+2H<sub>2</sub>O is -13.5°, and sat. solution contains 60.2% NaI. (Panfiloff, J. Russ. Phys. Chem. Soc. 1893, 25. 162.)

Sodium tin (stannous) iodide, NaI, SnI<sub>2</sub>.

Very sol. in H<sub>2</sub>O. When treated with little H<sub>2</sub>O, NaI is dissolved out, but a larger amt. of H<sub>2</sub>O dissolves it completely (Boullay, A. ch. (2) 34. 375)

Sodium zinc iodide, 2NaI, ZnI<sub>2</sub>+3H<sub>2</sub>O.  
Deliquescent.

NaZnI<sub>3</sub>+2H<sub>2</sub>O. Very hygroscopic. (Ephraïm, Z. anorg. 1910, 67. 383.)

Sodium nitride,

Decomp. by heat. (Franz Fisher, B 1910; 43. 1468.)

Sodium suboxide, Na<sub>2</sub>O.

Decomp. by H<sub>2</sub>O. (de Forciand, C. R. 1898, 127. 365)

Sodium oxide, Na<sub>2</sub>O.

Very deliquescent, and sol in H<sub>2</sub>O with evolution of heat

See Sodium hydroxide.

Sodium peroxide, Na<sub>2</sub>O<sub>2</sub>.

Deliquescent, and very sol. in H<sub>2</sub>O with partial decomp.

Solution decomp. on boiling.

Cryst. with 2H<sub>2</sub>O, and 8H<sub>2</sub>O. (Fairley, Chem. Soc. 1877. 125.)

Forms hydrate Na<sub>2</sub>O<sub>2</sub>(OH)<sub>2</sub>+4H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O or dil. acids without decomp. (Schone, A. 193. 241.)

Sodium peroxide carbonate, Na<sub>2</sub>CO<sub>4</sub>

Easily decomp. (Woffenstein, B. 1908, 41. 285.)

Sodium peroxide dicarbonate, Na<sub>2</sub>C<sub>2</sub>O<sub>6</sub>.

Easily decomp. (Woffenstein, B. 1908, 41. 287.)

Sodium trioxide, Na<sub>2</sub>O<sub>3</sub>

Sol. in H<sub>2</sub>O forming a solution of Na<sub>2</sub>O<sub>2</sub>. (Joannis, C. R. 1893, 116. 1371)

Sodium trioxide carbonate, Na<sub>2</sub>CO<sub>3</sub>

(Woffenstein, B 1908, 41. 296.)

Sodium trioxide dicarbonate, NaHCO<sub>4</sub>.

Two isomeric modifications. (Woffenstein, B. 1908, 41. 390)

Sodium trioxide hydrate, NaO OH.

See Sodium perhydroxide.

Isomeric with Tafel's sodyl hydroxide. O.Na OH (B. 27, 2297)

Insol. in alcohol

Very unstable. (Woffenstein, B 1908, 41. 290)

Sodium phosphide, NaP<sub>3</sub>.

Easily decomp. by H<sub>2</sub>O (Hugot, C. R. 1895, 121. 208.)

Sodium hydrogen phosphide, NaH<sub>2</sub>P.

Decomp by H<sub>2</sub>O. (Joannis, C. R. 1894, 119. 558.)

Na<sub>2</sub>H<sub>2</sub>P<sub>2</sub>. Decomp by acids and H<sub>2</sub>O. (Hugot, C. R., 1898, 126. 1721.)

Sodium selenide, Na<sub>2</sub>Se

Very deliquescent. Decomp. by H<sub>2</sub>O. (Uelsmann, A. 116. 127)

Insol. in liquid NH<sub>3</sub>; sol. in air free H<sub>2</sub>O to a colorless liquid. (Hugot, C. R. 1899, 129. 299.)

Cryst with 16H<sub>2</sub>O, 9H<sub>2</sub>O, and 1/2H<sub>2</sub>O. (Fabre, C. R. 102. 613)

+10H<sub>2</sub>O Very sol. in H<sub>2</sub>O; very unstable in the air (Clever, Z. anorg 1895, 10. 145.)

Sodium diselenide, Na<sub>2</sub>Se<sub>2</sub>.

(Jackson, B. 7. 1277)

Sodium triselenide, Na<sub>2</sub>Se<sub>3</sub>.

Sol. in H<sub>2</sub>O. (Mathewson, J. Am. Chem. Soc. 1907, 29. 873.)

Sodium hexaselenide, Na<sub>2</sub>Se<sub>6</sub>.

Sol. in H<sub>2</sub>O. (Mathewson, J. Am. Chem. Soc. 1907, 29. 873.)

Sodium monosulphide, Na<sub>2</sub>S.

Sol. in H<sub>2</sub>O Much less sol. in alcohol than in H<sub>2</sub>O. Insol in ether (Roussin.)

+5H<sub>2</sub>O. Tr. pt. from Na<sub>2</sub>S+5½H<sub>2</sub>O, 94°

+5½H<sub>2</sub>O.

The sat. solution contains.—

28	48	% anhydrous salt at	50°
29	27	" "	55°
29	92	" "	60°
31	38	" "	70°
33	95	" "	80°
37	20	" "	90°

Labile from 48–91.5°; stabile from 91.5–96°.

(Parravano and Fornani, C. C. 1908, I. 5.)

+6H<sub>2</sub>O Less efflorescent than with 9H<sub>2</sub>O. Sol. in H<sub>2</sub>O and alcohol.

The sat. solution contains.—

26	7	% anhydrous salt at	50°
28	1	" "	60°
30	22	" "	70°
32	95	" "	80°
36	42	" "	90°

Tr. pt. to Na<sub>2</sub>S+5½H<sub>2</sub>O, 91.5°.

(Parravano and Fornani.)

+9H<sub>2</sub>O Efflorescent. Much less sol in alcohol than H<sub>2</sub>O. When dissolved in H<sub>2</sub>O, temp. sinks from +22 to –6.1° (Finger, Pogg. 128. 635)

The sat. solution contains—

9	34	% anhydrous Na <sub>2</sub> S at	–10°
13	36	" "	+10°
14	36	" "	15°
15	30	" "	18°
16.2	"	" "	22°
17	73	" "	28°
19	09	" "	32°
20	98	" "	37°
24	19	" "	45°

Tr. pt. to Na<sub>2</sub>S+5½H<sub>2</sub>O, 48.9°.

(Parravano and Fornani.)

Sodium disulphide, Na<sub>2</sub>S<sub>2</sub>

Sol. in H<sub>2</sub>O and alcohol

+5H<sub>2</sub>O. Not efflorescent

Sodium trisulphide, Na<sub>2</sub>S<sub>3</sub>

Sol. in H<sub>2</sub>O with decomp

Cryst. with 3H<sub>2</sub>O from an alcoholic solution (Böttger, A. 223. 355)

Sodium tetrasulphide, Na<sub>2</sub>S<sub>4</sub>+6H<sub>2</sub>O.

Very deliquescent, and sol. in H<sub>2</sub>O. Difficultly sol. in absolute alcohol Insol. in ether. (Schöna)

+8H<sub>2</sub>O. Efflorescent. (Böttger.)

Sodium pentasulphide, Na<sub>2</sub>S<sub>5</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Schöna.)

Sol. in alcohol.

+8H<sub>2</sub>O (Böttger)

Solution is easily decomp. by warming. (Jones, Chem. Soc. 37. 461)

Sodium tellurium sulphide.

See Sulphotellurate, sodium.

Sodium stannic sulphide.

See Sulphostannate, sodium.

Sodium yttrium sulphide, Na<sub>2</sub>S, Y<sub>2</sub>S<sub>3</sub>.

Decomp. by dil. acids, even by HCl. H<sub>2</sub>O<sub>2</sub>+Aq. (Dubouin, C. R. 107. 243)

Sodium zinc sulphide, Na<sub>2</sub>S, 3ZnS

Not so stable as the corresponding K salt. (Schneider, J. pr. (2) 8. 29.)

Sodium sulphoselenide, Na<sub>2</sub>SSe<sub>2</sub>+5H<sub>2</sub>O

Hydroscopic, and decomp. in the air (Meesinger, B. 1897, 30. 806)

Sodium telluride, Na<sub>2</sub>Te.

Sol. in H<sub>2</sub>O. (Demarçay, Bull. Soc. (2) 40. 99)

Sodium tritelluride, Na<sub>2</sub>Te<sub>3</sub>

Sol. in H<sub>2</sub>O

Sol. in liquid NH<sub>3</sub>. (Hugot, C. C. 1899, II. 580)

Stannic acid, H<sub>2</sub>SnO<sub>4</sub>

Insol. in H<sub>2</sub>O Sol. in HCl, and H<sub>2</sub>SO<sub>4</sub>+Aq, even when dil. (Freny.) Easily sol. in acids, from which solution it may be pptd. by dilution or boiling. While moist it is sol. in HNO<sub>3</sub>+Aq, but gradually separates on standing, and conglutinates at once when heated to 50°. If NH<sub>4</sub>NO<sub>3</sub> be added to the solution, it remains clear at ord. temp. (Berzelius)

Easily sol. in HNO<sub>3</sub>+Aq, when previously treated with NH<sub>4</sub>OH+Aq (Thénard.)

Easily sol. in KOH+Aq, but addition of large excess ppts K<sub>2</sub>SnO<sub>3</sub>, insol. in KOH+Aq.

Easily sol. in NaOH+Aq, and not pptd. by an excess of that reagent. (Barfoed, J. B. 1867. 287.)

Sl. sol. in NH<sub>4</sub>OH+Aq or (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq Completely sol. in K<sub>2</sub>CO<sub>3</sub>+Aq, but not in Na<sub>2</sub>CO<sub>3</sub>+Aq

Insol. in alkali hydrogen carbonates or NH<sub>4</sub>Cl+Aq.

Sol. in alkali sulphides+Aq (Berzelius.)

Sol. in triethyltoluyl ammonium hydrate+Aq.

Not pptd. by NH<sub>4</sub>OH+Aq in presence of Na citrate+Aq

SnO<sub>2</sub>, 2H<sub>2</sub>O. (Weber, Pogg. 122. 358.)

"*α*-Orthostannic acid" Easily sol. in HCl+Aq. (Neumann, M. 12. 615.)

H<sub>2</sub>SnO<sub>4</sub> (?)

Metastannic acid Insol. in H<sub>2</sub>O, HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>+Aq. Insol. in HCl+Aq, but converted thereby into metastannic chloride, which dissolves after excess of HCl has been removed. (Fresenius.) Insol. in HCl+Aq of sp. gr. 1.1 (Barfoed.) Sol. in large amount

of conc. HCl+*Aq.* (Allen, Chem. Soc. (2) 10. 274.)

In contact with HCl+*Aq.*, metastannic acid is converted into stannic acid. (Barfoed.)

Insol. in  $\text{HNO}_3$ +*Aq.* even after treatment with  $\text{NH}_4\text{OH}$ +*Aq.*

Insol. in  $\text{NH}_4\text{OH}$ +*Aq.*

Sol. in KOH or NaOH+*Aq.* with formation of metastannates, which are insol. in dil NaOH+*Aq.*, but sol. in  $\text{H}_2\text{O}$  or KOH+*Aq.*, therefore KOH+*Aq.* dissolves metastannic acid, while NaOH+*Aq.* does not, but if the clear solution in KOH+*Aq.* is treated with a large excess of that reagent, a further pptn. occurs. (Barfoed, J. pr. 101. 368.)

Insol. in  $\text{K}_2\text{CO}_3$ +*Aq.* (Rose); alkali carbonates+*Aq.* (Fremy.)

Insol. in  $\text{NH}_4\text{Cl}$ +*Aq.* even after long boiling

Sol. in  $\text{Fe}(\text{NO}_3)_3$ +*Aq.* containing  $\text{HNO}_3$ . (Lepèz and Storch, W. A. B. 98, 2b. 270.)

Also in  $\text{Cr}(\text{NO}_3)_3$ +*Aq.*, but not in  $\text{Ce}(\text{NO}_3)_3$ ,  $\text{Al}(\text{NO}_3)_3$ ,  $\text{Co}(\text{NO}_3)_2$ +*Aq.*, etc. (L and S.)

A colloidal metastannic acid sol. in  $\text{H}_2\text{O}$  can be obtained. (Lepèz and Storch.)

According to Weber (Pogg. 122. 358), stannic and metastannic acids are only different hydrates of same oxide, and it is not a case of allotropic modification.

*Colloidal.*  $\text{H}_2\text{SnO}_3$  in colloidal state can be obtained in aqueous solution containing 5.164 g  $\text{SnO}_2$  in a litre. This solution is coagulated by  $\text{HNO}_3$ +*Aq.* only when in great excess; easily by dil  $\text{H}_2\text{SO}_4$ +*Aq.*, but not by conc HCl+*Aq.*  $\text{NH}_4\text{OH}$ +*Aq.* in large excess causes coagulation; also  $\text{NH}_4\text{Cl}$ , NaOH, NaCl,  $\text{Na}_2\text{SO}_4$ , etc. (Schneider, Z. anorg. 5. 83.)

*Parastannic acid*,  $\text{H}_2\text{Sn}_2\text{O}_{11}$ + $3\text{H}_2\text{O}$ .

(Engel, C. R. 1897, 125. 711.)

### Stannates.

Stannates of alkali metals are sol. in  $\text{H}_2\text{O}$ ; others are insol. All metastannates, excepting Na, K, and  $\text{NH}_4$  salts, are insol. in  $\text{H}_2\text{O}$  (Fremy, A. ch. (3) 12. 474.)

*Ammonium stannate*,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{SnO}_2$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{NH}_4\text{OH}$ +*Aq.* (Berzelius.)

+ $x\text{H}_2\text{O}$ . (Moberg, 1838.)

*Ammonium cupric stannate*,  $(\text{NH}_4)_2\text{O}$ ,  $\text{CuSnO}_2$ + $2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte, C. R. 96. 701.)

*Barium stannate*,  $\text{BaSnO}_3$ + $6\text{H}_2\text{O}$ .

Ppt. Sol. in HCl+*Aq.* (Moberg.)

$\text{Ba}_2\text{SnO}_4$ + $10\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte, C. R. 95. 641.)

*Calcium stannate*,  $\text{CaSnO}_3$ + $4\text{H}_2\text{O}$ .

Ppt. (Moberg.)

+ $5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids.

(Ditte, C. R. 96. 701.)

$2\text{CaO}$ ,  $\text{SnO}_2$ . (Zulkowski, Chem. Ind. 1901, 24. 422.)

*Cobaltous stannate*,  $\text{CoSnO}_3$ + $6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte.)

*Cupric stannate*,  $\text{CuSnO}_3$ + $3\text{H}_2\text{O}$ .

(Moberg.)

+ $4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Ditte.)

*Cuprous stannous stannate*,  $\text{Cu}_2\text{O}$ ,  $3\text{SnO}$ ,  $\text{SnO}_2$ + $5\text{H}_2\text{O}$ .

Slowly decomp. by dil acids, and  $\text{NH}_4\text{OH}$ +*Aq.*; completely decomp. by conc acids. (Lennsen, J. pr. 79. 90.)

*Gold (aurous) stannate.*

See Gold purple.

*Lead stannate*,  $\text{RbSn}(\text{OH})_3$ .

Ppt. (Bellucci, Chem. Soc. 1905, 88. (2) 40.)

*Lithium stannate hexatungstate*,  $2\text{Li}_2\text{O}$ ,  $\text{SnO}_2$ ,  $6\text{WO}_3$ = $\text{Li}_2\text{SnO}_3$ ,  $\text{Li}_2\text{W}_6\text{O}_{19}$ .

Insol. in  $\text{H}_2\text{O}$ . (Knorre, J. pr. (2) 27. 49.)

*Magnesium stannate.*

Ppt. (Moberg.)

*Manganous stannate.*

Ppt. (Moberg.)

*Mercurous stannate*,  $\text{Hg}_2\text{SnO}_3$ + $5\text{H}_2\text{O}$ .

Ppt.

*Mercuric stannate*,  $\text{HgSnO}_3$ + $6\text{H}_2\text{O}$ .

Ppt. (Moberg, J. pr. 28. 231.)

*Nickel stannate*,  $\text{NiSnO}_3$ + $5\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte, C. R. 96. 701.)

*Platinous sodium stannous stannate*,  $2\text{PtO}$ ,  $\text{Na}_2\text{O}$ ,  $\text{SnO}$ ,  $\text{SnO}_2$ (?).

(Schneider, Pogg. 136. 105.)

*Platinous stannous stannate*,  $\text{PtO}$ ,  $2\text{SnO}$ ,  $\text{SnO}_2$ .

Decomp. by conc. alkalis (Schneider, Pogg. 136. 105.)

*Potassium stannate*,  $\text{K}_2\text{SnO}_3$ + $3\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 106.6 pts. at  $10^\circ$ , solution has sp. gr.=1.618, 100 pts. dissolve 110.5 pts. at  $20^\circ$ , solution has sp. gr.=1.627. (Ordway, Sil. Am. J. (2) 40. 173.)

Very sl. sol. in conc. KOH + Aq.  
 Insol. in KCl + Aq. (Fremy.)  
 Insol. in alcohol  
 Pptd. from aqueous solution by the addition of any soluble salt, especially those of K, Na, and  $\text{NH}_4$  (Fremy); by  $\text{NH}_4\text{Cl}$ , but not by KCl or NaCl (Ordway).  
 Insol. in acetone. (Naumann, B. 1904, 37, 329)

**Potassium metastannate,  $\text{K}_2\text{O}$ ,  $10\text{SnO}_2$ .**

$\text{K}_2\text{O}$ ,  $78\text{SnO}_2 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Solution gelatinises on heating (Rose.)  
 $\text{K}_2\text{O}$ ,  $68\text{SnO}_2 + 6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , but loses its solubility by drying. (Fremy, A. ch. (3) 12, 475)

$\text{K}_2\text{O}$ ,  $58\text{SnO}_2 + 4\text{H}_2\text{O}$ . Completely sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Fremy, A. ch. (3) 23, 396.)

$\text{K}_2\text{O}$ ,  $38\text{SnO}_2 + 3\text{H}_2\text{O}$  Deliquescent. (Fremy)

**Silver stannate,  $\text{Ag}_2\text{SnO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Unacted upon by  $\text{NH}_4\text{OH}$  or  $\text{HCl}$  + Aq. (Ditte.)

**Silver (argenteous) stannous stannate (?),  $\text{Ag}_2\text{O}$ ,  $\text{SnO}$ ,  $38\text{SnO}_2 + 3\text{H}_2\text{O}$  (?)**

Cold dil.  $\text{HNO}_3$  + Aq slowly dissolves all Ag, hot  $\text{HNO}_3$  + Aq rapidly  
 Easily sol. in boiling conc.  $\text{H}_2\text{SO}_4$  (Schulze, J. B. 1857, 257)

**Sodium stannate,  $\text{Na}_2\text{SnO}_3 + 3\text{H}_2\text{O}$**

More easily sol. in cold than in hot  $\text{H}_2\text{O}$  (Fremy)

Sol. in 2 pts  $\text{H}_2\text{O}$  at  $20^\circ$  and  $100^\circ$  (Magnac.)

100 pts  $\text{H}_2\text{O}$  dissolve 67.4 pts at  $0^\circ$ , 61.3 pts. at  $20^\circ$ , and solutions have sp. gr. = 1.472 and 1.438 at  $15.5^\circ$  (Ordway, Sil. Am. J. (2) 40, 173.)

Pptd. from  $\text{Na}_2\text{SnO}_3$  + Aq by salts of K, Na, and  $\text{NH}_4$ .

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

+  $4\text{H}_2\text{O}$  (Prandtl, B. 1907, 40, 2129.)  
 +  $8\text{H}_2\text{O}$  (Haeffely, J. B. 1857, 650.)  
 +  $9\text{H}_2\text{O}$  (Jones, C. C. 1865, 607.)  
 +  $10\text{H}_2\text{O}$ . Very efflorescent. (Seheuer-Kestner, Bull. Soc. (2) 8, 389.)

**Sodium metastannate,  $\text{Na}_2\text{O}$ ,  $9\text{SnO}_2 + 8\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  Insol. in  $\text{NaOH}$  + Aq or alcohol (Barfoed, J. B. 1857, 267)

$\text{Na}_2\text{O}$ ,  $68\text{SnO}_2$  Very difficultly sol. in  $\text{H}_2\text{O}$ . (Fremy, A. ch. (3) 23, 399.)

Insol. in KOH + Aq  
 +  $8\text{H}_2\text{O}$  (Haeffely, Chem. Gaz. 1855, 59.)

**Sodium stannate vanadate,**

$\text{Na}_2\text{SnO}_3$ ,  $3\text{Na}_2\text{VO}_4 + 32\text{H}_2\text{O}$ .  
 $\text{Na}_2\text{SnO}_3$ ,  $4\text{Na}_2\text{VO}_4 + 48\text{H}_2\text{O}$ .  
 $\text{Na}_2\text{SnO}_3$ ,  $5\text{Na}_2\text{VO}_4 + 64\text{H}_2\text{O}$ .  
 $\text{Na}_2\text{SnO}_3$ ,  $6\text{Na}_2\text{VO}_4 + 80\text{H}_2\text{O}$  (Prandtl, B. 1907, 40, 2128.)

**Strontium stannate,  $3\text{SrO}$ ,  $2\text{SnO}_2 + 10\text{H}_2\text{O}$ .**

Ppt. Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte, C. R. 95, 641.)  
 $\text{SrSn}(\text{OH})_6$  (Belluci, Chem. Soc. 1905, 88 (2) 40.)

**Tin (stannous) stannate,  $\text{SnO}$ ,  $6\text{SnO}_2 + 5\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{HNO}_3$  + Aq into metastannic acid. (Schiff, A. 120, 53.)  
 Sol. in  $\text{HCl}$  + Aq, and in  $\text{KOH}$  + Aq.

**Tin (stannous) metastannate,  $\text{SnO}$ ,  $78\text{SnO}_2$ .**

$\text{SnO}$ ,  $68\text{SnO}_2 + 9\text{H}_2\text{O}$ . Sol. in  $\text{KOH}$  + Aq or in  $\text{HCl}$  + Aq. (Fremy.)  
 +  $4\text{H}_2\text{O}$ . (Schiff.)

**Zinc stannate,  $\text{ZnSnO}_3 + 2\text{H}_2\text{O}$ .**

Ppt. (Moberg, 1838.)  
 $3\text{ZnO}$ ,  $28\text{SnO}_2 + 10\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte.)

**Perstannic acid,  $\text{H}_2\text{Sn}_2\text{O}_7$ .**

See Perstannic acid.

**Stannophosphomolybdic acid.**

**Ammonium stannophosphomolybdate,**  
 $3(\text{NH}_4)_2\text{O}$ ,  $48\text{SnO}_2$ ,  $3\text{P}_2\text{O}_5$ ,  $16\text{MoO}_3 + 28\text{H}_2\text{O}$ .

Quite insol. even in boiling  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7, 392.)

**Stannophosphotungstic acid.**

**Ammonium stannophosphotungstate,**  
 $2(\text{NH}_4)_2\text{O}$ ,  $28\text{SnO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 15\text{H}_2\text{O}$ .

Precipitate. Sl. sol. in boiling  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7, 319.)

**Stannosulphuric acid.**

See Sulphate, stannic.

**Stibine.**

See Hydrogen antimonide.

**Strontium, Sr.**

Decomp. by  $\text{H}_2\text{O}$  with violence. Dil.  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$  + Aq decomp. and dissolve; cold  $\text{H}_2\text{SO}_4$  attacks slowly. Fuming  $\text{HNO}_3$  has scarcely any action even when boiling. (Franz, J. pr. 197, 253.)  
 Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 829.)

Sol. in excess of liquid  $\text{NH}_3$  at  $-60^\circ$  forming  $\text{Sr}(\text{NH}_2)_2$ . (Roederer, C. R. 1905, 140, 1252.)

**Strontium amalgam,  $\text{SrHg}_{12}$ .**

Stable below  $30^\circ$ . Above  $30^\circ$  the composition of the amalgam varies. Can be cryst. from Hg at any temp. below  $30^\circ$ . (Kerp, Z. anorg. 1900, 25, 68.)

**Strontium amide,  $\text{Sr}(\text{NH}_2)_2$ .**

(Roederer, Bull. Soc. 1906, (3) 35, 715.)

**Strontium arsenide,  $\text{Sr}_2\text{As}_2$** 

Decomp. by  $\text{H}_2\text{O}$ . (Lebeau, C. R. 1899, 129. 47.)

**Strontium azoimide,  $\text{SrN}_2$** 

Hydroscoptic.

45.83 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ .

0.095 " " " " 100 " abs alcohol at  $16^\circ$ .

Insol. in pure ether. (Curtius, J. pr. 1898, (2) 58. 287.)

**Strontium boride,  $\text{SrB}_2$** 

Sol. in fused oxidizing agents; not decomp. by  $\text{H}_2\text{O}$ , insol. in aq. acids; sl. sol. in conc.  $\text{H}_2\text{SO}_4$ ; sol. in dil. and conc.  $\text{HNO}_3$ . (Moissan, C. R. 1897, 126. 633.)

**Strontium bromide,  $\text{SrBr}_2$ , and  $+6\text{H}_2\text{O}$ .**

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$  20° 38° 59° 83° 110°  
87.7 99 112 133 182 250 pts.  $\text{SrBr}_2$

(Kremers, Pogg. 103. 65.)

Sat  $\text{SrBr}_2 + \text{Aq}$  contains at.

$-11^\circ$   $-1^\circ$   $+7^\circ$   $18^\circ$   
43.1 46.85 48.2 51.7%  $\text{SrBr}_2$ ,

20° 93° 97° 107°  
51.8 68.5 68.7 69.8%  $\text{SrBr}_2$ .

(Étard, A. ch. 1894, (7) 2. 540.)

Sp. gr. of  $\text{SrBr}_2 + 19.5^\circ$  containing:

5 10 15 20 25 %  $\text{SrBr}_2$   
1.046 1.094 1.146 1.204 1.266

30 35 40 45 50 %  $\text{SrBr}_2$   
1.332 1.41 1.492 1.59 1.694

(Kremers, Pogg. 99. 444; calculated by Gerlach, Z. anal. 8. 285.)

Somewhat sol. in absolute alcohol (Lowig.)

Solubility of anhydrous  $\text{SrBr}_2$  in alcohol is practically constant between  $0^\circ$  and  $40^\circ$ , 100 ccm. of abs. alcohol dissolving about 64.5 g. of the anhydrous salt and forming a solution having a sp. gr. = 1.210 at  $0^\circ$ . (Fonczes-Diacon, Chem. Soc. 1895, 68 (2) 223.)

Much more sol. than  $\text{BaBr}_2$  in boiling amyl alcohol.

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Strontium stannic bromide.**

See Bromostannate, strontium.

**Strontium bromide ammonia,  $2\text{SrBr}_2 \cdot \text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 56. 238.

**Strontium bromide hydrazine,  $\text{SrBr}_2 \cdot 3\text{N}_2\text{H}_4$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Franzen, Z. anorg. 1908, 60. 290.)

**Strontium bromofluoride,  $\text{SrF}_2 \cdot \text{SrBr}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Defacqz, A. ch. 1904, (8) 1. 356.)

**Strontium carbide,  $\text{SrC}_2$ .**

Easily decomp. by  $\text{H}_2\text{O}$  and dil. acids. (Moissan, Bull. Soc. 1894, (3) 11. 1008.)

**Strontium carbonyl,  $\text{Sr}(\text{CO})_2$ .**

(Roederer, Bull. Soc. 1906, (3) 35. 725.)

**Strontium chloride,  $\text{SrCl}_2$ , and  $+6\text{H}_2\text{O}$ .**

Deliquescent in moist air.

Sol. in 1.5 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 0.8 pt. at boiling (Dumas), in 1.906 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach).  
1 pt. anhydrous  $\text{SrCl}_2$  is sol. in 2.27 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , in 1.88 pts. at  $20^\circ$ , in 1.54 pts. at  $40^\circ$ , in 1.18 pts. at  $60^\circ$ , in 1.08 pts. at  $80^\circ$ , in 0.98 pt. at  $100^\circ$ . (Kremers, Pogg. 103. 66.)

100 pts.  $\text{H}_2\text{O}$  dissolve 106.2 pts.  $\text{SrCl}_2 + 6\text{H}_2\text{O}$  at  $0^\circ$ , and 205.8 pts. at  $40^\circ$ . (Tilden, Chem. Soc. 45. 409.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{SrCl}_2$	$t^\circ$	Pts $\text{SrCl}_2$	$t^\circ$	Pts $\text{SrCl}_2$
0	44.2	41	67.4	81	92.7
1	44.5	42	68.2	82	93.1
2	44.8	43	68.9	83	93.4
3	45.2	44	69.7	84	93.7
4	45.6	45	70.4	85	94.1
5	46.0	46	71.2	86	94.5
6	46.5	47	72.0	87	94.9
7	46.9	48	72.8	88	95.4
8	47.4	49	73.6	89	95.8
9	47.8	50	74.4	90	96.2
10	48.3	51	75.3	91	96.7
11	48.8	52	76.1	92	97.2
12	49.4	53	77.0	93	97.9
13	49.9	54	77.9	94	98.2
14	50.4	55	78.7	95	98.8
15	51.0	56	79.6	96	99.4
16	51.5	57	80.4	97	100.0
17	52.1	58	81.3	98	101.6
18	52.7	59	82.2	99	101.3
19	53.3	60	83.1	100	101.9
20	53.9	61	84.0	101	102.6
21	54.5	62	84.9	102	103.3
22	55.1	63	85.8	103	104.0
23	55.7	64	86.6	104	104.7
24	56.3	65	87.5	105	105.4
25	56.9	66	88.4	106	106.1
26	57.5	67	88.8	107	106.9
27	58.1	68	89.9	108	107.6
28	58.7	69	90.1	109	108.4
29	59.3	70	89.3	110	109.1
30	60.0	71	89.6	111	109.9
31	60.6	72	89.8	112	110.7
32	61.3	73	90.1	113	111.4
33	61.9	74	90.3	114	112.2
34	62.5	75	90.6	115	113.0
35	63.2	76	90.9	116	113.8
36	63.9	77	91.2	117	114.6
37	64.6	78	91.5	118	115.5
38	65.3	79	91.8	118.8	116.4
39	66.0	80	92.1		
40	66.7	80	92.4		

(Mulder, Scheik. Verhand. 1864. 118.)

100 pts.  $\text{H}_2\text{O}$  dissolve 52.4 pts  $\text{SrCl}_2$  at  $18^\circ$ .  
(Gerardin)

Sat.  $\text{SrCl}_2 + \text{Aq}$  contains %  $\text{SrCl}_2$  at  $t^\circ$

$t^\circ$	% $\text{SrCl}_2$	$t^\circ$	% $\text{SrCl}_2$
-17	26.5	75	46.5
-11	28.6	80	47.1
-5	29.3	92	47.5
-1	30.8	98	49.6
+2	31.3	104	50.7
7	31.7	105	50.7
18	33.7	118	52.0
21.5	34.7	132	52.5
35	37.8	144	54.7
44.5	39.8	153	55.7
54	42.8	175	60.5
55	43.8	215	64.1
59	47.7	222	65.4
64	46.4	250	67.3
70	46.1		

(Étard, A. ch. 1894, (7) 2. 535.)

$\text{SrCl}_2 + \text{Aq}$  sat. at  $5^\circ$  has sp. gr. = 1.379 (Anthon, A. 24. 211.)

Sp. gr. of  $\text{SrCl}_2 + \text{Aq}$ .

Pts. $\text{SrCl}_2$ to 100 pts $\text{H}_2\text{O}$	Sp. gr.	Pts. $\text{SrCl}_2$ to 100 pts $\text{H}_2\text{O}$	Sp. gr.
9.81	1.0823	41.04	1.3114
20.12	1.1032	51.69	1.3510
30.57	1.2401		

(Kremers, Pogg. 99. 444.)

Sp. gr. of  $\text{SrCl}_2 + \text{Aq}$  at  $15^\circ$

% $\text{SrCl}_2$	Sp. gr.	% $\text{SrCl}_2$	Sp. gr.
5	1.0453	25	1.2580
10	1.0929	30	1.3220
15	1.1439	33	1.3633
20	1.1989		

(Gerlach, Z. anal. 8. 283.)

Sp. gr. of  $\text{SrCl}_2 + \text{Aq}$  at  $24.7^\circ$ . a=no. of molecules in grms dissolved in 1,000 g.

$\text{H}_2\text{O}$ , b=sp. gr. when a= $\text{SrCl}_2 + 6\text{H}_2\text{O}$ ,  
 $\frac{1}{2}$  mol  $\text{SrCl}_2 + 6\text{H}_2\text{O} = 133.5$  g.; c=sp. gr. when a= $\text{SrCl}_2$ ,  $\frac{1}{2}$  mol = 79.5 g.

a	b	c	a	b	c
1	1.063	1.067	7	1.304	1.401
2	1.118	1.130	8	1.330	..
3	1.166	1.190	9	1.354	..
4	1.207	1.247	10	1.376	..
5	1.243	1.301	11	1.396	..
6	1.275	1.352			

(Favre and Valson, C. R. 79. 968.)

Sp. gr. of  $\text{SrCl}_2 + \text{Aq}$  at  $18^\circ$

% $\text{SrCl}_2$	Sp. gr.	% $\text{SrCl}_2$	Sp. gr.
5	1.0443	20	1.2023
10	1.0632	22	1.2250
15	1.1456		

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{SrCl}_2 + \text{Aq}$  at  $0^\circ$ . S=pts.  $\text{SrCl}_2$  in 100 pts solution

S	Sp. gr.	S	Sp. gr.
31.8193	1.3600	18.2620	1.1915
27.7170	1.3086	12.9907	1.1284
23.2300	1.2515	6.7243	1.0637

(Charpy, A. ch. (6) 29. 24.)

Sat.  $\text{SrCl}_2 + \text{Aq}$  boils at  $114^\circ$  (Kieners);  $118.8^\circ$  (Mulder);  $117.45^\circ$ , and contains 117.5 pts  $\text{SrCl}_2$  to 100 pts  $\text{H}_2\text{O}$  (Legend), forms a crust at  $115.5^\circ$ , and contains 120.7 pts.  $\text{SrCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp. observed,  $119^\circ$ . (Gerlach, Z. anal. 26. 436.)

B-pt. of  $\text{SrCl}_2 + \text{Aq}$  containing pts  $\text{SrCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ . G=according to Gerlach (Z. anal. 26. 442); L=according to Legend (A. ch. (2) 59. 436.)

B-pt	G	L	B-pt	G	L
101°	11	16.7	110°	71.4	68.9
102	20.5	25.2	111	70.5	74.1
103	28.9	32.1	112	81.6	79.6
104	36.2	37.9	113	87	85.3
105	43.2	43.4	114	93.1	91.2
106	49.6	48.8	115	99.5	97.5
107	55.4	54.0	116	105.9	104.0
108	60.8	59.0	117	112.3	110.9
109	66.2	63.9	117.5		

Melts in its crystal  $\text{H}_2\text{O}$  at  $112^\circ$  (Tilden, Chem. Soc. 45. 409.)

Sp. gr. of  $\text{SrCl}_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{SrCl}_2 + \text{Aq}$	Sp. gr.
1-normal	1.0676
$\frac{1}{2}$ -normal	1.0336
$\frac{1}{4}$ -normal	1.0171
$\frac{1}{8}$ -normal	1.0084

(Wagner, Z. phys. Ch. 1890. 5. 40.)

$\text{SrCl}_2 + \text{Aq}$  containing 3.24%  $\text{SrCl}_2$  has sp. gr.  $20^\circ/20^\circ = 1.0284$ .

$\text{SrCl}_2 + \text{Aq}$  containing 7.08%  $\text{SrCl}_2$  has sp. gr.  $20^\circ/20^\circ = 1.0638$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896. 19. 279.)

Sp. gr. of  $\text{SrCl}_2 + \text{Aq}$  at  $20^\circ$ .

g mols $\text{SrCl}_2$ per l	Sp gr
0 01	1 0012284
0 02937	1 0038396
0 03987	1 0053832
0 05017	1 007028
0 07077	1 009660
0 10	1 013205
0 25	1 034433
0.50	1 068379
0.75	1 101760
1.00	1.135423

(Jones and Pearce, Am. Ch. J. 1907, 38. 697.)

Conc.  $\text{HCl} + \text{Aq}$  pts part of the  $\text{SrCl}_2$  from  $\text{SrCl}_2 + \text{Aq}$ . (Hope.)

Solubility of  $\text{SrCl}_2$  in  $\text{HCl} + \text{Aq}$  at  $0^\circ$ .  $\text{SrCl}_2 = \frac{1}{2}$  mols.  $\text{SrCl}_2$  (in milligrammes) dissolved in 10 ccm of liquid;  $\text{HCl} =$  mols  $\text{HCl}$  (in milligrammes) dissolved in 10 ccm. of liquid.

$\text{SrCl}_2$	$\text{HCl}$	Sum of mols	Sp gr.
55	0	55 0	1 334
48.2	6 1	54 3	1.3045
41 25	12 75	54 00	1.2695
30 6	23 8	53 9	1 220

(Engel, Bull. Soc (2) 45. 655)

Solubility of  $\text{SrCl}_2$  in  $\text{HCl} + \text{Aq}$  at  $0^\circ$ .

Mg. mols per 10 cc solution		Sp. gr of solution	G per 100 cc solution	
$\frac{\text{SrCl}_2}{2}$	$\text{HCl}$		$\text{SrCl}_2$	$\text{HCl}$
51 6	0	1.334	40 9	0 0
44 8	6 1	1 304	35 5	2 22
37.85	12 75	1 269	30 0	4.65
27 2	23 3	1 220	21 56	8.49
22 0	28 38	1 201	17 44	10 35
14 0	37 25	1 167	11 09	13.58
4 25	52 75	1 133	3 37	19 23

(Engel, A. ch. 1888, (6) 13. 376)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sol in 6 pts alcohol of 0.833 sp gr. at  $16^\circ$  (Vauquelin.)

Sol in 24 pts absolute alcohol at  $15^\circ$  and in 10 pts at boiling. (Bucholz.) Sol in 2.5 pts. of boiling alcohol

Anhydrous  $\text{SrCl}_2$  is sol in 111.6-116.4 pts. alcohol of 99.3% at  $14.5^\circ$ , and in 26.3 pts. of the same alcohol at boiling. (Fresenius, A. 59. 127.)

100 pts. alcohol of given sp. gr. at  $0^\circ$  dissolve pts.  $\text{SrCl}_2$  at  $18^\circ$ .

0.990 0.985 0.973 0.966 0.953 sp. gr.  
49.81 47.0 39.6 35.9 30.4 pts.  $\text{SrCl}_2$ ,

0.939 0.909 0.846 0.832 sp. gr.  
26.8 19.2 4.9 3.2 pts.  $\text{SrCl}_2$ .

Insol in absolute alcohol. (Gerardin, A. ch. (4) 5. 156.)

100 pts. absolute methyl alcohol dissolve 63.3 pts.  $\text{SrCl}_2 + 6\text{H}_2\text{O}$  at  $6^\circ$ ; ethyl alcohol, 3.8 pts (de Bruyn, Z. phys. Ch. 10. 787.)

Sl. sol. in boiling amyl alcohol. (Browning, Sill Am. J. 144. 459.)

100 g. 95% formic acid dissolve 23 8 g.  $\text{SrCl}_2$  at room temp. (Aschan, Ch. Ztg. 1913, 37. 1117)

Absolutely insol. in acetic ether. (Cann, C. R. 102. 363.)

Very sl. sol. in acetone. (Krug and M'Elroy.)

Sol. in acetone. (Eidmann, C. C. 1899, II 1014.)

Insol in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol in benzonitrile (Naumann, B. 1914, 47 1370.)

Sl sol in anhydrous pyridine Sol in 97%, 95% and 93% pyridine + Aq. (Kahlenberg, J Am Chem. Soc. 1908, 30. 1107.)

+  $2\text{H}_2\text{O}$ . Tr. pt. from +  $6\text{H}_2\text{O}$  is  $61.5^\circ$ . (Richards and Churchill, Z. phys. Ch. 1899, 28. 313.)

+  $6\text{H}_2\text{O}$ . See above

Strontium thallic chloride,  $\text{SrCl}_2 \cdot 2\text{TlCl}_2 + 6\text{H}_2\text{O}$ .

(Gewecke, A. 1909, 366. 223.)

Strontium tin (stannous) chloride,  $\text{SrCl}_2 \cdot \text{SnCl}_2 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Poggiale, C R. 20. 1183.)

Strontium tin (stannic) chloride.

See Chlorostannate, strontium.

Strontium uranium chloride,  $\text{SrCl}_2 \cdot \text{UCl}_4$

Decomp. by  $\text{H}_2\text{O}$ . (Aloy, Bull. Soc. 1899, (3) 21. 265.)

Strontium zinc chloride,  $\text{SrZnCl}_2 + 4\text{H}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1910, 67. 380)

Strontium chloride ammonia,  $\text{SrCl}_2 \cdot 8\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Rose, Pogg. 20. 155.)

Strontium chloride hydrazine,  $\text{SrCl}_2 \cdot 2\text{N}_2\text{H}_4 + \text{H}_2\text{O}$ .

Hydroscopic. (Franzen, Z. anorg. 1908, 60. 289.)

Strontium chloride hydroxylamine,  $2\text{SrCl}_2 \cdot 5\text{NH}_2\text{OH} + 2\text{H}_2\text{O}$ .

As Ca comp. (Antonow, J. Russ. Phys. Chem. Soc 1905, 37. 482)

Strontium hydrogen chloride hydroxylamine,  $2\text{SrCl}_2 \cdot 3\text{HCl} \cdot 9\text{NH}_2\text{OH} + \text{H}_2\text{O}$ .

(Antonow, J. Russ. Phys. Chem. Soc. 1905, 37. 482.)

Strontium chlorofluoride,  $\text{SrF}_2 \cdot \text{SrCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$ , by very dil  $\text{HCl}$ ,  $\text{HNO}_3$  or acetic acid, by hot dil. or conc.  $\text{H}_2\text{SO}_4$ .

Sol. in conc HCl or HNO<sub>3</sub>. Insol. in, and not decomp. by cold or boiling alcohol. (Defacqz, A. ch. 1904, (8) 1. 355)

### Strontium fluoride, SrF<sub>2</sub>.

Somewhat sol. in H<sub>2</sub>O. (Fr. Roudier.)  
1 l. H<sub>2</sub>O dissolves 113.5 mg. SrF<sub>2</sub> at 0.26°;  
117.3 mg. at 17.4°; 119.3 mg. at 27.4°.  
(Kohhausch, Z. phys. Ch. 1908, 64. 168)

Insol in HF + Aq. (Berzelius)  
Boiling HCl + Aq dissolves; sl attacked by boiling HNO<sub>3</sub> + Aq; decomp. by hot H<sub>2</sub>SO<sub>4</sub>. (Poulenc, C. R. 118. 987)

### Strontium stannic fluoride.

See Fluostannate, strontium.

### Strontium titanium fluoride.

See Fluotitanate, strontium.

### Strontium fluorosulfide, SrF<sub>2</sub>, SrI<sub>2</sub>.

Decomp. by cold H<sub>2</sub>O, more rapidly by hot H<sub>2</sub>O. Decomp. by dil HCl, dil. HNO<sub>3</sub>, dil. H<sub>2</sub>SO<sub>4</sub> or conc. H<sub>2</sub>SO<sub>4</sub>, also by alcohol and by ether, if not absolute. (Defacqz, A. ch. 1904, (8) 1. 358.)

### Strontium hydride, SrH.

Decomp. by H<sub>2</sub>O or HCl + Aq. (Winkler, B. 24. 1976)

SrH<sub>2</sub>. Decomp. by H<sub>2</sub>O. (Gautier, C. R. 1902, 134. 100)

### Strontium hydroselenide.

Sol. in H<sub>2</sub>O

### Strontium hydrosulphide, SrS<sub>2</sub>H<sub>2</sub>.

Sol in H<sub>2</sub>O; decomp. by boiling.

### Strontium hydroxide, SrO<sub>2</sub>H<sub>2</sub>, and +SH<sub>2</sub>O.

Deliquescent.

Sol in 50 pts cold, and 2.4 pts boiling H<sub>2</sub>O (Buchholz); in 50 pts. H<sub>2</sub>O at 15.56° (Dalton), in 51.4 pts H<sub>2</sub>O at 15.56°, and 2 pts. at 100° (Hope); in 52 pts H<sub>2</sub>O at 18°, and 2.4 pts at 100° (Berzelius), in 48 pts. H<sub>2</sub>O at 18.75° (Abb.)  
100 pts. H<sub>2</sub>O at 20° dissolve 1.48 pts SrO. (Binouen, C. R. 41. 500)

100 pts. aqueous solution of SrO<sub>2</sub>H<sub>2</sub> contain pts SrO and pts. SrO<sub>2</sub>H<sub>2</sub> + SH<sub>2</sub>O at t°.

t°	Pts SrO	Pts SrO <sub>2</sub> H <sub>2</sub> +SH <sub>2</sub> O	t°	Pts SrO	Pts SrO <sub>2</sub> H <sub>2</sub> +SH <sub>2</sub> O
0	0.35	0.90	55	2.54	6.52
5	0.41	1.05	60	3.03	7.77
10	0.48	1.23	65	3.62	9.29
15	0.57	1.46	70	4.35	11.16
20	0.68	1.74	75	5.30	13.60
25	0.82	2.10	80	6.56	16.83
30	1.00	2.57	85	9.00	23.09
35	1.22	3.13	90	12.00	30.78
40	1.48	3.80	95	15.15	38.86
45	1.78	4.57	100	18.60	47.71
50	2.13	5.46	..	..	..

(Scheibler, J. pharm. Chim. 1883, (5) 8. 540.)

### Solubility in Sr(NO<sub>3</sub>)<sub>2</sub> + Aq at 25°

Sr gr. 25°/25°	G SrO <sub>2</sub> H <sub>2</sub> Sr(OH) <sub>2</sub> in 100 g. H <sub>2</sub> O	G Sr(NO <sub>3</sub> ) <sub>2</sub> in 100 g. H <sub>2</sub> O
1.481	0 0	79.27
*1.506	1 76	81.06
1.490	1 71	74.27
1.450	1 55	66.88
1.419	1 51	63.71
1.403	1.47	60.37
1.381	1.41	56.30
1.359	1.34	52.90
1.327	1.27	46.97
1.317	1.20	44.03
1.291	1.14	40.83
1.267	1.11	37.81
1.239	1.03	32.41
1.217	1.01	28.80
1.206	0.96	26.58
1.178	0.95	23.83
1.148	0.91	17.96
1.126	0.87	16.21
1.108	0.84	12.78
1.079	0.81	8.96
1.059	0.79	6.29
1.033	0.78	4.45

\*Solution is sat. with respect to both substances.

(Parsons and Perkins, J. Am. Chem. Soc. 1910, 32. 1388.)

Sol in methyl alcohol. At room temp. 1 l. contains 31.5 g. SrO. (Neuberg and Re-wald, Biochem. Z. 1908, 9. 540.)

Insol. in acetone (Eidmann, C. C. 1899, II. 1014)

Sol in an aqueous solution of cane sugar. (Hunton, Phil. Mag. (3) 11. 156.)

### Solubility in H<sub>2</sub>O containing 10 g. sugar at t°.

t°	g. SrO <sub>2</sub> H <sub>2</sub> + SH <sub>2</sub> O	t°	g. SrO <sub>2</sub> H <sub>2</sub> + SH <sub>2</sub> O
3	3.10	24	4.79
15	3.79	40	9.70

(Sidersky, C. C. 1886. 57.)

+SH<sub>2</sub>O. 0.0835 mol. as sol. in 1 l. H<sub>2</sub>O at 25°. (Rothmund, Z. phys. Ch. 1909, 69. 539.)

### Solubility in organic compds. + Aq at 25°

Solvent	Mol SrO <sub>2</sub> H <sub>2</sub> + SH <sub>2</sub> O sol in litre
water	0.0835
0.5-N methyl alcohol	0.0820
" ethyl alcohol	0.0744
" propyl alcohol	0.0708
" tert. amyl alcohol	0.0630
" acetone	0.0692
" ether	0.0645

Solubility in organic compds. +Aq at 25°.—  
*Continued.*

Solvent	Mol $\text{SrO}_2\text{H}_2 + 8\text{H}_2\text{O}$ sol at 1 litre
0.5-N glycol	0.0922
“ glycerine	0.1094
“ mannitol	0.1996
“ urea	0.0820
“ ammonia	0.0785
“ diethyl amine	0.0586
“ pyridine	0.0694

(Rothmund, Z. phys. Ch. 1900, 69, 539)

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

See also Strontium oxide.

Strontium iodide,  $\text{SrI}_2$ , and +6, or  $7\text{H}_2\text{O}$ .

100 pts  $\text{H}_2\text{O}$  dissolve at

0° 20° 40° 70° 100°

164 179 196 250 370 pts.  $\text{SrI}_2$

(Kremer, Pogg. 103, 65)

Sat. aq. solution contains at:

—20° —10° —3° +7° 11° 18° 38°

60.0 60.3 62.2 63.0 63.4 63.5 64.8 %  $\text{SrI}_2$

52° 63° 77° 81° 97° 105° 120° 175°

66.0 68.5 70.5 74.0 79.2 79.4 80.8 85.6 %  $\text{SrI}_2$

(Etard, A. ch. 1894, (7) 2, 543)

Sp gr. of  $\text{SrI}_2 + \text{Aq}$  at 19.5° containing:

5 10 20 30 %  $\text{SrI}_2$

1.045 1.091 1.200 1.330

40 50 60 65 %  $\text{SrI}_2$

1.491 1.695 1.955 2.150

(Kremer, Pogg. 103, 67; calculated by Gerlach, Z. anal. 8, 285.)

Sat. solution in abs. ethyl alcohol contains at:

—20° +4° 39° 82°

2.6 3.1 4.3 4.7 %  $\text{SrI}_2$

(Etard, A. ch. 1894, (7) 2, 565.)

Strontium periodide,  $\text{SrI}_2 + 15\text{H}_2\text{O}$ .

(Mosnier, A. ch. 1897, (7) 12, 399.)

$\text{SrI}_4$ . (Herz and Bulla, Z. anorg. 1911, 71, 255.)

Strontium stannous iodide.

Very sol. in  $\text{H}_2\text{O}$ . (Boullay)

Strontium zinc iodide,  $\text{SrZnI}_4 + 9\text{H}_2\text{O}$

Hydrosopic. (Ephraim, Z. anorg. 1910, 67, 385.)

Strontium nitride,  $\text{Sr}_3\text{N}_2$

Decomp.  $\text{H}_2\text{O}$  violently, but not alcohol. (Maquenne, A. ch. (6) 29, 225.)

Strontium oxide,  $\text{SrO}$

Decomp. by  $\text{H}_2\text{O}$  to  $\text{SrO}_2\text{H}_2$ , which see

Sol. in 160 pts  $\text{H}_2\text{O}$  at 15.56° (Dalton); in 50 pts. at 100° (Dalton), in 130 pts. at 20° (Bineau), in 40 pts. cold, and 20 pts. hot  $\text{H}_2\text{O}$  (Dumas)

Very sl. sol. in alcohol. Insol. in ether

1 l. methyl alcohol dissolves 11.2 g.  $\text{SrO}$ . (Neuberg and Rewald, Biochem. Z. 1908, 9, 540.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014.)

Sol. in cane sugar + Aq.

Solubility in  $\text{H}_2\text{O}$  containing 10 g. sugar at t°.

t°	g. $\text{SrO}$	t°	g. $\text{SrO}$
8	1.21	24	1.87
15	1.48	40	3.55

(Sidersky, C. C. 1886, 57.)

See also Strontium hydroxide.

Strontium peroxide,  $\text{SrO}_2$

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in acids and  $\text{NH}_4\text{Cl} + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Conroy, Chem. Soc. (2) 11, 812.)

Insol. in acetone (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014.)

Strontium oxybromide,  $\text{SrBr}_2, \text{SrO} + 9\text{H}_2\text{O}$ .

Not hydrosopic; sol. in  $\text{H}_2\text{O}$  (Tassilly, C. R. 1895, 120, 1339.)

Strontium oxychloride,  $\text{SrCl}_2, \text{SrO} + 9\text{H}_2\text{O}$ .

Very easily decomp. by  $\text{H}_2\text{O}$  and alcohol. (André, A. ch. (6) 3, 78.)

Strontium oxyiodide,  $2\text{SrI}_2, 5\text{SrO} + 30\text{H}_2\text{O}$ .

Not hydrosopic; sol. in  $\text{H}_2\text{O}$ . (Tassilly, C. R. 1895, 120, 1339.)

Strontium oxysulphide,  $\text{Sr}_2\text{OS}_4 + 12\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ .

Insol. in alcohol, ether, and  $\text{CS}_2$  (Schone.) Mixture of  $\text{Sr}_2\text{O}_3$  and  $\text{SrS}_2$ . (Geuther, A. 224, 178.)

Strontium phosphide,  $\text{Sr}_3\text{P}_2$ .

Crystallized. Sol. in dil. acids, insol. in conc. acids; decomp. by  $\text{H}_2\text{O}$ . Insol. in organic solvents at ord. temp. (Jaboin, C. R. 1899, 129, 764.)

Strontium selenide,  $\text{SrSe}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 102, 1469.)

Strontium silicide,  $\text{SrSi}_2$

Decomp. by  $\text{H}_2\text{O}$ . (Bradley, C. N. 1900, 82, 150.)

**Strontium sulphide, SrS**

Sol. in  $H_2O$  with decomp. into  $SrO_2H_2$  and  $SrS_2H_2$ .

Insol. in acetone. (Eidmann, C. C. 1899, II 1014; Naumann, B. 1904, 37, 4329)  
Insol. in methyl acetate. (Naumann, B. 1900, 42, 3790)

**Strontium tetr sulphide,  $SrS_4$** 

Very deliquescent, and sol. in  $H_2O$  and alcohol. Aqueous solution decomp. on air. Cryst. with 2, or  $6H_2O$ . (Schöne, Pogg. 117, 58)

**Strontium pentasulphide,  $SrS_5$** 

Known only in solution

**Strontium stannic sulphide.**

See Sulphostannate, strontium.

**Sulphaluminic acid.****Silver sulphaluminate,  $4Ag_2S, 5Al_2S_3$** 

(Camb. Reul. Ae. Linc. 1912, (5) 21, II 837.)

**Sulphamic acid,  $HOSO_2NH_2$** 

See Amidosulphonic acid.

**Ammonium sulphamate,  $2NH_3, SO_2$** 

(Woronin)

Is ammonium imidosulphonate, which see (Berghund)

**Ammonium sulphamate, acid,  $3NH_3, 2SO_2$** 

(Woronin)

Is basic ammonium imidosulphonate, which see (Berghund.)

**Barium sulphamate, basic,  $2BaO, 3SO_2, 2NH_3$** 

Somewhat sol. in  $H_2O$ , easily in  $HCl + Aq$  (Jacquelin, A. ch. (3) 8, 304)

$BaSO_3(NH_3)_2$ . Sol. in  $H_2O$ . Decomp. by heating with  $H_2O$ . (Woronin, J. B. 1860, 80)

Is barium imidosulphonate. (Berghund)

**Sulphamide,  $SO_2(NH_2)_2$** 

Very sol. in  $H_2O$ . (Regnault, A. ch. 69, 170; Mente, A. 248, 267)

Insol. in alcohol, ether, etc. (Traube, B. 26, 607)

Very sol. in  $H_2O$ .

Sl. sol. in abs. alcohol.

Sl. sol. in dry ether. (Divers and Ogawa, Chem. Soc. 1902, 81, 504.)

Very sol. in liquid  $NH_3$ . (Franklin and Stafford, Am. Ch. J. 1902, 28, 95.)

Sol. in alcohol; very sol. in  $H_2O$ . (Hantzsch, B. 1901, 34, 3436.)

**Silver sulphamide,  $SO_2(NHAg)_2$** 

Sl. sol. in cold  $H_2O$ . Sol. in  $HNO_3$ , and  $(NH_4)_2CO_3 + Aq$  (Traube, B. 26, 607.)

$3NH_3, 2SO_2$ . (Jacquelin.)

Is basic ammonium imidosulphonate, which see. (Berghund.)

**Sulphamidic acid.**

(Fremy.)

See Imidosulphonic acid.

**Sulphaminoplatinous acid.****Ammonium tetr sulphaminoplatinite,**

$[Pt(SO_2NII_3)_4](NH_4)_7 + 6H_2O$ .

Sl. sol. in cold  $H_2O$ . (Ramberg, B. 1912, 45, 1512.)

**Potassium —,  $[Pt(SO_2NH_3)_4]K_2 + 2H_2O$** 

Very al. sol. in cold  $H_2O$ . (Ramberg.)

**Sodium —,**

Easily sol. in cold  $H_2O$ . (Ramberg.)

**Sulphammonic, and Metasulphammonic acids.**

(Fremy.)

See Nitrosulphonic acid.

**Monosulphammonic acid.**

(Claus.)

See Amidosulphonic acid.

**Disulphammonic acid.**

(Claus)

See Imidosulphonic acid.

**Trisulphammonic acid.**

(Claus.)

See Nitrosulphonic acid.

**Tetrasulphammonic acid.**

(Claus.)

Does not exist. See Nitrosulphonic acid.

**Sulphammonium,  $S(NH_2)_2, 2NH_3$** 

Sol. in liquid  $NH_3$ .

Sol. in abs. alcohol and anhydrous ether. (Moissan, C. R. 1901, 132, 517.)

**Sulphantimonic acid.****Sulphantimonates.**

The alkali sulphantimonates are sol. in  $H_2O$ , but the solutions decomp. on the air; most of the other sulphantimonates are insol. in  $H_2O$ ; all sulphantimonates are insol. in alcohol. (Rammelsberg.)

Ammonium sulphantimonate,  $(\text{NH}_4)_3\text{SbS}_4$ .

Sol. in  $\text{H}_2\text{O}$ .

Sol. in dil. acids with decomp. (Stanek,

Z. anorg. 1898, 17, 122.)

+4 $\text{H}_2\text{O}$ . (Stanek.)

Solubility of  $(\text{NH}_4)_3\text{SbS}_4 + 4\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $(\text{NH}_4)_3\text{SbS}_4$	Solid phase
-1.9	9.9	Ice
-5	20.0	"
-8	30.2	"
-13.5	41.6	Ice + $(\text{NH}_4)_3\text{SbS}_4 \cdot 4\text{H}_2\text{O}$
0	41.6	$(\text{NH}_4)_3\text{SbS}_4 \cdot 4\text{H}_2\text{O}$
+20	47.7	"
30	54.5	"

(Donk, Chem. Weekbl, 1908, 5, 529.)

Solubility of  $(\text{NH}_4)_3\text{SbS}_4$  in alcohol at  $10^\circ$ .

Solid phase,  $(\text{NH}_4)_3\text{SbS}_4 + 4\text{H}_2\text{O}$ .

% $\text{C}_2\text{H}_5\text{OH}$	% $(\text{NH}_4)_3\text{SbS}_4$	% $\text{C}_2\text{H}_5\text{OH}$	% $(\text{NH}_4)_3\text{SbS}_4$
0	43.2	43.1	8.7
5.1	35.9	53.1	4.1
19.1	23.1	93.3	0

(Donk, l. c.)

Antimonyl sulphantimonate,  $(\text{SbO})_3\text{SbS}_4$ .

Sol. in  $\text{HCl}$ . (Rammelsberg, Pogg. 1841, 52, 236.)

Barium sulphantimonate,  $\text{Ba}_3(\text{SbS}_4) + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

Barium potassium sulphantimonate,

$\text{KBaSbS}_4 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ .

Decomp. by acids. (Glatzel, Z. anorg. 1911, 72, 100.)

Bismuth sulphantimonate.

Ppt.

Cadmium sulphantimonate.

Ppt. (Rammelsberg, Pogg. 52, 236.)

Calcium sulphantimonate,  $\text{Ca}_3(\text{SbS}_4)_2$ .

Partially sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

Cobaltous sulphantimonate,  $\text{Co}_3(\text{SbS}_4)_2$ .

Ppt. Decomp. by  $\text{HCl} + \text{Aq}$ . (Rammelsberg, Pogg. 52, 236.)

Cupric sulphantimonate,  $\text{Cu}_3(\text{SbS}_4)_2$ .

Ppt. (Rammelsberg, Pogg. 52, 226.)

Iron (ferrous) sulphantimonate.

Ppt.

Iron (ferric) sulphantimonate,  $\text{Fe}_2(\text{SbS}_4)_2$ .

(Rammelsberg, Pogg. 52, 234.)

Lead sulphantimonate,  $\text{Pb}_3(\text{SbS}_4)_2$ .

Ppt. Decomp. by  $\text{KOH} + \text{Aq}$ . (Rammelsberg, Pogg. 52, 223.)

Lithium sulphantimonate,  $\text{Li}_3\text{SbS}_4 + 8\frac{1}{2}\text{H}_2\text{O}$ .

100 g. sat. solution in  $\text{H}_2\text{O}$  contain 50.8 g. anhyd.  $\text{Li}_3\text{SbS}_4$ .

Solubility in alcohol at  $30^\circ$ .

% alcohol	% $\text{Li}_3\text{SbS}_4$	Solid phase
0	50.8	$\text{Li}_3\text{SbS}_4 \cdot 8\frac{1}{2}\text{H}_2\text{O}$
13.3	46.3	"
51.9	30.7	"
54.8	29.9	"
58.4	30.8	$\text{Li}_3\text{SbS}_4 \cdot 8\frac{1}{2}\text{H}_2\text{O} + \text{Li}_4\text{SbS}_4$
58.6	32.3	"
65.26	29.31	$\text{Li}_3\text{SbS}_4$
74.3	24.1	"
79.5	20.5	"

(Schreinemakers and Jacobs, Ch. Weekbl. 1910, 72, 213.)

+9 $\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Brinkmann, Dissert. 1891.)

+10 $\text{H}_2\text{O}$ . Solubility of  $\text{Li}_3\text{SbS}_4 + 10\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Li}_3\text{SbS}_4$	Solid phase
-1.7	7.1	Ice
-3.2	12.8	"
-5.1	17.5	"
-10.8	23.2	"
-15.9	28.5	"
-26.2	35.3	"
-42	40.4	Ice + $\text{Li}_3\text{SbS}_4 \cdot 10\text{H}_2\text{O}$
0	45.5	$\text{Li}_3\text{SbS}_4 \cdot 10\text{H}_2\text{O}$
+10	48.9	"
30	50.1	"
50	51.3	"

(Donk, Chem. Weekbl. 1908, 5, 529.)

At  $10^\circ$ , 100 g. sat.  $\text{Li}_3\text{SbS}_4 + 10\text{H}_2\text{O}$  in 10.7 % alcohol contain 41.8 g.  $\text{Li}_3\text{SbS}_4$ ; 26.2 % alcohol, 36.5 g.  $\text{Li}_3\text{SbS}_4$ . (Donk, l. c.)

Magnesium sulphantimonate,  $\text{Mg}_3(\text{SbO}_4)_2$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol.

Mercurous sulphantimonate,  $(\text{Hg}_2)_3(\text{SbS}_4)_2$ .

Ppt.

Mercuric sulphantimonate,  $\text{Hg}_3(\text{SbS}_4)_2$ .

Mercuric sulphantimonate chloride,  
 $\text{Hg}_2(\text{SbS}_4)_2, 3\text{HgCl}_2, 3\text{HgO}$ .

Insol. in acids, except aqua regia. (Ram-  
 melsberg.)

Nickel sulphantimonate,  $\text{Ni}_2(\text{SbS}_4)_2$ .

Ppt. Decomp. by hot  $\text{HCl} + \text{Aq}$ . (Ram-  
 melsberg, Pogg. 52, 226.)

Potassium sulphantimonate,  $\text{K}_2\text{SbS}_4$ .

Sol. in  $\text{H}_2\text{O}$ .

Solubility of  $\text{K}_2\text{SbS}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	$\frac{\%}{\text{K}_2\text{SbS}_4}$	Solid phase
-13	9.5	Ice
-26	17.1	"
-4	24.2	"
-7.2	35.4	"
-10.6	42.9	"
-13.5	48.8	"
-18.5	52.6	"
-28.8	59.6	"
-34	62	Ice + $\text{K}_2\text{SbS}_4, 6\text{H}_2\text{O}$
-10	65.5	$\text{K}_2\text{SbS}_4, 6\text{H}_2\text{O}$
-4.5	69.1	"
0	75.4	$\text{K}_2\text{SbS}_4, 5\text{H}_2\text{O}$
+10	76.2	"
30	77.1	"
50	77.7	$\text{K}_2\text{SbS}_4, 3\text{H}_2\text{O}$
80	79.2	"

(Donk, Chem. Weekbl. 1908, 5, 529, 629, 767.)

Solubility of  $\text{K}_2\text{SbS}_4$  in  $\text{KOH} + \text{Aq}$  at  $25^\circ$ .

$\frac{\%}{\text{K}_2\text{SbS}_4}$	$\frac{\%}{\text{KOH}}$	Solid phase
75	0	$\text{K}_2\text{SbS}_4, 5\text{H}_2\text{O}$
68.4	3.4	$\text{K}_2\text{SbS}_4, 3\text{H}_2\text{O}$
56.8	11.0	"
50.9	16.1	$\text{K}_2\text{SbS}_4$
37.7	25.5	"
19.8	40.5	"
11.5	43.9	$\text{K}_2\text{SbS}_4 + \text{KOH}, 2\text{H}_2\text{O}$
9.4	49.9	$\text{KOH}, 2\text{H}_2\text{O}$
00.0	56.3	"

(Donk.)

Solubility of  $\text{K}_2\text{SbS}_4$  in alcohol +  $\text{Aq}$  at  $10^\circ$ .

$\frac{\%}{\text{C}_2\text{H}_5\text{OH}}$	$\frac{\%}{\text{K}_2\text{SbS}_4}$	Solid phase
94	0	$\text{K}_2\text{SbS}_4, 5\text{H}_2\text{O}$
90.5	0	"
0.8	69.2	"
0	79.1	"

\* Two liquid layers are formed.

Composition of the liquid layers.

Alcohol layer		$\text{H}_2\text{O}$ layer	
$\frac{\%}{\text{C}_2\text{H}_5\text{OH}}$	$\frac{\%}{\text{K}_2\text{SbS}_4}$	$\frac{\%}{\text{alcohol}}$	$\frac{\%}{\text{K}_2\text{SbS}_4}$
85	0	1.1	67.4
54.7	2.2	3.4	49.0
46.9	4.2	3.8	45.6
16	27.4	31.1	12.7

(Donk, l. c.)

+  $4\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent Sol. in  $\text{H}_2\text{O}$ ;  
 more sol. than the Na salt

+ 3, 5, and  $6\text{H}_2\text{O}$ . See Donk above.

$2\text{K}_2\text{S}_2\text{S}_7, \text{Sb}_2\text{S}_3$ . Decomp. by cold  $\text{H}_2\text{O}$ .  
 (Ditte, C. R. 102, 168.)

$\text{K}_2\text{S}_2\text{S}_7, 2\text{Sb}_2\text{S}_3 + 3\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ .  
 (Ditte)

$\text{K}_2\text{S}_2\text{S}_7, \text{Sb}_2\text{S}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Ditte.)

$\text{K}_2\text{S}_2\text{S}_7, 2\text{Sb}_2\text{S}_3$ . (Ditte.)

Silver sulphantimonate,  $\text{Ag}_3\text{SbS}_4$ .

Insol. in  $\text{H}_2\text{O}$  or acids. Decomp. by  $\text{KOH}$   
 +  $\text{Aq}$ . (Rammelsberg, Pogg. 52, 218.)

Sodium sulphantimonate,  $\text{Na}_3\text{SbS}_4 + 9\text{H}_2\text{O}$ .

(Schlippe's salt.) Sol. in 29 pts.  $\text{H}_2\text{O}$  at  
 $15^\circ$ . Aqueous solution is precipitated by  
 alcohol (Rammelsberg.)

Sol. in 3 pts. cold  $\text{H}_2\text{O}$ . (van den Corput.)

Sol. in 4 pts. cold  $\text{H}_2\text{O}$ . (Duflos.)

Sol. in 1 pt. boiling  $\text{H}_2\text{O}$ . (Duflos.)

Solubility of  $\text{Na}_3\text{SbS}_4 + 9\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	$\frac{\%}{\text{Na}_3\text{SbS}_4}$	Solid phase
-0.1	0.5	Ice
-0.65	4	"
-0.9	5.7	"
-1.26	7.8	"
-1.45	9.2	"
-1.75	11.2	"
0	11.3	$\text{Na}_3\text{SbS}_4, 9\text{H}_2\text{O}$
15	19.3	"
30	27.1	"
38	32	"
49.6	38.9	"
59.6	45	"
69.6	50.7	"
79.5	57.1	"

(Donk, Chem. Weekbl. 1908, 5, 529, 629, 767.)

Solubility of  $\text{Na}_3\text{SbS}_4 + \text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$ .

$\frac{\%}{\text{Na}_3\text{SbS}_4}$	$\frac{\%}{\text{Na}_2\text{S}_2\text{O}_3}$	Solid phase
$t^\circ = 10^\circ$		
11.8	0	$\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$
4.4	4.9	"
0.8	14.6	"
0.1	27.3	"
0.0	33.6	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
$t^\circ = 30^\circ$		
19.9	7.7	$\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$
12.5	16.4	"
4.2	37.7	"
1	43.8	"
1	47	"
1	47.8	$\text{Na}_3\text{SbS}_4 + \text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
0	45.8	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$

(Donk, l. c.)

Solubility of  $\text{Na}_3\text{SbS}_4$  in alcohol + Aq at  $t^\circ$ .Solid phase,  $\text{Na}_3\text{SbS}_4 + 9\text{H}_2\text{O}$ .

$t = 0^\circ$		$t = 30^\circ$		$t = 65^\circ$	
$\frac{\%}{\text{C}_2\text{H}_5\text{OH}}$	$\frac{\%}{\text{Na}_3\text{SbS}_4}$	$\frac{\%}{\text{C}_2\text{H}_5\text{OH}}$	$\frac{\%}{\text{Na}_3\text{SbS}_4}$	$\frac{\%}{\text{C}_2\text{H}_5\text{OH}}$	$\frac{\%}{\text{Na}_3\text{SbS}_4}$
0	11.8	5	19.3	0	47.9
3.7	8.3	10.3	14.6	4.7	39.3
12.7	3.2	24.8	6.4	8	36.5
29.	0.9	46	1.2	* 54.1	4.1
60.8	0	76.2	0	81	0

\* Two layers are formed.

Composition of above layers

Alcohol layer		$\text{H}_2\text{O}$ layer	
$\frac{\%}{\text{alcohol}}$	$\frac{\%}{\text{Na}_3\text{SbS}_4}$	$\frac{\%}{\text{alcohol}}$	$\frac{\%}{\text{Na}_3\text{SbS}_4}$
54.1	4.1	8.0	36.5
40.4	10.2	14.8	27.8
33.5	14.1	18.8	24.1
.	...	27.2	18.0

(Donk, l. c.)

Solubility of  $\text{Na}_3\text{SbS}_4$  in methyl alcohol at  $t^\circ$ .  
Solid phase,  $\text{Na}_3\text{SbS}_4 + 9\text{H}_2\text{O}$ .

$t = 0^\circ$		$t = 30^\circ$	
$\frac{\%}{\text{CH}_3\text{OH}}$	$\frac{\%}{\text{Na}_3\text{SbS}_4}$	$\frac{\%}{\text{CH}_3\text{OH}}$	$\frac{\%}{\text{Na}_3\text{SbS}_4}$
3.4	8.6	0	27.1
15.5	2.8	18.1	12.8
23.1	2.1	33.1	5.8
50.3	0.3	65.7	0.1
57	0.1	84.2	0.1
81.7	0.05	91.2	1.2
92	0.2	94.	3.9
95.9	2.0		

(Donk, l. c.)

Sodium sulphantimonate thiosulphate,  
 $\text{Na}_3\text{SbS}_4 \cdot 2\text{Na}_2\text{S}_2\text{O}_3 + 20\text{H}_2\text{O}$ Efflorescent, and decomp. by  $\text{H}_2\text{O}$ . (Unger, Arch. Pharm. (2) 147. 193.)No double salt exists. See Donk,  $\text{Na}_3\text{SbS}_4 + \text{Na}_2\text{S}_2\text{O}_3$  under  $\text{Na}_3\text{SbS}_4$ .

Strontium sulphantimonate.

Sol in  $\text{H}_2\text{O}$ , pptd. by alcohol.

Uranium sulphantimonate.

Ppt

Zinc sulphantimonate,  $\text{Zn}_3(\text{SbS}_4)_2$ .Ppt Sol in hot  $\text{Na}_3\text{SbS}_4 + \text{Aq}$ ; insol in  $\text{ZnSO}_4 + \text{Aq}$ . Partially sol. in  $\text{KOH} + \text{Aq}$ ; sol in hot  $\text{HCl} + \text{Aq}$ . (Rammelsberg, Pogg. 52. 233.)

Sulphantimonous acid.

Ammonium metasulphantimonite,  $\text{NH}_4\text{SbS}_3$ .Insol. in  $\text{H}_2\text{O}$ . (Rouget, C. R. 1898, 126. 1145.)+  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and alcohol  
Decomp. in the air. (Stanek, Z. anorg. 1898, 17. 119.)Ammonium orthosulphantimonite,  
 $(\text{NH}_4)_2\text{Sb}_2\text{S}_5$ Easily decomp. Stable only in presence of  $(\text{NH}_4)_2\text{S}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol, by which it is pptd. from aqueous solution. (Pouget, A. ch. 1899, (7) 18. 536.)Ammonium parasulphantimonite,  
 $(\text{NH}_4)_2\text{Sb}_2\text{S}_7$ 

Stable in the air.

Insol. in  $\text{H}_2\text{O}$ .

Decomp. by acids. (Stanek, Z. anorg. 1898, 17. 120.)

Stable, cryst. from hot solutions. (Pouget C. R. 1898, 126. 1145.)

Ammonium silver <i>orthosulphantimonite</i> , $\text{NH}_4\text{Ag}_3\text{SbS}_4$ Decomp. by $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 551.)	Cuprous potassium <i>orthosulphantimonite</i> , $\text{Cu}_3\text{KSbS}_4$ Ppt.; easily decomp. by $\text{H}_2\text{O}$ . (Pouget, C. R. 1899, 129. 104.) + $3\text{H}_2\text{O}$ . Ppt., decomp. by $\text{H}_2\text{O}$ . (Pou- get, A. ch. 1899, (7) 18. 556.)
Barium <i>metasulphantimonite</i> , $\text{BaSb}_2\text{S}_4$ + $4\frac{1}{2}\text{H}_2\text{O}$ Insol. in $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 541.)	Iron (ferrous) <i>orthosulphantimonite</i> , $\text{Fe}_3(\text{Sb}_2\text{S})_2$ Ppt. (Pouget, A. ch. 1899, (7) 18. 554.) Min. <i>Berthierite</i> . Sl. sol. in $\text{HCl} + \text{Aq}$ ; easily sol. in aqua regia.
Barium <i>orthosulphantimonite</i> , $\text{Ba}_2\text{Sb}_2\text{S}_5$ + $8\text{H}_2\text{O}$ Decomp. in the air and by $\text{H}_2\text{O}$ Some- what sol. in $\text{BaS} + \text{Aq}$ . (Pouget, C. R. 1898, 126. 1792.)	Lead <i>orthosulphantimonite</i> , $\text{Pb}_2(\text{SbS})_2$ Ppt. Very sl. sol. in $\text{H}_2\text{O}$ . Decomp. by $\text{H}_2\text{O}$ (Pouget, A. ch. 1899, (7) 18. 553.) Min. <i>Boulangerite</i> . Completely sol. in hot $\text{HCl} + \text{Aq}$ ; decomp. by $\text{HNO}_3 + \text{Aq}$ .
Barium <i>pyrosulphantimonite</i> , $\text{Ba}_2\text{Sb}_2\text{S}_5$ + $8\text{H}_2\text{O}$ Decomp. by $\text{H}_2\text{O}$ Nearly insol. in $\text{BaS} + \text{Aq}$ . (Rouget.)	Lead sulphantimonite. Sol. in boiling conc. $\text{HNO}_3 + \text{Aq}$ (Four- net.) $\text{Pb}(\text{SbS}_2)_2$ Min. <i>Zinckenite</i> . Decomp. by hot $\text{HCl} + \text{Aq}$ . $4\text{PbS}, \text{Sb}_2\text{S}_3$ Min. <i>Plagionite</i> . $2\text{PbS}, \text{Sb}_2\text{S}_3$ Min. <i>Jamesonite</i> Decomp. by hot $\text{HCl} + \text{Aq}$ . $4\text{PbS}, \text{Sb}_2\text{S}_3$ Min. <i>Meneghinite</i> . $5\text{PbS}, \text{Sb}_2\text{S}_3$ Min. <i>Geokronite</i> . $6\text{PbS}, \text{Sb}_2\text{S}_3$ Min. <i>Kihlckenite</i> (?).
Barium sulphantimonite, $\text{Ba}_2\text{Sb}_2\text{S}_5 + 10\text{H}_2\text{O}$ . Pptd. from aq. solution of ortho and pyro- barium salts. (Pouget.) $\text{Ba}_4\text{Sb}_2\text{S}_{11} + 16\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 538.)	Lead potassium <i>orthosulphantimonite</i> , $\text{PbKSbS}_2$ Very sl. sol. in $\text{H}_2\text{O}$ . Decomp. by $\text{H}_2\text{O}$ (Pouget, A. ch. 1899, (7) 18. 554.)
Calcium sulphantimonite basic, $\text{Ca}(\text{OH})\text{SbS}_3$ . Insol. in $\text{H}_2\text{O}$ . Sol. in conc. $\text{HCl}$ . (Pouget, A. ch. 1899, (7) 18. 544.)	Lead silver sulphantimonite, $(\text{Ag}_2, \text{Pb})_2\text{Sb}_2\text{S}_{11}$ . Min. <i>Freyesenite</i> .
Calcium <i>pyrosulphoantimonite</i> , $\text{Ca}_2\text{Sb}_2\text{S}_5$ + $15\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ without decomp. (Pouget, C. R. 1898, 128. 1793.)	Lithium <i>orthosulphantimonite</i> , $\text{Li}_2\text{SbS}_2$ • + $3\text{H}_2\text{O}$ . Very deliquescent. Very sol. in $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 530.)
Cobaltous <i>orthosulphantimonite</i> , $\text{Co}_2\text{Sb}_2\text{S}_5$ . Ppt (Pouget, A. ch. 1899, (7) 18. 554.)	Lithium <i>parasulphantimonite</i> , $\text{Li}_2\text{Sb}_2\text{S}_7 + 3\text{H}_2\text{O}$ . Ppt (Pouget, A. ch. 1899, (7) 18. 531.)
Cuprous <i>metasulphantimonite</i> , $\text{CuSbS}_3$ . Sol. in mixture of $\text{HNO}_3$ and tartaric acid with separation of S. Insol. in $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by hot $\text{KOH}$ and alkali sulphides + $\text{Aq}$ . (Sommer- lad, Z. anorg. 1898, 18. 430.) Min. <i>Wolfsbergite</i> Sol. in $\text{HNO}_3 + \text{Aq}$ with separation of S and $\text{Sb}_2\text{O}_3$ .	Lithium silver <i>orthosulphantimonite</i> , $\text{LiAg}_2\text{SbS}_4$ . Decomp. by $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 551.)
Cuprous <i>orthosulphantimonite</i> , $\text{Cu}_2\text{SbS}_4$ . (Sommerlad, Z. anorg. 1898, 18. 432.) Ppt. Insol. in $\text{H}_2\text{O}$ . Decomp. by $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 556.)	Manganous <i>orthosulphantimonite</i> , $\text{Mn}_2\text{Sb}_2\text{S}_4$ . Ppt. Sl. sol. in $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 553.)
Cuprous sulphantimonite, $\text{Cu}_2\text{Sb}_2\text{S}_7$ . Min. <i>Guejarite</i> .	Manganous potassium <i>orthosulphantimonite</i> , $\text{MnKSbS}_2$ . Sl. sol. in $\text{H}_2\text{O}$ . Decomp. by $\text{H}_2\text{O}$ . (Pou- get, A. ch. 1899, (7) 18. 553.)
Cupric <i>orthosulphantimonite</i> , $\text{Cu}_2\text{Sb}_2\text{S}_4$ . Ppt. (Pouget, A. ch. 1899, (7) 18. 557.)	
Cuprous lead sulphantimonite, $\text{Cu}_2\text{SbS}_2$ , $2\text{PbSbS}_3$ . Min. <i>Bourmonite</i> . Decomp. by $\text{HNO}_3 +$ $\text{Aq}$ , and aqua regia.	

**Nickel orthosulphantimonite,  $\text{NiSb}_2\text{S}_4$** 

Ppt. (Pouget, A. ch. 1899, (7) 18. 554.)

**Potassium metasulphantimonite,  $\text{KSbS}_3$** Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 513.)+  $1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , but decomp. quickly.Sol. in  $\text{H}_2\text{O}$ . (Stanek, Z. anorg. 1898, 17. 119.)**Potassium orthosulphantimonite,  $\text{K}_2\text{SbS}_2$** 

Very deliquescent.

Very sol in  $\text{H}_2\text{O}$ 

Decomp. by acids (Pouget, A. ch. 1899, (7) 18. 518.)

**Potassium sulphantimonite,  $\text{K}_2\text{Sb}_2\text{S}_7 + 3\text{H}_2\text{O}$** Sl. sol. in  $\text{H}_2\text{O}$  and not decomp. thereby. (Pouget, A. ch. 1899, (7) 18. 522.)

Decomp. in the air.

Sol. in  $\text{K}_2\text{S} + \text{Aq.}$  (Stanek, Z. anorg. 1898, 17. 120.) $2\text{K}_2\text{S}, \text{Sb}_2\text{S}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 68.) $2\text{K}_2\text{S}, 7\text{Sb}_2\text{S}_3$ . Deliquescent. When  $\text{K}_2\text{S}$  is in excess, sol in  $\text{H}_2\text{O}$ , when  $\text{Sb}_2\text{S}_3$  is in excess, partially sol. Aqueous solution is decomp. by all acids, even  $\text{CO}_2$ , and by  $\text{K}_2\text{CO}_3$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{NaHCO}_3$ ,  $\text{KHCO}_3$ ,  $\text{NH}_4\text{HCO}_3 + \text{Aq.}$  Insol. in absolute alcohol. (Kohl.)**Potassium hydrogen sulphantimonite,  $\text{KHSb}_2\text{S}_7$** 

(Pouget, A. ch. 1899, (7) 18. 522.)

**Potassium silver orthosulphantimonite,  $\text{Ag}_3\text{KSbS}_3$** Decomp. by boiling  $\text{H}_2\text{O}$  (Pouget, C. R. 1897, 124. 1519.)**Potassium zinc orthosulphantimonite,  $\text{KZnSbS}_3$** Decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 552.)**Silver orthosulphantimonite,  $\text{Ag}_3\text{SbS}_3$** Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 547.)Min. *Pyrgaryrite*. Sol. in  $\text{HNO}_3 + \text{Aq}$  with residue of S and  $\text{Sb}_2\text{O}_3$ .  $\text{KOH} + \text{Aq}$  dissolves out  $\text{Sb}_2\text{S}_3$ .**Silver sulphantimonite.** $\text{AgSbS}_3$ . Min. *Miargyrite*. $5\text{Ag}_2\text{S}, \text{Sb}_2\text{S}_3$ . Min. *Stephanite*. Easily decomp. by warm  $\text{HNO}_3 + \text{Aq}$ . $12\text{Ag}_2\text{S}, \text{Sb}_2\text{S}_3$ . Min. *Polyargyrite*.**Silver sodium orthosulphantimonite,  $\text{Ag}_3\text{NaSbS}_3$** Decomp. by  $\text{H}_2\text{O}$ . Pouget, A. ch. 1899, (7) 18. 551.)**Sodium metasulphantimonite,  $\text{NaSbS}_3$** Deliquescent. Decomp. by hot  $\text{H}_2\text{O}$ . When  $\text{Na}_2\text{S}$  is in excess, sol. in  $\text{H}_2\text{O}$ , but partially sol. if  $\text{Sb}_2\text{S}_3$  is in excess. (Unger, Arch. Pharm. (2) 148. 1.)Ppt. Insol. in  $\text{H}_2\text{O}$ . (Pouget, C. R. 1898, 126. 1145.)**Sodium orthosulphantimonite,  $\text{Na}_2\text{SbS}_3 + 9\text{H}_2\text{O}$** Decomp. in solution in  $\text{H}_2\text{O}$ . (Pouget, C. R. 1898, 126. 1144.)**Sodium sulphantimonite,  $\text{Na}_2\text{Sb}_2\text{S}_7 + 2\text{H}_2\text{O}$** Sol. in  $\text{H}_2\text{O}$  (Pouget, C. R. 1898, 126. 1145.) $\text{Na}_2\text{Sb}_2\text{S}_7$  (Pouget, C. R. 1898, 126. 1144.) $4\text{Na}_2\text{S}, 3\text{Sb}_2\text{S}_3 + 3\text{H}_2\text{O}$ . Permanent; sol. in  $\text{H}_2\text{O}$  Insol. in alcohol and ether. (Kohl.)**Strontium orthosulphantimonite,  $\text{Sr}_2\text{Sb}_2\text{S}_6 + 10\text{H}_2\text{O}$** Sol. in  $\text{H}_2\text{O}$ . (Pouget, C. R. 1898, 126. 1793.)**Strontium pyrosulphantimonite,  $\text{Sr}_2\text{Sb}_2\text{S}_6 + 15\text{H}_2\text{O}$** Sol. in  $\text{H}_2\text{O}$  without essential decomp. (Pouget, C. R. 1898, 126. 1793.)**Zinc orthosulphantimonite,  $\text{Zn}_2\text{Sb}_2\text{S}_6$** 

Ppt. (Pouget, A. ch. 1899, (7) 18. 552.)

**Orthosulpharsenic acid,  $\text{H}_2\text{AsS}_4$** Ppt. Loses  $\text{H}_2\text{S}$  by prolonged boiling with  $\text{H}_2\text{O}$ . (Nilson, J. pr (2) 14. 145.)

See also Sulphoxyarsenic acid.

**Ammonium sulpharsenate,  $(\text{NH}_4)_4\text{As}_2\text{S}_7$** Known only in solution in  $\text{H}_2\text{O}$ . Decomp. on boiling into— $\text{NH}_4\text{AsS}_3$ . Sol. in alcohol. $(\text{NH}_4)_3\text{AsS}_4$ . Sol. in  $\text{H}_2\text{O}$ . Precipitated by alcohol. $(\text{NH}_4)_2\text{S}, 12\text{As}_2\text{S}_3$ . Ppt. Insol. in  $\text{H}_2\text{O}$ .**Ammonium magnesium sulpharsenate,  $(\text{NH}_4)_2\text{S}, \text{MgS}, \text{As}_2\text{S}_3$** **Ammonium sodium sulpharsenate,  $(\text{NH}_4)_2\text{AsS}_4, \text{Na}_2\text{AsS}_4$** Much more sol. in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{AsS}_4$ ; sl. sol. in cold, more sol. in hot alcohol. (Berzelius.)**Barium sulpharsenate,  $\text{Ba}(\text{AsS}_3)_2$** Sol. in  $\text{H}_2\text{O}$  and alcohol. Decomp. by evaporation. $\text{Ba}_2\text{AsS}_7$ . Sol. in  $\text{H}_2\text{O}$  in all proportions with decomp. Decomp. by alcohol. $\text{Ba}_3(\text{AsS}_4)_2$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. $\text{BaS}, 3\text{As}_2\text{S}_3$ . Ppt. Insol. in  $\text{H}_2\text{O}$ .

Barium potassium sulpharsenate,  
 $\text{KBaAsS}_4 + 6\text{H}_2\text{O}$   
 Easily sol. in  $\text{H}_2\text{O}$ .  
 Decomp. by acids with separation of  $\text{As}_2\text{S}_3$ .  
 (Glitzel, Z. anorg. 1911, 71. 209.)

Barium sulpharsenate sulpharsenite,  
 $\text{Ba}_3(\text{AsS}_4)_2, \text{Ba}_2\text{As}_2\text{S}_5 + 4\text{H}_2\text{O}$ .  
 Sl. sol in cold, more easily in hot  $\text{H}_2\text{O}$ .  
 (Nilson.)

Bismuth sulpharsenate,  $2\text{Bi}_2\text{S}_3, 3\text{As}_2\text{S}_5$ .  
 Sol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$ .  
 $\text{Bi}_2\text{S}_3, 3\text{As}_2\text{S}_5$ . As above. (Berzelius.)

Cadmium sulpharsenate.  
 Ppt. (Berzelius, Pogg. 7. 88.)

Calcium sulpharsenate,  $\text{Ca}_2\text{As}_2\text{S}_7$ .  
 Sol. in  $\text{H}_2\text{O}$  and alcohol.  
 $\text{Ca}_2(\text{AsS}_4)_2$ . Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.  
 $+10\text{H}_2\text{O}$  Easily sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 169.)  
 $5\text{CaS}, 2\text{As}_2\text{S}_5 + 6\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ .  
 (Nilson, J. pr. (2) 14. 163.)

Cerous sulpharsenate,  $\text{Ce}_2\text{As}_2\text{S}_7$ .  
 Ppt.  
 $\text{Ce}_2(\text{AsS}_4)_2$ . Ppt.  
 $\text{Ce}_2(\text{As}_2\text{S}_7)_2$ . Ppt.

Cobaltous sulpharsenate,  $\text{Co}_2\text{As}_2\text{S}_7$ .  
 Ppt. Sol. in excess of sodium sulpharsenate + Aq.

Cuprous sulpharsenate,  $\text{Cu}_2\text{As}_2\text{S}_4$ .  
 Ppt. (Preis, A. 257. 201.)  
 Min. *Enargite*. *Clarite*. Not wholly decomp. by  $\text{HCl} + \text{Aq}$  Sol. in  $\text{HCl} + \text{Aq}$  with residue of  $\text{As}_2\text{O}_3$ . Not attacked by  $\text{KOH} + \text{Aq}$ .

Cupric sulpharsenate,  $\text{Cu}_2\text{As}_2\text{S}_7$ .  
 Ppt. Sol. in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Decomp. by  $\text{NH}_4\text{OH} + \text{Aq}$ . (Berzelius.)  
 $\text{Cu}_2(\text{AsS}_4)_2$ . Ppt. (Preis, A. 257. 201.)

Glucinum sulpharsenate.  
 Sl. sol. in  $\text{H}_2\text{O}$ .

Gold sulpharsenate,  $\text{AuAsS}_4$ .  
 Sol. in pure  $\text{H}_2\text{O}$  Insol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$ .  
 $2\text{Au}_2\text{S}_3, 3\text{As}_2\text{S}_5$ . Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

Iron (ferrous) sulpharsenate,  $\text{Fe}_2\text{As}_2\text{S}_7$ .  
 Ppt. Sol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$ . (Berzelius.)

Iron (ferric) sulpharsenate,  $\text{Fe}_2(\text{As}_2\text{S}_7)_2$ .  
 Ppt. Sol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$ . (Berzelius.)

Lead sulpharsenate,  $\text{Pb}_2\text{As}_2\text{S}_7$ .  
 Ppt (Berzelius.)  
 $\text{Pb}_2(\text{AsS}_4)_2$ . Ppt.

Lithium sulpharsenate,  $\text{Li}_4\text{AsS}_4$ .  
 Easily sol. in hot, less sol. in cold  $\text{H}_2\text{O}$ .  
 Insol. in alcohol.  
 $\text{Li}_4\text{As}_2\text{S}_5$ . Completely sol. in  $\text{H}_2\text{O}$ .  
 Decomp. by alcohol  
 $\text{LiAsS}_4$ . Known only in acid solution.

Magnesium sulpharsenate,  $\text{Mg}_2\text{As}_2\text{S}_7$ .  
 Sol. in all proportions of  $\text{H}_2\text{O}$ , and in alcohol.  
 $\text{Mg}_2(\text{AsS}_4)_2$ . Sol. in  $\text{H}_2\text{O}$ . Decomp. alcohol.  
 $3\text{MgS}, \text{As}_2\text{S}_5$ . Nearly insol. in  $\text{H}_2\text{O}$ .  
 $5\text{MgS}, 2\text{As}_2\text{S}_5 + 15\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ .  
 (Nilson.)

Manganous sulpharsenate,  $\text{Mn}_2\text{As}_2\text{S}_7$ .  
 Sl. sol. in  $\text{H}_2\text{O}$ .  
 $\text{Mn}_2(\text{AsS}_4)_2$ . Permanent. Sl. sol. in  $\text{H}_2\text{O}$ .  
 $6\text{MnS}, \text{As}_2\text{S}_5$ . Sl. sol. in  $\text{H}_2\text{O}$ .

Mercurous sulpharsenate,  $(\text{Hg}_2)_2\text{As}_2\text{S}_7$ .  
 Ppt.

Mercuric sulpharsenate,  $\text{Hg}_2\text{As}_2\text{S}_7$ .  
 Ppt. (Berzelius, Pogg. 7. 29.)  
 $\text{Hg}_2(\text{AsS}_4)_2$ . Ppt. (Preis, A. 257. 200.)

Nickel sulpharsenate,  $\text{Ni}_2(\text{AsS}_4)_2$ .  
 Ppt. Not decomp. by  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$ . (Berzelius.)  
 $2\text{NiS}, \text{As}_2\text{S}_5$ . As above.

Potassium sulpharsenate,  $\text{KAsS}_4$ .  
 Known only in alcoholic solution.  
 $\text{K}_4\text{As}_2\text{S}_5$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ , from which alcohol ppts.  $\text{K}_4\text{AsS}_4$ .  
 $\text{K}_4\text{AsS}_4$ . Deliquescent. Very sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by alcohol.  
 $+ \text{H}_2\text{O}$ . Very deliquescent. (Nilson, J. pr. (2) 14. 160.)

Potassium sodium sulpharsenate.  
 Sol. in  $\text{H}_2\text{O}$ .

Silver sulpharsenate,  $\text{Ag}_2\text{As}_2\text{S}_7$ .  
 Ppt. (Berzelius, Pogg. 7. 29.)  
 $\text{Ag}_2\text{As}_2\text{S}_7$ . Ppt.

Sodium sulpharsenate,  $\text{NaAsS}_4$ .  
 Known only in alcoholic solution.  
 $\text{Na}_4\text{As}_2\text{S}_5$ . Sol. in  $\text{H}_2\text{O}$ . Alcohol ppts.  $\text{Na}_2\text{AsS}_4$  from  $\text{H}_2\text{O}$  solution.  
 $\text{Na}_2\text{AsS}_4 + 7\frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by alcohol.  
 $+ 8\text{H}_2\text{O}$ . Insol. in alcohol; very sol. in  $\text{H}_2\text{O}$ . (McCay, Z. anal. 1895, 34. 726.)  
 $+ 9\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 160.)  
 $\text{Na}_2\text{S}, 12\text{As}_2\text{S}_5$  (?). Insol. in  $\text{H}_2\text{O}$ .

Sodium zinc sulpharsenate,  $\text{NaZnAsS}_4 + 4\text{H}_2\text{O}$ .  
 Sol. in hot  $\text{H}_2\text{O}$  with decomp. (Preis, A. 257. 202.)

**Strontium sulpharsenate,  $\text{Sr}_2(\text{AsS}_4)_2$ .**

Easily sol in  $\text{H}_2\text{O}$ ; insol. in alcohol.  
 $\text{Sr}_2\text{As}_2\text{S}_7$ . Easily sol in  $\text{H}_2\text{O}$ , from which alcohol ppts.  $\text{Sr}_2(\text{AsS}_4)_2$

**Strontium sulpharsenate sulpharsenite,**

$\text{Sr}_2(\text{AsS}_4)_2$ ,  $\text{Sr}_2\text{As}_2\text{S}_4 + 4\text{H}_2\text{O}$   
 Easily sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr (2) 14. 162.)

**Thallous sulpharsenate,  $\text{Tl}_2\text{AsS}_4$ .**

Not decomp. by  $\text{H}_2\text{O}$ . Decomp. by dil. acids. Insol. in dil. alkali sulphides. Partially decomp. by boiling with a conc solution of sodium sulphide (Hawley, J. Am. Chem. Soc. 1907, 29. 1013)

**Tin (stannous) sulpharsenate.**

Ppt.

**Tin (stannic) sulpharsenate.**

Ppt.

**Uranic sulpharsenate,  $2\text{U}_2\text{S}_5$ ,  $\text{As}_2\text{S}_5$ .**

Ppt. Sol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq.}$

**Zinc sulpharsenate,  $\text{Zn}_2(\text{AsS}_4)_2$ .**

Ppt (Berzelius)  
 $2\text{ZnS}$ ,  $\text{As}_2\text{S}_5$  Ppt. (Berzelius)  
 $\text{ZnS}$ ,  $\text{As}_2\text{S}_5$  (Wohler)

**Disulpharsenic acid.**

See Disulphoxyarsenic acid.

**Sulpharseniosulphomolybdic acid.****Ammonium sulpharseniosulphomolybdate,**  
 $(\text{NH}_4)_4\text{As}_2\text{S}_7(\text{MoS}_4)_2 + 5\text{H}_2\text{O}$ .

Very unstable.  
 Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland, Z anorg. 1897, 15. 49.)

**Barium —,  $\text{Ba}_2\text{As}_2\text{S}_7(\text{MoS}_4)_2 + 14\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland.)

**Potassium —,  $\text{KAsS}_2(\text{MoS}_4) + 4\text{H}_2\text{O}$** 

(Weinland.)  
 $\text{K}_4\text{As}_2\text{S}_7(\text{MoS}_4)_2 + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .  
 Decomp. by mineral acids. Insol. in alcohol. (Weinland.)

**Sodium —,  $\text{NaAsS}_2(\text{MoS}_4) + 6\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{NaOH}$  and  $\text{NH}_3 + \text{Aq.}$  (Weinland.)  
 $\text{Na}_4\text{As}_2\text{S}_7(\text{MoS}_4)_2 + 14\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .  
 Decomp. by mineral acids. (Weinland.)

**Sulpharseniosulphoxymolybdic acid.****Barium sulpharseniosulphoxymolybdate,**  
 $\text{Ba}_4\text{As}_2\text{S}_7(\text{Mo}_2\text{S}_2\text{O}_4) + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1897, 15. 60.)

**Magnesium sulpharseniosulphoxymolybdate,**  
 $\text{Mg}_2\text{As}_2\text{S}_7(\text{Mo}_2\text{S}_2\text{O}_4) + 16\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Weinland)

**Potassium —,  $\text{KAsS}_2(\text{MoS}_4) + 2\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland.)  
 $\text{K}_4\text{As}_2\text{S}_7(\text{Mo}_2\text{S}_2\text{O}_4) + 6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Weinland)  
 $+ 10\text{H}_2\text{O}$ . (Weinland)

**Sodium —,  $\text{NaAsS}_2(\text{MoS}_4) + 5\text{H}_2\text{O}$** 

Sl. sol. in cold, very sol. in hot  $\text{H}_2\text{O}$ . (Weinland)  
 $\text{Na}_4\text{As}_2\text{S}_7(\text{Mo}_2\text{S}_2\text{O}_4) + 15\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Weinland.)

**Sulpharsenious acid.****Ammonium sulpharsenite,  $\text{NH}_4\text{As}_2\text{S}_5 + 2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Ppt. Sol. in  $\text{KOH}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  Sl. attacked by boiling  $\text{HCl} + \text{Aq.}$  (Nilson, J. pr (2) 14. 42.)  
 $(\text{NH}_4)_4\text{As}_2\text{S}_5 = 2(\text{NH}_4)_2\text{S}$ ,  $\text{As}_2\text{S}_5$  Sol. in  $\text{H}_2\text{O}$ , from which alcohol ppts.  $(\text{NH}_4)_2\text{AsS}_3$ .  
 $(\text{NH}_4)_2\text{AsS}_3 = 3(\text{NH}_4)_2\text{S}$ ,  $\text{As}_2\text{S}_5$ . Decomp. on air; sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol  
 $(\text{NH}_4)_2\text{As}_2\text{S}_5$  Sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 160)

**Barium sulpharsenite,  $\text{Ba}_2\text{As}_2\text{S}_5$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol.  
 $+ 5\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 46)  
 $+ 15\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Nilson.)  
 $\text{Ba}_2(\text{AsS}_3)_2$ . Sl. sol. in  $\text{H}_2\text{O}$ . Precipitated by alcohol.  
 $+ 14\text{H}_2\text{O}$ . Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Nilson.)  
 $\text{Ba}(\text{AsS}_3)_2 + 2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 44)  
 $\text{BaAs}_2\text{S}_5$ . Insol. in  $\text{HCl} + \text{Aq}$  (Nilson.)

**Bismuth sulpharsenite,  $2\text{Bi}_2\text{S}_3$ ,  $\text{As}_2\text{S}_5$ .**

Ppt.

**Cadmium sulpharsenite.**

Ppt. (Berzelius, Pogg. 7. 146.)

**Calcium sulpharsenite,  $\text{Ca}_2\text{As}_2\text{S}_5$ .**

Sol. in  $\text{H}_2\text{O}$ , from which alcohol ppts.  $\text{Ca}_2(\text{AsS}_3)_2$ .  
 $\text{Ca}_2(\text{AsS}_3)_2$ . Sol. in  $\text{H}_2\text{O}$ .  
 $+ 15\text{H}_2\text{O}$ . Precipitated by alcohol  
 $\text{Ca}(\text{AsS}_3)_2 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 54.)  
 $\text{CaAs}_2\text{S}_5 + 10\text{H}_2\text{O}$  (?). Insol. in cold  $\text{H}_2\text{O}$ .  
 Decomp. by hot  $\text{H}_2\text{O}$ . (Nilson.)  
 $\text{CaAs}_2\text{S}_5 + 10\text{H}_2\text{O}$  (?). Sl. sol. in hot  $\text{H}_2\text{O}$ . (Nilson.)  
 $\text{Ca}_7\text{As}_2\text{S}_{18} + 25\text{H}_2\text{O}$  Sl. sol. in cold or hot  $\text{H}_2\text{O}$ . (Nilson.)

**Cerous sulpharsenite,  $\text{Ce}_2\text{As}_2\text{S}_5$ .**

Ppt.

Chromic sulpharsenite, $2\text{Cr}_2\text{S}_3, 3\text{As}_2\text{S}_3$ . Ppt. Insol. in $\text{Na}_2\text{S} + \text{Aq.}$	Platinum sulpharsenite, $\text{Pt}_2\text{As}_2\text{S}_3$ Ppt
Cobaltous sulpharsenite, $2\text{CoS}, \text{As}_2\text{S}_3$ . Ppt. Sol. in excess of sodium sulpharsenite + Aq.	Potassium sulpharsenite, $\text{K}_4\text{As}_2\text{S}_3$ . Decomp. by $\text{H}_2\text{O}$ or alcohol. (Berzelius.) $\text{K}_3\text{As}_2\text{S}_3$ . Sol. in $\text{H}_2\text{O}$ . Insol. in alcohol. (Berzelius.) $\text{K}_2\text{As}_2\text{S}_3$ . Sol. in $\text{H}_2\text{O}$ and alcohol. (Berzelius.) $\text{K}_3\text{As}_2\text{S}_3$ . Decomp. by $\text{H}_2\text{O}$ . (Berzelius.) $+2\frac{1}{2}\text{H}_2\text{O}$ . Not wholly sol. in $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 30.) $\text{KAs}_2\text{S}_3 + 8\text{H}_2\text{O}$ . (Nilson.) $\text{KAs}_2\text{S}_3 + \text{H}_2\text{O}$ . Insol. in $\text{H}_2\text{O}$ . Slowly attacked by hot $\text{HCl} + \text{Aq.}$ Sol. in $\text{KOH} + \text{Aq.}$ (Nilson.)
Cuprous sulpharsenite, $3\text{Cu}_2\text{S}, 2\text{As}_2\text{S}_3 = \text{Cu}_3\text{As}_2\text{S}_6$ . Min. <i>Bismite</i> . Decomp. by hot acids and $\text{KOH} + \text{Aq.}$ $2\text{Cu}_2\text{S}, \text{As}_2\text{S}_3 = \text{Cu}_3\text{As}_2\text{S}_6$ . Decomp. by acids, $\text{KOH}$ and $\text{K}_2\text{S} + \text{Aq.}$ (Sommerlad, Z. anorg. 1898, 18. 434.)	Silver sulpharsenite, $12\text{Ag}_3\text{S}, \text{As}_2\text{S}_3$ . Ppt (Sommerlad, Z. anorg. 1898, 18. 428.) $5\text{Ag}_3\text{S}, \text{As}_2\text{S}_3 = \text{Ag}_4\text{As}_2\text{S}_6$ . (Sommerlad.) $\text{Ag}_3\text{AsS}_3$ . Min. <i>Proustite</i> . Sol. in $\text{HNO}_3 + \text{Aq.}$ $\text{KOH} + \text{Aq.}$ dissolves out $\text{Sb}_2\text{S}_3$ . (Senarmont, A. ch. (3) 32. 129; Wöhler, A. 27. 159.) $2\text{Ag}_3\text{S}, \text{As}_2\text{S}_3$ . Partially sol. in $\text{HNO}_3 + \text{Aq.}$ (Berzelius.) $\text{AgAsS}_3$ . (Berzelius, Pogg. 7. 150.)
Cupric sulpharsenite, $\text{Cu}_4\text{As}_2\text{S}_6$ . Insol. in $\text{H}_2\text{O}$ or $\text{HCl} + \text{Aq.}$ Sol. in $\text{Na}_2\text{AsS}_3 + \text{Aq.}$ $\text{Cu}_3\text{As}_2\text{S}_6$ . Ppt (Berzelius.)	Sodium sulpharsenite, $\text{NaAsS}_3 + \frac{1}{2}\text{H}_2\text{O}$ . Attacked by $\text{HCl} + \text{Aq.}$ with difficulty. (Nilson, J. pr. (2) 14. 37.) $+1\frac{1}{2}\text{H}_2\text{O}$ . Forms coagulum with cold, sol. in hot $\text{H}_2\text{O}$ . (Nilson.) $\text{Na}_2\text{As}_2\text{S}_3 + 6\text{H}_2\text{O}$ . Sol. in much $\text{H}_2\text{O}$ ; not easily decomp. by $\text{HCl} + \text{Aq.}$ (Nilson.) $\text{NaAs}_2\text{S}_6 + 4\text{H}_2\text{O}$ Ppt (Nilson, J. pr. (2) 14. 3.)
Iron (ferrous) sulpharsenite. Ppt. Sol. in $\text{Na}_2\text{AsS}_3 + \text{Aq.}$ (Berzelius.)	Strontium sulpharsenite, $3\text{SrS}, \text{As}_2\text{S}_3 + 15\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O} + \text{Aq.}$ ; insol. in alcohol (Voigt and Götting.) $2\text{SrS}, \text{As}_2\text{S}_3$ . Sol. in $\text{H}_2\text{O}$ ; decomp. by alcohol. $+15\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 53.) $\text{Sr}(\text{AsS}_2)_2 + 2\frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in $\text{H}_2\text{O}$ . (Nilson.)
Iron (ferric) sulpharsenite. Ppt. Sol. in excess of a ferric salt, or $\text{Na}_2\text{AsS}_3 + \text{Aq.}$ (Berzelius.)	Thallous sulpharsenite, $\text{TlAsS}_3$ . Ppt. Decomp. by $\text{KOH} + \text{Aq.}$ (Gunning, J. B. 1868. 247.) Above compound is a mixture of $\text{As}_2\text{S}_3$ and $\text{Tl}_2\text{S}$ . (Hawley, J. Am. Chem. Soc. 1907, 29. 1012.) Min. <i>Lorandite</i> (Kuenner and Loezka, C. C. 1904, II. 844.)
Lead sulpharsenite, $\text{Pb}_2\text{As}_2\text{S}_6$ . Ppt. Min. <i>Dufrenoyite</i> $\text{Pb}(\text{AsS}_2)_2 = \text{PbS}, \text{As}_2\text{S}_3$ . Min. <i>Sartorite</i> . $\text{Pb}_4\text{As}_2\text{S}_7$ . Min. <i>Jordanite</i> .	Tin (stannous) sulpharsenite, $\text{Sn}_2\text{As}_2\text{S}_3$ . Ppt.
Lithium sulpharsenites. Resemble K salts	Tin (stannic) sulpharsenite, $\text{SnAs}_2\text{S}_3$ . Ppt. (Berzelius, Pogg. 7. 147.)
Magnesium sulpharsenite, $\text{Mg}_3\text{As}_2\text{S}_6$ . Almost completely sol. in $\text{H}_2\text{O}$ . Easily sol. in alcohol. (Berzelius.) $+8\text{H}_2\text{O}$ . Sl. sol. in $\text{H}_2\text{O}$ . (Nilson.) $\text{Mg}(\text{AsS}_2)_2 + 5\text{H}_2\text{O}$ . Slowly sol. in both cold and hot $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 59.) $\text{Mg}_3(\text{AsS}_2)_2 + 9\text{H}_2\text{O}$ . (Nilson.)	Uranic sulpharsenite, $2\text{U}_2\text{S}_3, \text{As}_2\text{S}_3$ . Ppt.
Manganous sulpharsenite, $\text{Mn}_2\text{As}_2\text{S}_6$ . Ppt. Decomp. by $\text{HCl} + \text{Aq.}$	
Mercurous sulpharsenite, $(\text{Hg}_2)_2\text{As}_2\text{S}_6$ . Ppt (Berzelius.)	
Mercuric sulpharsenite, $\text{Hg}_2\text{As}_2\text{S}_6$ . Ppt. $\text{Hg}(\text{AsS}_2)_2$ . Ppt. (Berzelius, Pogg. 7. 140.)	
Nickel sulpharsenite, $\text{Ni}_3(\text{AsS}_2)_2$ . Ppt. (Berzelius.)	

**Zinc sulpharsenite.**

Ppt (Berzelius, Pogg. 7. 145)

**Zirconium sulpharsenite,  $2\text{Zr}_2\text{S}_3, \text{As}_2\text{S}_3$ .**Ppt. Insol. in solutions of alkali sulpharsenites. Sl. sol. in  $\text{Na}_2\text{S}$  Aq Not decomp. by acids (Berzelius.)**"Sulphatammon,"  $2\text{NH}_3, \text{SO}_2$ .**

(Rose.)

Is ammonium imidosulphonate, which see. (Berglund.)

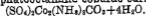
**"Parasulphatammon,"  $3\text{NH}_3, 2\text{SO}_2$ .**

(Rose)

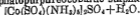
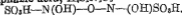
Is basic ammonium imidosulphonate, which see. (Berglund.)

**Sulphatiodic acid.****Potassium sulphatiodate,  $\text{K}_2\text{HO}_2\text{SIO}_4$  or  $\text{KIO}_3, \text{KHSO}_4$ .**Decomp. by  $\text{H}_2\text{O}$ . (Blomstrand, J. pr. (2) 40. 317.)

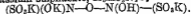
See Iodate sulphate, potassium.

**Sulphatooctamine cobaltic carbonate**Sol. in  $\text{H}_2\text{C}$ . (Vortmann and Blasberg, B. 22. 2650.) $(\text{SO}_4)_2\text{Co}_2(\text{NH}_3)_2(\text{CO}_2)_2 + 8\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (V. and B.)

See Carbonatotetramine cobaltic sulphate. (Jørgensen.)

**Sulphatoplatinamine sulphate,**Easily sol. in  $\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ .**Sulphatoplatinamine sulphate,**Insol. in  $\text{H}_2\text{O}$ .**Sulphatopurplecobaltic bromide,**Sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by conc.  $\text{HBr} + \text{Aq}$ . (Jørgensen, J. pr. (2) 25. 94.)— carbonate,  $[(\text{SO}_4)\text{Co}(\text{NH}_3)_2]_2\text{CO}_2 + 4\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Vortmann and Blasberg, B. 22. 2648.)— chloroplatinate,  $2\text{Co}(\text{SO}_4)(\text{NH}_3)_2\text{Cl}$ ,  $\text{PtCl}_4 + 2\text{H}_2\text{O}$ .Sl. sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen.)— nitrate,  $\text{Co}(\text{SO}_4)(\text{NH}_3)_2(\text{NO}_3)$ .Somewhat sl. sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen.)**Sulphatopurplecobaltic sulphate,**Very easily sol. in  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 25. 94.) $\text{Co}(\text{SO}_4)(\text{NH}_3)_2(\text{HSO}_4) + 2\text{H}_2\text{O}$  Sol. in about 25 pts. of cold  $\text{H}_2\text{O}$ . Sol. in dil., insol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Jørgensen.)**Sulphazic acid,  $\text{H}_2\text{S}_2\text{N}_2\text{O}_3 =$** 

Known only in its salts. (Raschig, A. 241. 161.)

**Potassium sulphazate,  $\text{K}_2\text{HS}_2\text{N}_2\text{O}_3 =$** Sol. in  $\text{H}_2\text{O}$ , but decomp. on standing. (Raschig, A. 241. 161.)**Sulphazidic acid.**

(Fremy)

See Hydroxylamine monosulphonic acid.

**Sulphazilinic acid.**

See Oxyulphazotic acid.

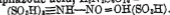
**Metasulphazilinic acid.**

See Trisulphoxyazotic acid.

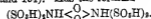
**Sulphazinous acid.**

(Fremy.)

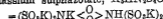
See Dihydroxylamine sulphonic acid.

**Sulphazotic acid,  $\text{H}_2\text{N}_2\text{S}_4\text{O}_{14} =$** 

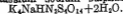
Known only in its salts. (Claus, A. 158. 52 and 194.) Has the formula



(Raschig, A. 241. 161.)

**Lead potassium sulphazotate.**Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Insol. in alcohol and ether. (Fremy, A. ch. (3) 15. 439.)**Potassium sulphazotate,  $\text{K}_2\text{HN}_2\text{S}_4\text{O}_{14} + \text{H}_2\text{O}$** Very sol. in hot, less in cold  $\text{H}_2\text{O}$ . (Raschig, A. 241. 161.) Decomp. gradually by boiling (Claus.) Insol. in alcohol or ether (Fremy, A. ch. (3) 15. 428.)True composition is  $\text{HON}(\text{SO}_2\text{K})_2, \text{KON}(\text{SO}_2\text{K})_2 + \text{H}_2\text{O}$ . Potassium hydroxylamine disulphonate. (Divers and Haga, Chem. Soc. 1900, 77. 432.)

Forms basic salt

 $(\text{SO}_2\text{K})_2\text{NK} < \text{O} > \text{NK}(\text{SO}_2\text{K})_2$ , which is easily sol and decomp. by  $\text{H}_2\text{O}$ . (Raschig.)**Potassium sodium sulphazotate,**Quite easily sol. in  $\text{H}_2\text{O}$ . (Raschig, A. 241. 161.)

**Disulphhydroxyazotic acid,  $\text{ONH}(\text{SO}_2\text{H})_2$ .**

Known only in its salts. (Claus, A. 158, 52 and 194.) Correct composition is hydroxylamine sulphonic acid  $\text{HON}(\text{SO}_2\text{H})_2$ , which see. (Raschig, A. 241. 101.)

**Sulphhydroxylamic acid.**

(Claus.)

See Hydroxylamine monosulphonic acid.

**Disulphhydroxyazotic acid.**

(Claus.)

See Hydroxylamine disulphonic acid.

**Sulphides.**

The sulphides of the alkali metals are sol. in  $\text{H}_2\text{O}$ ; those of the alkali-earth metals are much less sol., and are decomp. upon solution into hydrosulphide and hydroxide.

The other sulphides are insol. in  $\text{H}_2\text{O}$ . For each sulphide, see under the respective element.

**Sulphimide,  $\text{SO}_2\text{NH}$** 

See Imidosulphamide.

**Trisulphimide,  $\text{OHSO} \begin{smallmatrix} \text{NSO.OH} \\ \text{NSO.OH} \end{smallmatrix} \text{N}$**   
( $\text{SO}_2\text{NH}$ )<sub>2</sub>.

Sol. in methyl alcohol; sl. sol. in ether; insol. in chloroform and benzene. (Hantzsch B 1901, 34. 3440.)

**Ammonium sulphimide,  $\text{SO}_2\text{N}(\text{NH}_4)$ .**

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Traube.)

**Barium —,  $(\text{SO}_2\text{N})_2\text{Ba} + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Traube.)

**Potassium —,  $\text{SO}_2\text{NK}$ .**

Not very sol. in  $\text{H}_2\text{O}$ .

**Silver —,  $\text{SO}_2\text{NAg}$ .**

Sol. in 500–600 pts. cold, more easily in hot  $\text{H}_2\text{O}$ . Sol. in acids.

**Sodium —,  $\text{SO}_2\text{NNa}$ .**

Very sol. in  $\text{H}_2\text{O}$ .

**“Sulphitammion,”  $\text{NH}_4$ ,  $\text{SO}_2$** 

See Thionamic acid.

**Sulphobismuthous acid.****Cuprous sulphobismuthite,  $\text{AuBiS}_2$ .**

Min. *Emplectite*. Sol. in  $\text{HNO}_3 + \text{Aq}$ .

$\text{Cu}_2\text{Bi}_2\text{S}_5$  Min. *Klaprothite*. Completely

sol. in  $\text{HCl} + \text{Aq}$ .

$\text{Cu}_2\text{BiS}_4$  Min. *Wittichenite*. Sol. in  $\text{HCl} + \text{Aq}$  and in  $\text{HNO}_3 + \text{Aq}$ .

**Cuprous lead sulphobismuthite,  $\text{Cu}_2\text{S}$ ,  $2\text{PbS}$ ,  $\text{Bi}_2\text{S}_3$ .**

Min. *Patrinite*.

Sol. in  $\text{HNO}_3 + \text{Aq}$  with residue of S and  $\text{PbSO}_4$ .

**Lead —,  $2\text{PbS}$ ,  $\text{Bi}_2\text{S}_3$ .**

Min. *Cosinite*.

$2\text{PbS}$ ,  $3\text{Bi}_2\text{S}_3$  Min. *Chusovite*.

**Potassium —,  $\text{KBiS}$** 

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in  $\text{HCl} + \text{Aq}$ . (Schneider, Pogg. 1869, 136. 404.)

**Metasulphoboric acid,  $\text{B}_2\text{S}_3\text{H}_2\text{S}$ .**

Decomp. by  $\text{H}_2\text{O}$  and alcohol.

1 pt. is sol. in 5 pts. benzene

1 pt. is “ “ 5 “  $\text{CS}_2$

Very sl. sol. in  $\text{CS}_2$  at  $-20^\circ$ . (Stock, B. 1901, 34. 401.)

**Sulphocarbonic acid.****Ammonium cuprous sulphocarbonate,  $\text{CS}_2\text{CuNH}_4$ .**

This salt was formerly described as cupric sulphocarbonate ammonia,  $\text{CS}_2\text{Cu}$ ,  $\text{NH}_3$ . (Hofmann, B. 1903, 36. 1146.)

**Cuprous potassium sulphocarbonate,  $\text{CS}_2\text{CuK}$ .**

Nearly insol. in cold  $\text{H}_2\text{O}$ .

Somewhat sol. in hot  $\text{H}_2\text{O}$ ,  $\text{NaOH}$  and  $\text{NH}_4\text{OH} + \text{Aq}$  (Hofmann.)

**Cupric sulphocarbonate ammonia,  $\text{CS}_2\text{Cu}$ ,  $\text{NH}_3$ .**

Very sl. sol. in strong  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in cold  $\text{H}_2\text{O}$ , sl. sol. in hot  $\text{H}_2\text{O}$ . (Hofmann, Z. anorg. 1897, 14. 295.)

Is ammonium cuprous sulphocarbonate. (Hofmann, B. 1903, 36. 1146.)

**Cuprous sulphocarbonate potassium cyanide,  $\text{CS}_2\text{Cu}_2$ ,  $2\text{KCN} + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and dil. alkalis on warming. (Hofmann, B. 1903, 36. 1148.)

**Zinc sulphocarbonate ammonia,  $\text{CS}_2\text{Zn}$ ,  $2\text{NH}_3$ .**

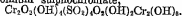
Ppt. (Hofmann, Z. anorg. 1897, 14. 277.)

**Sulphochromic acid,  $\text{H}_2\text{CrO}_4$ ,  $\text{SO}_2$ . (?)**

Sol. in  $\text{H}_2\text{O}$ . (Bolley, A. 56. 113.)

$(\text{SO}_2)_2\text{Cr}_2\text{O}_7(\text{OH})_2$ . Sol. in  $\text{H}_2\text{O}$ . All salts even alkali salts are insol. in  $\text{H}_2\text{O}$ . (Recours, Bull. Soc. 1896, (3) 16. 315.)

$[\text{Cr}_2\text{O}_7(\text{OH})_4(\text{SO}_2)_2\text{O}_2]$ ,  $\text{Cr}_2\text{O}_7(\text{OH})_2(\text{SO}_2)_2(\text{OH})_2(\text{OH})_2$ . Sol. in  $\text{H}_2\text{O}$ . (Wyrouboff, Bull. Soc. 1902, (3) 27. 721.)

**Chromium sulphochromate,**

Ppt; decomp by boiling  $\text{H}_2\text{O}$ . (Wyrsohoff, Bull. Soc. 1902, (3) 27. 720)

**Sulphochromous acid.****Ferrous sulphochromite,  $\text{FeCr}_2\text{S}_4$** 

Insol. in  $\text{H}_2\text{O}$ , and nearly so in  $\text{HCl} + \text{Aq}$ . (Gröger, W. A. B. 81, 2. 531.)

**Manganous —,  $\text{MnCr}_2\text{S}_4$ .**

Insol. in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$ . (Gröger.)

**Potassium —,  $\text{K}_2\text{Cr}_2\text{S}_4$** 

Insol. in  $\text{H}_2\text{O}$  and in hot  $\text{HCl} + \text{Aq}$ .

Easily sol. in aqua regia. Slowly sol. in cold, rapidly sol. in hot dil.  $\text{HNO}_3 + \text{Aq}$ . (Milbauer, Z. anorg. 1904, 42. 443)

$\text{K}_2\text{Cr}_2\text{S}_7$ . Stable in the air, sol. in  $\text{HNO}_3$  and aqua regia with decomp. (Schneider, J. pr. 1897, (3) 56. 407.)

**Silver —,  $\text{Ag}_2\text{Cr}_2\text{S}_4$** 

Not attacked by  $\text{HCl} + \text{Aq}$  even on heating. Decomp. by conc.  $\text{HNO}_3$ . (Schneider, J. pr. 1897, (2) 56. 401.)

**Sodium —,  $\text{Na}_2\text{Cr}_2\text{S}_4$** 

Insol. in  $\text{H}_2\text{O}$ . Sl. attacked by dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in cold conc.  $\text{HNO}_3$  or aqua regia. Sol. in hot dil.  $\text{HNO}_3 + \text{Aq}$  (Gröger.)

Sol. in acids with decomp. (Schneider, J. pr. 1897, (3) 56. 415.)

**Zinc —,  $\text{ZnCr}_2\text{S}_4$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in traces in boiling conc.  $\text{HCl}$  or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ . (Gröger, W. A. B. 81, 2. 531)

**Sulphocyanhydric acid,  $\text{HSCN}$ .**

Sol. in  $\text{H}_2\text{O}$

Sat.  $\text{HSCN} + \text{Aq}$  has sp. gr. = 1.022. (Portt, 1814.)  $\text{HSCN} + \text{Aq}$  containing 12.7%  $\text{HSCN}$  has sp. gr. 1.040 at  $12.7^\circ$ . (Hermes, Z. Ch. 1866. 417.)

**Sulphocyanides**

Most sulphocyanides are sol. in  $\text{H}_2\text{O}$ , but  $\text{Cu}$ ,  $\text{Pb}$ ,  $\text{Hg}$ , and  $\text{Ag}$  sulphocyanides are insol.

**Aluminium sulphocyanide,  $\text{Al}(\text{SCN})_3$ .**

Known only in solution.

$\text{Al}(\text{SCN})_2(\text{OH})_4$ . Known only in solution (Suida.)

**Aluminium potassium sulphocyanide,**

Very hygroscopic.

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Rosenheim, Z. anorg. 1901, 27. 302.)

**Ammonium sulphocyanide,  $\text{NH}_4\text{SCN}$ .**

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ .

100 pts  $\text{H}_2\text{O}$  dissolve 128.1 pts. at  $0^\circ$  and 162.2 pts. at  $20^\circ$ .

$\text{NH}_4\text{SCN} + \text{Aq}$  sat. at ord. temp. has density of 1.138 and 100 cc. contains 69.16 g.  $\text{NH}_4\text{SCN}$ . (Klason, J. pr. 1887, (2) 36. 67)

By dissolving 90 g.  $\text{NH}_4\text{SCN}$  in 90 g.  $\text{H}_2\text{O}$  at  $17^\circ$ , the temp. falls to  $-12^\circ$  (Clowes, Z. Ch. 1866. 190.)

133 pts  $\text{NH}_4\text{SCN} + 100$  pts  $\text{H}_2\text{O}$  at  $13.2^\circ$  lower the temp.  $31.2^\circ$ . (Rüddorff, B. 2. 68.)

Sol. in liquid  $\text{SO}_2$ . (Walden, B. 1899, 32. 2864)

Difficultly sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Very easily sol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 826)

Easily sol. in alcohol

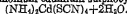
Easily sol. in acetone. (Krug and M'Elroy. Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

Difficultly sol. in ethyl acetate (Naumann, B. 1910, 43. 314.)

**Ammonium bismuth sulphocyanide,**

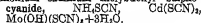
As K salt. (Rosenheim and Vogelgesang Z. anorg. 1906, 48. 215.)

**Ammonium cadmium sulphocyanide,**

Somewhat deliquescent.

Melts in crystal  $\text{H}_2\text{O}$  at  $25^\circ$ .

Insol. in alcohol. (Grossmann, B. 1902, 35. 2667.)

**Ammonium cadmium molybdenyl sulphocyanide,**

(Maas and Sand, B. 1908, 41. 1513.)

**Ammonium cobaltous sulphocyanide,**

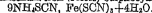
Decomp. in moist air.

Cannot be recryst. from  $\text{H}_2\text{O}$ . (Treadwell, Z. anorg. 1901, 26. 109)

$+ 4\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ .

Sol. in methyl, ethyl and amyl alcohol, in acetone and in ether  $+ \text{Aq}$ .

Can be recryst. from  $\text{H}_2\text{O}$  or alcohol without decomp. (Rosenheim and Cohn, Z. anorg. 1901, 27. 289)

**Ammonium iron (ferric) sulphocyanide,**

Deliquescent, and sol. in  $\text{H}_2\text{O}$  (Krüss and Morait, A. 260, 207)

$3\text{NH}_4\text{SCN}, \text{Fe}(\text{SCN})_3$ . Extremely deliquescent.

**Ammonium mercuric sulphocyanide,**

Easily sol. in  $\text{H}_2\text{O}$ . (Fleischer, A. 179. 228.)

- $\text{NH}_4\text{Hg}(\text{SCN})_2$  Insol. in cold; sol. in hot  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1901, 27. 284.)
- Ammonium molybdenyl sulphocyanide,**  
 $3\text{NH}_4\text{SCN}$ ,  $\text{Mo}(\text{OH})(\text{SCN})_2 + 3\text{H}_2\text{O}$ .  
 (Sand and Maas, B. 1907, 40. 4507.)
- Ammonium nickel sulphocyanide,**  
 $(\text{NH}_4)_2\text{Ni}(\text{SCN})_2 + 4\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$  with decomp.  
 Sl. sol. in cold; easily sol. in hot alcohol (Rosenheim, Z. anorg. 1901, 27. 292.)
- Ammonium silver sulphocyanide,**  $\text{NH}_4\text{SCN}$ ,  
 $\text{AgSCN}$ .  
 Decomp. by  $\text{H}_2\text{O}$ .
- Ammonium vanadium sulphocyanide,**  
 $\text{V}(\text{SCN})_3$ ,  $3\text{NH}_4\text{SCN} + 4\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ ; sol. in alcohol, sl. sol. in ether. (Croci, Z. anorg. 1898, 19. 311.)
- Ammonium vanadyl sulphocyanide,**  
 $(\text{NH}_4)_2\text{VO}(\text{SCN})_2 + 5\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ , alcohol, ether, acetone, amyl alcohol and ethyl acetate. (Koppel, Z. anorg. 1903, 38. 290.)
- Ammonium zinc sulphocyanide,**  
 $(\text{NH}_4)_2\text{Zn}(\text{SCN})_2 + 3\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$  and in alcohol. (Walden, Z. anorg. 1900, 23. 374.)  
 $+ 3\text{H}_2\text{O}$  Easily sol. in cold  $\text{H}_2\text{O}$ , acetone, alcohols and ether. (Rosenheim and Huld-schinsky, B. 1901, 34. 3913.)
- Ammonium sulphocyanide mercuric bromide,**  
 $\text{NH}_4\text{SCN}$ ,  $\text{HgBr}_2$ .  
 Very sol. in  $\text{H}_2\text{O}$ .  
 Sol. in alcohol. (Grossmann, B. 1902, 35. 2945.)  
 $2\text{NH}_4\text{SCN}$ ,  $\text{HgBr}_2 + \text{H}_2\text{O}$ . Somewhat deliquescent.  
 Very sol. in  $\text{H}_2\text{O}$ .  
 Sol. in alcohol. (Grossmann.)
- Arsenic sulphocyanide,**  $\text{As}(\text{SCN})_3$ .  
 Decomp. by  $\text{H}_2\text{O}$ . Insol. in all ordinary solvents (Miguel, A. ch. (5) 11. 341.)
- Barium sulphocyanide,**  $\text{Ba}(\text{SCN})_2 + 2\text{H}_2\text{O}$ .  
 Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Boiling solution in alcohol contains 32.8% anhydrous salt. Solution sat. at  $20^\circ$  contains 30%. (Tscherniak, B. 16. 349.)  
 Cryst. with  $3\text{H}_2\text{O}$ . (Tscherniak, B. 25. 2627.)
- Barium cadmium sulphocyanide,**  
 $4\text{Ba}(\text{SCN})_2$ ,  $\text{Cd}(\text{SCN})_2 + 10\text{H}_2\text{O}$ .  
 Deliquescent. (Grossmann, B. 1902, 38. 2669.)
- Barium caesium cuprous sulphocyanide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $3\text{CsSCN}$ ,  $2\text{CuSCN}$ .  
 Rapidly decomp. by  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1902, 28. 273.)
- Barium caesium silver sulphocyanide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $3\text{CsSCN}$ ,  $2\text{AgSCN}$ .  
 100 pts  $\text{H}_2\text{O}$  dissolve 92 pts. at  $19^\circ$ .  
 Decomp. by much  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1902, 28. 272.)
- Barium cobaltous sulphocyanide,**  
 $\text{BaCo}(\text{SCN})_4 + 8\text{H}_2\text{O}$ .  
 Ppt. (Rosenheim, Z. anorg. 1901, 27. 290.)
- Barium mercuric sulphocyanide,**  
 $\text{BaHg}(\text{SCN})_4$ .  
 Very sol. in  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim, Z. anorg. 1901, 27. 286.)  
 $\text{BaHg}(\text{SCN})_4 + 2\text{H}_2\text{O}$ . Ppt. Nearly insol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Rosenheim.)
- Barium potassium silver sulphocyanide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $4\text{KSCN}$ ,  $2\text{AgSCN} + \text{H}_2\text{O}$ .  
 Very sol. in a little  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$  (Wells, Am. Ch. J. 1902, 28. 283.)
- Barium rubidium silver sulphocyanide,**  
 $\text{BaRb}_2\text{Ag}_2(\text{SCN})_6 + 2\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1903, 30. 186.)  
 $\text{BaRb}_4\text{Ag}_2(\text{SCN})_8 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Wells.)
- Barium silver sulphocyanide,**  $\text{Ba}(\text{SCN})_2$ ,  
 $2\text{AgSCN} + 2\text{H}_2\text{O}$ .  
 Stable in the air. (Wells, Am. Ch. J. 1902, 28. 269.)
- Barium zinc sulphocyanide,**  $\text{BaZn}(\text{SCN})_4$ .  
 $+ 3\text{H}_2\text{O}$ .  
 Easily sol. in alcohol. (Walden, Z. anorg. 1900, 23. 374.)
- Barium sulphocyanide mercuric bromide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $2\text{HgBr}_2 + 5\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1903, 37. 420.)
- Bismuth sulphocyanide, basic,**  
 $\text{Bi}(\text{OH})(\text{SCN})_2 + 5\text{H}_2\text{O}$ .  
 (Rosenheim and Vogelgesang, Z. anorg. 1906, 48. 214.)  
 $\text{Bi}(\text{SCN})_3$ ,  $2\text{Bi}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ , but when recently pptd. decomp. by boiling therewith. Insol. in  $\text{HSCN} + \text{Aq}$ . (Metzendorf.)
- Bismuth sulphocyanide,**  $\text{Bi}(\text{SCN})_3$ .  
 Insol. or sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , and  $\text{HSCN} + \text{Aq}$ . (Metzendorf, Pogg. 58. 53.)

Decomp. by cold  $H_2O$ . (Bender, B. 20 723.)  
 $+14H_2O$ . Extremely deliquescent.  
 Decomp. by  $H_2O$ . (Rosenheim and Vogelgesang, Z. anorg. 1906, 48. 214.)

**Bismuth potassium sulphocyanide,**  
 $K_3Bi(SCN)_4$ .

Decomp. by  $H_2O$ . (Rosenheim and Vogelgesang, Z. anorg. 1906, 48. 215.)

Not hygroscopic.

Decomp. by  $H_2O$ .

Easily sol. in alcohol. (Vanino, Z. anorg. 1901, 28. 220.)

$Bi(SCN)_3$ , 9KSCN. Very hygroscopic.

Decomp. by  $H_2O$ .

Sol. in alcohol. (Vanino, Z. anorg. 1901, 28. 221.)

**Bismuth sodium sulphocyanide,**  
 $Na_3Bi(SCN)_4$ .

As K salt. (Rosenheim and Vogelgesang, Z. anorg. 1906, 48. 215.)

**Boron sulphocyanide,  $B(SCN)_3$ .**

Sol. in benzene and ether. (Cooksedge, Chem. Soc. 1908, (2) 93. 217.)

**Cadmium sulphocyanide,  $Cd(SCN)_2$ .**

Sl. sol. in  $H_2O$ . Sol. in  $NH_4OH$  + Aq with combination.

**Cadmium caesium sulphocyanide,**  
 $CsCd(SCN)_2$ .

Recryst. from  $H_2O$ . (Wells, Am. Ch. J. 1903, 30. 148.)

$Cs_2Cd(SCN)_4 + 2H_2O$ . Very sol. in  $H_2O$ . Can be recryst. from conc. solution but decomp. on dilution to  $CsCd(SCN)_2$ . (Wells.)

**Cadmium caesium silver sulphocyanide,**  
 $Cs_2CdAg_2(SCN)_6$ .

(Wells.)

$+2H_2O$ . (Wells.)

$Cs_2CdAg_2(SCN)_6 + 2H_2O$ . (Wells.)

$Cs_2Cd_2Ag_{10}(SCN)_{20} + 6H_2O$  (Wells.)

**Cadmium mercuric sulphocyanide,  $Cd(SCN)_2$ ,  $Hg(SCN)_2$ .**

Very sol. in hot  $H_2O$ . (Grossmann, Z. anorg. 1903, 37. 414.)

**Cadmium molybdenum sulphocyanide,**  
 $Cd(SCN)_2$ ,  $Mo(SCN)_4 + 2H_2O$ .

(Maas and Sand, B. 1908, 41. 1513.)

$+3H_2O$ . (Maas and Sand.)

**Cadmium molybdenyl potassium sulphocyanide,  $KSCN$ ,  $4Cd(SCN)_2$ ,  $3Mo(OH)(SCN)_3 + 18H_2O$ .**

(Maas and Sand, B. 1908, 41. 1513.)

**Cadmium molybdenyl sulphocyanide ammonia,  $3Cd(SCN)_2$ ,  $2Mo(OH)(SCN)_3$ ,  $18NH_3$ .**

(Maas and Sand, B. 1908, 41. 1512.)

$+2H_2O$ . (Maas and Sand.)

**Cadmium potassium sulphocyanide,**  
 $K_2Cd(SCN)_4 + 2H_2O$ .

Very sol. in  $H_2O$ . (Grossmann, B. 1902, 35. 2668.)

**Cadmium rubidium sulphocyanide,**  
 $Rb_2Cd(SCN)_4 + 2H_2O$ .

Very sol. in  $H_2O$ . (Grossmann, B. 1902, 35. 2668.)

**Cadmium sodium sulphocyanide,**  
 $Na_2Cd(SCN)_4 + 3H_2O$ .

(Grossmann, B. 1902, 35. 2668.)

**Cadmium sulphocyanide ammonia,  $Cd(SCN)_2$ ,  $NH_3$ .**

Decomp. by  $H_2O$ . (Grossmann, B. 1902, 35. 2666.)

$Cd(SCN)_2$ ,  $2NH_3$ . Decomp. by pure  $H_2O$ . (Grossmann.)

**Cadmium sulphocyanide ammonium bromide,**  
 $Cd(SCN)_2$ ,  $NH_4Br + H_2O$ .

Can be recryst. from  $H_2O$ . Decomp. in dil. solution. (Grossmann, Z. anorg. 1903, 37. 425.)

$Cd(SCN)_2$ ,  $2NH_4Br$ . Easily splits off  $NH_4Br$  (Grossmann.)

**Cadmium sulphocyanide ammonium chloride,**  
 $Cd(SCN)_2$ ,  $2NH_4Cl$ .

Can be recryst. from  $H_2O$ . Decomp. in dil. solution. (Grossmann, Z. anorg. 1903, 37. 423.)

**Cadmium sulphocyanide potassium bromide,**  
 $Cd(SCN)_2$ ,  $KBr + H_2O$ .

Recryst. from  $H_2O$ . (Grossmann, Z. anorg. 1903, 37. 425.)

$Cd(SCN)_2$ ,  $2KBr$ . Recryst. from  $H_2O$ . (Grossmann.)

**Cadmium sulphocyanide potassium chloride,**  
 $Cd(SCN)_2$ ,  $2KCl$ .

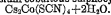
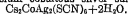
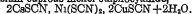
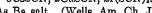
Recryst. from  $H_2O$ . Decomp. in dil. solution. (Grossmann, Z. anorg. 1903, 37. 423.)

**Cadmium sulphocyanide potassium iodide,**  
 $Cd(SCN)_2$ ,  $2KI$ .

Recryst. from  $H_2O$ . (Grossmann.)

**Caesium calcium silver sulphocyanide,**  
 $2CsSCN$ ,  $Ca(SCN)_2$ ,  $2AgSCN + 2H_2O$ .

Recryst. from  $H_2O$ . (Wells, Am. Ch. J. 1902, 28. 275.)

**Cæsium chromium sulphocyanide.***See Chromisulphocyanide, cæsium.***Cæsium cobaltous sulphocyanide,**Stable in the air. (Shunn and Wells, *Am. Ch. J.* 1903, 29, 476.)**Cæsium cobaltous silver sulphocyanide,**Slowly attacked by  $\text{H}_2\text{O}$ ; decomp. by boiling  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{CsSCN}$  or  $\text{Co}(\text{SCN})_2 + \text{Ag}$ . (Shunn and Wells, *Am. Ch. J.* 1903, 29, 478.)**Cæsium cuprous sulphocyanide,  $\text{CsSCN}$ ,  $\text{CuSCN}$ .** $\text{H}_2\text{O}$  separates  $\text{CuSCN}$ . (Roberts, *Am. Ch. J.* 1902, 28, 262.)**Cæsium cuprous nickel sulphocyanide,**Sl. sol. in  $\text{H}_2\text{O}$ . (Roberts and Wells, *Am. Ch. J.* 1902, 28, 277.)**Cæsium cuprous strontium sulphocyanide,**As Ba salt. (Wells, *Am. Ch. J.* 1902, 28, 275.)**Cæsium magnesium silver sulphocyanide,**As Ca comp. (Wells, *Am. Ch. J.* 1902, 28, 275.)**Cæsium manganous silver sulphocyanide,**Rather sl. sol. in  $\text{H}_2\text{O}$ . (Wells.)**Cæsium mercuric sulphocyanide,  $\text{CsSCN}$ ,  $\text{Hg}(\text{SCN})_2.$** Sl. sol. in hot  $\text{H}_2\text{O}$ . (Bristol and Wells, *Am. Ch. J.* 1902, 28, 280.)**Cæsium mercuric sulphocyanide,  $2\text{CsSCN}$ ,  $\text{Hg}(\text{SCN})_2 + \text{H}_2\text{O}.$** Moderately sol. in  $\text{H}_2\text{O}$ , especially when warm. Recryst. without decomp. (Bristol and Wells, *Am. Ch. J.* 1902, 28, 260.)**Cæsium nickel silver sulphocyanide,**Slowly decomp. by hot  $\text{H}_2\text{O}$ . (Wells, *Am. Ch. J.* 1902, 28, 277.)**Cæsium silver sulphocyanide,  $\text{CsSCN}$ ,  $\text{AgSCN}.$** Easily forms supersat. solution. (Wells, *Am. Ch. J.* 1902, 28, 264.) $2\text{CsSCN}$ ,  $\text{AgSCN}$ . Stable in the air. (Wells.) $3\text{CsSCN}$ ,  $\text{AgSCN}$ . Stable in the air. (Wells.)**Cæsium silver strontium sulphocyanide,**

As Ba comp. (Wells.)

**Cæsium silver zinc sulphocyanide,**

(Wells.)

 $\text{Cs}_2\text{ZnAg}(\text{SCN})_3$ . Ppt. Stable in the air. (Wells.) $\text{CsZn}_2\text{Ag}_2(\text{SCN})_3$ . Decomp. by cold, more rapidly by hot  $\text{H}_2\text{O}$ . (Wells.) $\text{CsZn}_2\text{Ag}_2(\text{SCN})_3$ . Slowly decomp. by  $\text{H}_2\text{O}$ . (Wells.)**Cæsium zinc sulphocyanide,  $\text{Cs}_2\text{Zn}(\text{SCN})_4 + 2\text{H}_2\text{O}.$** Moderately sol. in  $\text{H}_2\text{O}$  and can be recryst. therefrom. (Wells.)**Calcium sulphocyanide,  $\text{Ca}(\text{SCN})_2 + 3\text{H}_2\text{O}.$** Deliquescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol.**Calcium silver sulphocyanide,  $\text{Ca}(\text{SCN})_2$ ,  $2\text{AgSCN} + 2\text{H}_2\text{O}.$** 

(Wells.)

**Calcium stannic sulphocyanide,  $\text{CaSn}(\text{SCN})_2 + 7\text{H}_2\text{O}.$** Very sol. in  $\text{H}_2\text{O}$ . Can be recryst. therefrom. Sol. in alcohol and acetone. (Weinland and Barnes, *Z. anorg.* 1900, 62, 258.)**Cerous sulphocyanide,  $\text{Ce}(\text{SCN})_3 + 7\text{H}_2\text{O}.$** Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol (John, *Bull. Soc.* (2) 21, 534.)**Chromous sulphocyanide with  $\text{MSCN}.$** *See Chromosulphocyanide, M.***Chromic sulphocyanide,  $\text{Cr}(\text{SCN})_3.$** Deliquescent, and sol. in  $\text{H}_2\text{O}$ . Somewhat sol. in organic solvents. (Speransky, *C. C.* 1897, I, 141.)*See also Chromisulphocyanhydric acid.***Chromic sulphocyanide with  $\text{MSCN}.$** *See Chromisulphocyanide, M.***Cobaltous sulphocyanide,  $\text{Co}(\text{SCN})_2 + \frac{1}{2}\text{H}_2\text{O}.$** Sol. in  $\text{H}_2\text{O}$  and alcohol; also in ether. Sol. in liquid  $\text{SO}_2$ . (Walden, *B.* 1899, 82, 2864.)

Sol. in acetone. (Krug and M'Elroy.)

Sol. in methyl acetate. (Naumann, *B.* 1900, 42, 3790.) $+ 3\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim and Cohn, *Z. anorg.* 1901, 27, 288.)**Cobaltous mercuric sulphocyanide,  $\text{Co}(\text{SCN})_2$ ,  $\text{Hg}(\text{SCN})_2.$** Very sl. sol. in  $\text{H}_2\text{O}$  and dil.  $\text{HCl} + \text{Ag}$ . Easily sol. in  $\text{HNO}_3 + \text{Ag}$ . (Cleve, *J. pr.* 91, 227.)

Cobaltous potassium sulphocyanide,  
 $\text{CoK}_2(\text{SCN})_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Treadwell, Z. anorg. 1901, 26, 109.)

+4 $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Sol. in methyl, ethyl and amyl alcohol, in acetone and in ether+Aq. Can be recryst. from  $\text{H}_2\text{O}$  or alcohol without decomp. (Rosenheim and Cohn, Z. anorg. 1901, 27, 289.)

Cobaltous silver sulphocyanide,  $\text{CoAg}(\text{SCN})_4$ ,  
 +2 $\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Shunn and Wells, Am. Ch. J. 1903, 29, 476.)

$\text{Ag}_2\text{Co}(\text{SCN})_4$ . Almost unsol. in  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim, Z. anorg. 1901, 27, 291.)

Cobaltous sodium sulphocyanide,  
 $\text{Na}_2\text{Co}(\text{SCN})_4 \cdot 8\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim.)

Cobaltous sulphocyanideammonia,  $\text{Co}(\text{SCN})_2$ ,  
 2 $\text{NH}_3$  and  $\text{Co}(\text{SCN})_2$ , 6 $\text{NH}_3$ .

(Peters, B. 1903, 41, 3178.)

$\text{Co}(\text{SCN})_2$ , 4 $\text{NH}_3$ . Sol. in  $\text{H}_2\text{O}$  and alcohol (Sand, B. 1903, 36, 1439.)

Cobaltous sulphocyanide mercuric chloride,  
 $2\text{Co}(\text{SCN})_2$ , 2 $\text{HgCl}_2$ .

(Hantzsch and Shibata, Z. anorg. 1912, 73, 320.)

$2\text{Co}(\text{SCN})_2$ , 3 $\text{HgCl}_2$ . Easily decomp. (Hantzsch and Shibata.)

Cuprous sulphocyanide,  $\text{CuSCN}$

1 l.  $\text{H}_2\text{O}$  at 18° dissolves 0.004 mg. mols. or 0.5 mg.  $\text{CuSCN}$ . (Kohlrausch and Rose, Z. phys. Ch. 1893, 12, 241.)

Insol. in dil. acids. Sl. sol. in cold, easily in warm conc.  $\text{HCl}$ +Aq. Decomp. by conc.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ +Aq. Sol. with combination in  $\text{NH}_4\text{OH}$ +Aq. Insol. in  $\text{KSCN}$ +Aq.

Less sol. in  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{SO}_4$ +Aq than in  $\text{HNO}_3$ . (Kuhn, Ch. Z. 1908, 32, 1056.)

Sol. in  $\text{Fe}_2(\text{SO}_4)_3$ +Aq. (Johnson, J. Soc. Chem. Ind 1889, 8, 603.)

$\text{KSCN}$ +Aq (85-90 g. in 50 g.  $\text{H}_2\text{O}$ ) dissolves 18 g.  $\text{CuSCN}$ . (Thurnauer, B. 1890, 23, 770.)

Sol. in ether. (Skey, C. N. 1867, 16, 201.)

Cupric sulphocyanide,  $\text{Cu}(\text{SCN})_2$ .

Decomp. by  $\text{H}_2\text{O}$  to cuprous salt. Sol. in warm  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3$ +Aq. Sol. in  $\text{MSCN}$ +Aq, but solutions decomp. by dilution. Sol. in  $\text{NH}_4\text{OH}$ +Aq.

Solubility in  $\text{NH}_4\text{OH}$ +Aq at 25° and at 40°

At 25°.

Sp. gr. 25°/25°	One gram of solution contains			1000 mols. $\text{H}_2\text{O}$ dissolve		Composition of solid salt in contact with solution
	g $\text{NH}_3$	g $\text{Cu}(\text{SCN})_2$	g $\text{H}_2\text{O}$	Mols $\text{NH}_3$	Mols. $\text{Cu}(\text{SCN})_2$	
0.99853	0.2147	0.1522	0.6331	358.04	24.09	$\text{Cu}(\text{SCN})_2$ , 4 $\text{NH}_3$
0.99871	0.1855	0.1124	0.7221	242.02	15.60	
1.00703	0.0993	0.0798	0.8209	127.76	9.74	
1.01336	0.0639	0.0659	0.8702	77.51	7.69	
1.01506	0.0535	0.0622	0.8843	64.05	7.04	
1.01705	0.0426	0.0596	0.8978	50.21	6.65	$\text{Cu}(\text{SCN})_2$ , 2 $\text{NH}_3$
1.02132	0.0250	0.0511	0.9239	28.55	5.55	
1.01661	0.0198	0.0408	0.9394	22.27	4.35	
1.00816	0.0079	0.0245	0.9676	18.61	2.54	

At 40°.

0.1802	0.1976	0.6222	306.28	31.83	Cu(SCN) <sub>2</sub> , 4NH <sub>3</sub>
0.1398	0.1658	0.6944	213.10	23.93	
0.0758	0.1299	0.7943	101.00	16.38	
0.0550	0.1207	0.8243	70.59	14.67	
0.0435	0.1178	0.8388	54.82	14.07	
0.0352	0.0876	0.8772	42.53	10.00	Cu(SCN) <sub>2</sub> , 2NH <sub>3</sub>
0.0257	0.0655	0.9088	30.00	7.22	
0.0177	0.0418	0.9405	19.86	4.46	
0.0094	0.0281	0.9625	10.31	2.93	

(Horn, Am. Ch. J. 1907, 37, 471.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Cuprocupric sulphocyanide,  $\text{Cu}(\text{SCN})_3$ ,  
 $\text{Cu}_2(\text{SCN})_5$ .

Not attacked by hot  $\text{HCl}$ +Aq. Insol. in  $\text{KSCN}$ +Aq.

- Cupric mercuric sulphocyanide,  $\text{CuHg(SCN)}_2$ .  
Almost insol. in cold  $\text{H}_2\text{O}$  and in alcohol;  
sl. sol. in boiling  $\text{H}_2\text{O}$  (Rosenheim, Z. anorg.  
1901, 27. 286.)
- Cuprous potassium sulphocyanide,  $\text{CuSCN}$ ,  
 $6\text{KSCN}$ .  
Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Thurn-  
auer, B. 1890, 23. 770.)
- Cuprous sulphocyanide ammonia,  $\text{Cu}_2(\text{SCN})_2$ ,  
 $2\text{NH}_3$ .  
Decomp. in the air. (Richards, Z. anorg.  
1898, 17. 247.)  
 $\text{Cu}_2(\text{SCN})_2$ ,  $5\text{NH}_3$ . Very unstable in the  
air. (Richards.)
- Cupric sulphocyanide ammonia,  $\text{Cu(SCN)}_2$ ,  
 $2\text{NH}_3$ .  
Sol. in little  $\text{H}_2\text{O}$ , but decomp. by dilution  
with pptn. of basic salt. Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$   
By long standing a small amount dissolves  
in  $\text{H}_2\text{O}$  with separation of  $\text{CuSCN}$ . (Litter-  
scheid, Aich. Pharm. 1901, 239. 337.)  
Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  containing  
a small amount of ammonia (Horn, Am.  
Ch. J. 1907, 37. 477.)  
 $\text{Cu(SCN)}_2$ ,  $4\text{NH}_3$ . Very unstable in the  
air.  
Sol. in  $\text{H}_2\text{O}$ , but decomp. by much  $\text{H}_2\text{O}$   
with pptn. of a basic salt. (Horn.)  
100 pts.  $\text{N}/10 \text{ NH}_4\text{OH} + \text{Aq.}$  dissolve 10.4  
pts. anhydrous salt at  $25^\circ$ . (Pudschlies, Dis-  
sert.)  
Loses  $\text{NH}_3$  in the air.  
Sol. in  $\text{H}_2\text{O}$ . (Kohlschutter, B. 1904, 37.  
1156.)  
Decomp. in the air and by  $\text{H}_2\text{O}$  and dil.  
and conc. acids, sol. in cold conc.  $\text{HNO}_3$  and  
 $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in boiling conc.  $\text{HCl}$ .  
(Richards, Z. anorg. 1898, 17. 250.)
- Didymium sulphocyanide,  $\text{Dy(SCN)}_2 + 6\text{H}_2\text{O}$   
Deliquescent, and sol. in  $\text{H}_2\text{O}$ .
- Erbium sulphocyanide,  $\text{Er(SCN)}_2 + 6\text{H}_2\text{O}$ .  
Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Höglund.)
- Glucinum sulphocyanide,  $\text{Gl(SCN)}_2$  (?).  
f Sol. in  $\text{H}_2\text{O}$  (Hermes, J. pr. 97. 465.)
- Gold (aurous) potassium sulphocyanide,  
 $\text{AuSCN}$ ,  $\text{KSCN}$ .  
Easily sol. in  $\text{H}_2\text{O}$ , less in absolute alcohol.  
(Cleve, J. pr. 94. 16.)
- Gold (aurous) potassium sulphocyanide  
ammonia,  $\text{KAu(SCN)}_2$ ,  $5\text{NH}_3$ .  
(Peters, B. 1908, 41. 3178.)
- Gold (auric) potassium sulphocyanide am-  
monia,  $\text{KAu(SCN)}_4$ ,  $4\text{NH}_3$ .  
(Peters.)
- Gold (aurous) silver sulphocyanide,  $\text{AuSCN}$ ,  
 $\text{AgSCN}$ .  
Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$
- Gold (auric) potassium sulphocyanide.  
Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. (Cleve.)
- Gold (aurous) sulphocyanide ammonia,  
 $\text{AuSCN}$ ,  $\text{NH}_3$ .  
Very sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ .
- Iron (ferrous) sulphocyanide,  $\text{Fe(SCN)}_2 + 3\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$ , alcohol, or ether.  
Sol. in acetone. (Krug and M'Elroy.)
- Iron (ferric) sulphocyanide,  $\text{Fe(SCN)}_3 + 3\text{H}_2\text{O}$ .  
Deliquescent. Very sol. in  $\text{H}_2\text{O}$ , alcohol,  
or ether. Ether extracts the salt from  
 $\text{Fe(SCN)}_2 + \text{Aq.}$  Decomp. by much  $\text{H}_2\text{O}$   
if pure. Not decomp. by monobasic acids,  
but conc.  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$ , also oxalic,  
tartaric, malic, etc., acids destroy the colour.
- Iron (ferric) lithium sulphocyanide,  $\text{Fe(SCN)}_3$ ,  
 $9\text{LiSCN} + 4\text{H}_2\text{O}$ .  
More deliquescent than the other ferric  
sulphocyanides (Krüss and Morahit.)
- Iron (ferrous) mercuric sulphocyanide,  
 $\text{Fe(SCN)}_2$ ,  $\text{Hg(SCN)}_2 + 2\text{H}_2\text{O}$ .  
Moderately sol. in hot  $\text{H}_2\text{O}$  (Cleve, J.  
pr. 91. 227.)
- Iron (ferric) potassium sulphocyanide,  
 $\text{Fe(SCN)}_3$ ,  $3\text{KSCN} + x\text{H}_2\text{O}$ .  
Extremely deliquescent, and sol. in  $\text{H}_2\text{O}$ .  
(Krüss and Morahit.)  
 $\text{Fe(SCN)}_3$ ,  $9\text{KSCN} + 4\text{H}_2\text{O}$ . Hygroscopic.  
Sol. in  $\text{H}_2\text{O}$  without decomp. Insol. in pure  
anhydrous ether, but decomp. by ether con-  
taining traces of  $\text{H}_2\text{O}$  into  $\text{Fe(SCN)}_2$  and  
 $\text{KSCN}$ . (Krüss and Morahit, A. 260. 204.)
- Iron (ferrous) sodium sulphocyanide,  
 $\text{Na}_2\text{Fe(SCN)}_6 + 12\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$  and alcohol. (Rosenheim, Z.  
anorg. 1901, 27. 299.)
- Iron (ferric) sodium sulphocyanide,  $\text{Fe(SCN)}_3$ ,  
 $9\text{NaSCN} + 4\text{H}_2\text{O}$ .  
Less deliquescent than the corresponding  
 $\text{NH}_4$  or  $\text{K}$  salt. (Krüss and Morahit.)  
 $\text{Na}_2\text{Fe(SCN)}_6 + 12\text{H}_2\text{O}$ . (Rosenheim, Z.  
anorg. 1901, 27. 297.)
- Lanthanum sulphocyanide,  $\text{La(SCN)}_3 + 7\text{H}_2\text{O}$ .  
Deliquescent, sol. in  $\text{H}_2\text{O}$ . (Cleve.)
- Lead sulphocyanide, basic,  
 $6\text{PbO}$ ,  $\text{Pb(SCN)}_2 + 2\text{H}_2\text{O}$ . Ppt.  
 $\text{Pb(SCN)}_2$ ,  $\text{PbO} + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .  
(Stromholm, Z. anorg. 1904, 38. 440.)

**Lead sulphocyanide,  $\text{Pb}(\text{SCN})_2$ .**

Nearly insol. in cold, decomp. by boiling  $\text{H}_2\text{O}$ . (Liebig.)  
Sl. sol. in  $\text{H}_2\text{O}$ .

$4.5 \times 10^{-1}$  g. are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46, 603.)

**Lead sulphocyanide bromide,  $\text{Pb}(\text{SCN})_2 \cdot 8\text{PbBr}_2$ .**

(Grissom and Thorp, Am. Ch. J. 10, 219.)

**Lead sulphocyanide chloride,  $\text{PbSCNCl}$** 

Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Murtry, Chem. Soc. 55, 50.)

Sol. in  $\text{H}_2\text{O}$ . (Grissom and Thorp, Am. Ch. J. 10, 229.)

**Lead sulphocyanide iodide,  $3\text{Pb}(\text{SCN})_2 \cdot \text{PbI}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Grissom and Thorp, Am. Ch. J. 10, 229.)

**Lithium sulphocyanide,  $\text{LiSCN}$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Hermes, Z. Ch. 1866, 417.)

Sol. in methyl acetate. (Naumann, B. 1909, 42, 3789.)

**Magnesium sulphocyanide,  $\text{Mg}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol.

**Magnesium stannic sulphocyanide,  $\text{MgSn}(\text{SCN})_2 \cdot 6\text{H}_2\text{O}$ .**

Hygroscopic. Sol. in  $\text{H}_2\text{O}$ , alcohol and acetone. (Weinland and Barnes, Z. anorg. 1909, 62, 258.)

**Manganese sulphocyanide,  $\text{Mn}(\text{SCN})_2 \cdot 8\text{H}_2\text{O}$** 

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol.

**Mercurous sulphocyanide,  $\text{Hg}_2(\text{SCN})_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in hot  $\text{HCl} + \text{Aq}$ . Slowly decomp. by hot aqua regia. Sol. in hot  $\text{KSCN} + \text{Aq}$ .

**Mercuric sulphocyanide, basic,  $\text{Hg}(\text{SCN})_2 \cdot 3\text{HgO}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . Insol. in  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$ . (Fiescher.)

$\text{Hg}(\text{SCN})_2 \cdot 2\text{HgO}$ . Insol. in  $\text{H}_2\text{O}$ . Sl. attacked by acids. (Claus, J. pr. 15, 401.)

**Mercuric sulphocyanide,  $\text{Hg}(\text{SCN})_2$ .**

Very sl. sol. in cold, much more easily in hot  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HCl} + \text{Aq}$ . (Crookes, Chem. Soc. 4, 18.)

Solubility in  $\text{H}_2\text{O} = 0.00218$  mol. in 1 l. (Grossmann, Z. anorg. 1904, 43, 358.)

More sol. in  $\text{H}_2\text{O}$  than in alcohol. (Peters, B. 1908, 41, 3180.)

Very sl. sol. in  $\text{H}_2\text{O}$  at  $25^\circ$ . Appreciably sol. only in boiling  $\text{H}_2\text{O}$ . (Jander, Dissert. 1902.)

Sol. in  $\text{Hg}(\text{NO}_3)_2$  or  $\text{KSCN} + \text{Aq}$ , also in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in many sulphocyanides +  $\text{Aq}$ .

Easily sol. in cold  $\text{HCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$  or  $\text{BaCl}_2 + \text{Aq}$ . (Hermes, J. pr. 1866, (1) 97, 477.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 829.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

**Mercuric hydrogen sulphocyanide,**

$\text{Hg}(\text{SCN})_2 \cdot 2\text{HSCN}$ .

Easily decomp. (Hermes, Dissert. 1866.)

**Mercuric nickel sulphocyanide,  $\text{Hg}(\text{SCN})_2 \cdot \text{Ni}(\text{SCN})_2 \cdot 2\text{H}_2\text{O}$ .**

Moderately sol. in hot  $\text{H}_2\text{O}$ . (Cleve, J. pr. 91, 227.)

Very sol. in  $\text{MSCN} + \text{Aq}$ . (Orloff, C. C. 1906, I, 1411.)

**Mercuric potassium sulphocyanide,**

$\text{Hg}(\text{SCN})_2 \cdot \text{KSCN}$

Sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Sol. in alcohol and ether. Very sol. in  $\text{NH}_4\text{Cl}$  or  $\text{KCl} + \text{Aq}$ . (Claus.)

$\text{K}_2\text{Hg}(\text{SCN})_4$ . Very sol. in  $\text{H}_2\text{O}$ ; sol. in alcohol.

Insol. in anhydrous ether. (Rosenheim, Z. anorg. 1901, 27, 285.)

**Mercuric rubidium sulphocyanide,**

$\text{Hg}(\text{SCN})_2 \cdot \text{RbSCN}$ .

Sol. in alcohol without decomp. Decomp. by  $\text{H}_2\text{O}$ .

$\text{Hg}(\text{SCN})_2 \cdot 2\text{RbSCN} + \frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  without decomp. (Grossmann, B. 1904, 37, 1259.)

**Mercuric sodium sulphocyanide,**

$\text{Na}_2\text{Hg}(\text{SCN})_2$ .

Very hygroscopic. (Rosenheim, Z. anorg. 1901, 27, 286.)

**Mercuric zinc sulphocyanide,  $\text{Hg}(\text{SCN})_2 \cdot \text{Zn}(\text{SCN})_2$ .**

Scarcely sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Cleve.)

**Mercuric sulphocyanide ammonia,**

$2\text{Hg}(\text{SCN})_2 \cdot 3\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol.

$\text{Hg}(\text{SCN})_2 \cdot 4\text{NH}_3$ . (Peters, B. 1908, 41, 3178.)

**Mercuric sulphocyanide ammonium bromide,**

$\text{Hg}(\text{SCN})_2 \cdot \text{NH}_4\text{Br}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol. (Grossmann, Z. anorg. 1903, 37, 418.)

Mercuric sulphocyanide ammonium chloride,  $\text{Hg}(\text{SCN})_2, \text{NH}_4\text{Cl}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in warm alcohol from which it can be cryst. (Grossmann.)

Mercuric sulphocyanide bromide,  $\text{HgSCNBr}$ .

Insol. in cold  $\text{H}_2\text{O}$ ; sol. in hot  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim, Z. anorg. 1901, 27, 282.)

Mercuric sulphocyanide chloride,  $\text{HgSCNCl}$ .

Insol. in cold  $\text{H}_2\text{O}$   
Sol. in hot  $\text{H}_2\text{O}$  and alcohol. (Rosenheim.)

Mercuric sulphocyanide potassium bromide,  $\text{Hg}(\text{SCN})_2, 2\text{KBr}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1903, 37, 418.)

Mercuric sulphocyanide potassium chloride,  $\text{Hg}(\text{SCN})_2, \text{KCl}$ .

Decomp. by  $\text{H}_2\text{O}$   
Not decomp. by recryst. from warm alcohol (Grossmann.)

Molybdenum sulphocyanide,  $\text{Mo}(\text{SCN})_4(?)$ .

Sol. in  $\text{H}_2\text{O}$  and ether. (Braun, Z. anal. 6, 86.)

Molybdenum potassium sulphocyanide,  $\text{K}_4\text{Mo}(\text{SCN})_4 + 4\text{H}_2\text{O}$

Cryst. from boiling  $\text{H}_2\text{O}$  and alcohol (Chilesotti, Gazz. ch. it 1904, 34, (2) 493.)

Molybdenum sodium sulphocyanide,

$\text{Na}_4\text{Mo}(\text{SCN})_4 + 12\text{H}_2\text{O}$ .  
(Rosenheim, B. 1909, 42, 154.)

Molybdenum thallos sulphocyanide,

$\text{MoTi}_2(\text{SCN})_4$ .  
(Rosenheim and Garfunkel, B. 1908, 41, 2388.)

Molybdenum sulphocyanide zinc amine,

$2\text{Mo}(\text{SCN})_4, 3\text{Zn}(\text{NH}_4)_4$ .  
(Rosenheim and Garfunkel, B. 1908, 41, 2390.)

$2\text{Mo}(\text{SCN})_4(\text{OH}), \text{Zn}_3(\text{NH}_4)_{11}$ . Can be cryst. from boiling  $\text{NH}_4\text{OH} + \text{Aq}$ . An-dried salt probably has the composition  $2\text{Mo}(\text{SCN})_4(\text{OH}), 3\text{Zn}(\text{NH}_4)_4 + 2\text{H}_2\text{O}$ . (Maas and Sand, B. 1908, 41, 1510.)  
 $2\text{Mo}(\text{SCN})_4(\text{OH}), \text{Zn}_3(\text{NH}_4)_{11}$ . (Maas and Sand.)

Nickel sulphocyanide,  $\text{Ni}(\text{SCN})_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Grossmann, B. 1904, 37, 565.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and alcohol. Insol. in acetone. (Krug and M'Elroy.)

$+ 1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Rosenheim and Cohn, Z. anorg. 1901, 27, 292.)

Nickel potassium sulphocyanide,

$\text{K}_4\text{Ni}(\text{SCN})_6 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Sl. sol. in cold, easily sol. in hot alcohol. (Rosenheim, Z. anorg. 1901, 27, 292.)

Nickel sodium sulphocyanide,

$\text{NiNa}_2(\text{SCN})_4 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Sl. sol. cold, readily sol. hot alcohol. (Rosenheim, Z. anorg. 1901, 27, 292.)

Nickel sulphocyanide ammonia,  $\text{Ni}(\text{SCN})_2, 3\text{NH}_3$ .

(Peters, B. 1908, 41, 3178.)

$\text{Ni}(\text{SCN})_2, 4\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ .

Platinous sulphocyanide,  $\text{Pt}(\text{SCN})_2(?)$ .

Insol. in  $\text{H}_2\text{O}$ .

See Platinosulphocyanides, and Platinosulphocyanides.

Potassium sulphocyanide,  $\text{KSCN}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 177.2 pts. at  $0^\circ$ , and 217.0 pts. at  $20^\circ$ .

100 g. sat.  $\text{KSCN} + \text{Aq}$  contain 70.5 g.  $\text{KSCN}$  at  $25^\circ$ . (Foote, Z. phys. Ch. 1903, 46, 81.)

150 pts.  $\text{KSCN} + 100$  pts.  $\text{H}_2\text{O}$  at  $10.8^\circ$  lower the temp.  $34.5^\circ$ . (Rüdorff, B. 2, 68.)

Solubility of  $\text{KSCN} + \text{AgSCN}$  at  $25^\circ$ .

% $\text{KSCN}$	% $\text{AgSCN}$	Solid phase
70.53	0 00	$\text{KSCN}$
66.55	9 32	$\text{KSCN} + 2\text{KSCN}, \text{AgSCN}$
64.47	10 62	$2\text{KSCN}, \text{AgSCN}$
61.25	11 76	"
58.34	13 55	"
53.21	17 53	"
50 68	20 43	$2\text{KSCN}, \text{AgSCN} + \text{KSCN}, \text{AgSCN}$
49 43	20 32	$\text{KSCN}, \text{AgSCN}$
32 51	18 34	"
24 68	16 41	"
23.86	16 07	$\text{KSCN}, \text{AgSCN} + \text{AgSCN}$

(Foote, Z. phys. Ch. 1903, 46, 81.)

See also  $\text{AgSCN}$ .

Sol. in alcohol, especially easily if boiling.

Sol. in acetone. (Krug and M'Elroy.)

Sol. in liquid  $\text{SO}_2$ . (Walden, Z. anorg. 1902, 30, 160.)

100 g. acetone dissolve 20.75 g.  $\text{KSCN}$  at  $22^\circ$ , and 20.40 g. at  $58^\circ$ .

100 g. amyl alcohol dissolve 0.18 g.  $\text{KSCN}$  at  $13^\circ$ ; 1.34 g. at  $65^\circ$ ; 2.14 g. at  $100^\circ$ ; 3.15 g. at  $133.5^\circ$ .

100 g. ethyl acetate dissolve 0.44 g.  $\text{KSCN}$  at  $0^\circ$ ; 0.40 g. at  $14^\circ$ ; 0.20 g. at  $79^\circ$ .

100 g. pyridine dissolve 6.75 g.  $\text{KSCN}$  at  $0^\circ$ ; 6.15 g. at  $20^\circ$ ; 4.97 g. at  $58^\circ$ ; 3.88 g. at

97°; 3.21 g at 115°. (Lasceynski, B. 1894, 27. 2285.)

100 g. acetonitrile dissolve 11.31 g. KSCN at 18°. (Naumann and Schier, B. 1914, 47. 249.)

Sl. sol. in benzonitrile (Naumann, B. 1914, 47. 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

Potassium molybdenyl sulphocyanide,  $3\text{KSCN}, \text{Mo}(\text{OH})(\text{SCN})_3 + 4\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Sand and Maas, B. 1908, 41. 1506.)

Potassium silver sulphocyanide,  $\text{KSCN}, \text{AgSCN}$ .

Decomp. by  $\text{H}_2\text{O}$ .

See Donk under KSCN.

$2\text{KSCN}, \text{AgSCN}$ . Stable in the air. (Wells, Am. Ch. J. 1902, 28. 265.)

See Donk under KSCN.

$3\text{KSCN}, \text{AgSCN}$  (Wells.)

Potassium stannic sulphocyanide,

$\text{K}_2\text{Sn}(\text{SCN})_6 + 4\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ .

Sol. in alcohol and acetone. (Weinland and Barnes, Z. anorg. 1909, 62. 258.)

Potassium titanyl sulphocyanide,

$2\text{KSCN}, \text{TiO}(\text{SCN})_2 + \text{H}_2\text{O}$ .

Sol. in cold  $\text{H}_2\text{O}$  without immediate decomp. but slowly decomp. (Rosenheim and Cohn, Z. anorg. 1901, 28. 169.)

Potassium vanadium sulphocyanide,

$3\text{KSCN}, \text{V}(\text{SCN})_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol with a green color. Sl. sol. in ether. (Ciocci, Z. anorg. 1898, 19. 309.)

Sol. in  $\text{H}_2\text{O}$  with decomp; stable in aq. solution in the presence of an excess of KSCN; sol. in alcohol. (Locke, Am. Ch. J. 1898, 20. 604.)

Potassium vanadyl sulphocyanide,

$\text{K}_2\text{VO}(\text{SCN})_4 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , alcohol, ether, amyl alcohol and ethyl acetate (Koppel, Z. anorg. 1903, 36. 292.)

Potassium zinc sulphocyanide,  $2\text{KSCN},$

$\text{Zn}(\text{SCN})_2 + 3\text{H}_2\text{O}$ .

Easily sol. in alcohol. (Walden, Z. anorg. 1900, 23. 374.)

Potassium sulphocyanide mercuric bromide,  $\text{KSCN}, \text{HgBr}_2$ .

Very sol. in  $\text{H}_2\text{O}$ .

Sol. in alcohol. (Grossmann, B. 1902, 35. 2945.)

$2\text{KSCN}, \text{HgBr}_2$ . Very sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol. (Grossman.)

Potassium sulphocyanide mercuric iodide,  $2\text{KSCN}, \text{HgI}_2$

Undecomp. by solution in conc. alcohol, or in  $\text{KSCN} + \text{Aq}$  (Grossmann, Z. anorg. 1903, 37. 421.)

$+ 2\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . (Philipp, Pogg, 1867, 131. 94.)

Silicon sulphocyanide,  $\text{Si}(\text{SCN})_4$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol.

Sol. in  $\text{CS}_2$ ,  $\text{CHCl}_3$  and ligroin. (Reynolds, Proc. Chem. Soc. 1906, 22. 17.)

Silver sulphocyanide,  $\text{AgSCN}$ .

1 l.  $\text{H}_2\text{O}$  dissolves  $1.08 \times 10^{-4}$  g. mols.  $\text{AgSCN}$  at 25°. (Kuster and Thiel, Z. anorg. 1902, 33. 139.)

1 l.  $\text{H}_2\text{O}$  dissolves  $1.25 \times 10^{-4}$  gram-atoms of silver at 25° (Abegg and Cox, Z. phys. Ch. 1903, 46. 11.)

Sl. sol. in  $\text{H}_2\text{O}$  1 liter of sat. solution at 19.96° contains  $1.37 \times 10^{-4}$  g. (Böttger, Z. phys. Ch. 1903, 46. 603.)

6.4 milligrams are dissolved in 1 liter of sat. solution at 100°. (Böttger, Z. phys. Ch. 1906, 56. 93.)

Solubility product of  $\text{AgSCN}$  is 0.49 and  $1.16 \times 10^{-12}$  mols. per l. at 18° and 25° respectively. (Kirschner, Z. phys. Ch. 1912, 79. 245.)

Solubility in  $\text{H}_2\text{O} = 1.2 \times 10^{-4}$  g. mol. per liter at 25°. (A. E. Hill, J. Am. Chem. Soc. 1908, 30. 74.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.00025 g.  $\text{AgSCN}$  at 21°. (Whitby, Z. anorg. 1910, 67. 108.)

Insol. in acids, excepting conc.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ . Insol. in dil. sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $\text{KSCN} + \text{Aq}$ . Insol. in  $\text{AgNO}_3$  or  $\text{NH}_4\text{SCN} + \text{Aq}$ . Sol. in  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$ .

Solubility in KSCN at 25°

Mol. KSCN in 1 litre	g. $\text{AgSCN}$ in 1 litre
1.25	22.34
1.20	19.93
1.12	16.18
1.066	14.10
0.626	2.80
0.573	2.06

(Hellwig, Z. anorg. 1900, 25. 184.)

Solubility in  $\text{N}/10$   $\text{KSCN} + \text{Aq}$  at 18° =  $2.5 \times 10^{-4}$ . (Kirschner, Z. phys. Ch. 1912, 79. 247.)

See also KSCN.

1 l. of a 3-N solution of  $\text{AgNO}_3$  dissolves 0.432 g.  $\text{AgSCN}$  at 25°. Nearly insol. in less dil. solution. (Hellwig, Z. anorg. 1900, 25. 179.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Hamers, Dissert. 1906; Naumann, B. 1910, 43. 314.)

Silver strontium sulphocyanide, $2\text{AgSCN}$ , $\text{Sr}(\text{SCN})_2 + 2\text{H}_2\text{O}$ . Stable in the air. (Wells, Am Ch. J. 1902, 28. 270.)	Zinc sulphocyanide, $\text{Zn}(\text{SCN})_2$ . Less sol. in $\text{H}_2\text{O}$ and alcohol than most other cyanides.
Silver zinc sulphocyanide, $2\text{AgSCN}$ , $\text{Zn}(\text{SCN})_2$ . Decomp. by hot $\text{H}_2\text{O}$ . (Wells)	Zinc sulphocyanide ammonia, $\text{Zn}(\text{SCN})_2$ , $12\text{NH}_3$ . Decomp. by $\text{H}_2\text{O}$ . Sol. in $\text{NH}_4\text{OH} + \text{Aq}$ .
Silver sulphocyanide ammonia, $\text{AgSCN}$ , $2\text{NH}_3$ . Decomp. by $\text{H}_2\text{O}$ .	Sulphocyanoplatinic acid. See Platinosulphocyanhydric acid.
Samarium sulphocyanide, $\text{Sm}(\text{SCN})_3 + 6\text{H}_2\text{O}$ . Very deliquescent. (Cleve.)	Sulphocyanoplatinous acid. See Platinosulphocyanhydric acid.
Sodium sulphocyanide, $\text{NaSCN}$ . Very deliquescent. Very sol. in $\text{H}_2\text{O}$ and alcohol. Sol. in benzonitrile. (Naumann, B 1914, 47. 1369) Sol. in methyl acetate (Naumann, B 1909, 42. 3789.)	Sulphohypophosphoric acid.
Sodium stannic sulphocyanide, $\text{Na}_2\text{Sn}(\text{SCN})_4 + 6\text{H}_2\text{O}$ . Very sol. in $\text{H}_2\text{O}$ . Sol. in alcohol and acetone (Weinland and Barnes, Z. anorg. 1909, 62. 257)	Aluminium sulphohypophosphate, $\text{Al}_3(\text{PS}_2)_3$ . Unstable in the air. Sol. in $\text{H}_2\text{O}$ with decomp. (Friedel, C. R. 1894, 119. 262.)
Sodium vanadium sulphocyanide, $3\text{NaSCN}$ , $\text{V}(\text{SCN})_3 + 12\text{H}_2\text{O}$ . Very hygroscopic. Sol. in $\text{H}_2\text{O}$ and alcohol. (Ciocci, Z. anorg. 1893, 19. 313.)	Cadmium —, $\text{Cd}_3\text{P}_2\text{S}_6$ . Partially decomp. in moist air. Decomp. by $\text{H}_2\text{O}$ , cold $\text{HNO}_3$ or alkalis + Aq. (Ferrand, A. ch. 1899, (7) 17. 423, Bull. Soc 1895, (3) 13. 116.)
Strontium sulphocyanide, $\text{Sr}(\text{SCN})_2 + 3\text{H}_2\text{O}$ . Very deliquescent, and sol. in $\text{H}_2\text{O}$ and alcohol.	Chromium —, $\text{Cr}_2\text{P}_2\text{S}_6$ . Insol. in $\text{HNO}_3$ . Very sl. attacked by aqua regia. (Ferrand)
Strontium stannic sulphocyanide, $\text{SrSn}(\text{SCN})_6 + 12\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ , alcohol and acetone. (Weinland and Barnes, Z. anorg. 1909, 62. 259.)	Cupric —, $\text{Cu}_2\text{P}_2\text{S}_6$ . Ppt. (Friedel, C. R. 1894, 119. 262.)
Thallium sulphocyanide, $\text{TlSCN}$ . Sl. sol. in $\text{H}_2\text{O}$ . 3.15 g. are contained in 1 liter of sat. solution at $20^\circ$ ; 3.905 g. at $25^\circ$ ; 7.269 g. at $39.75^\circ$ . Insol. in alcohol. (Böttger, Z. phys. Ch. 1903, 46. 603.)	Iron (ferrous) —, $\text{Fe}_2\text{P}_2\text{S}_6$ . Sol. in $\text{HNO}_3$ and in a mixture of $\text{HNO}_3$ with $\text{KClO}_3$ (Friedel.)
Titanyl sulphocyanide, $\text{TiO}(\text{SCN})_2 + 2\text{H}_2\text{O}$ . Sol. in cold $\text{H}_2\text{O}$ .	Lead —, $\text{Pb}_2\text{P}_2\text{S}_6$ . • Not decomp. by boiling $\text{H}_2\text{O}$ . (Friedel.)
Tin (stannous) sulphocyanide, $\text{Sn}(\text{SCN})_2$ . Sol. in $\text{H}_2\text{O}$ and alcohol. (Classen, J. pr. 96. 349.) Sol. in cold $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1901, 28. 168.)	Mercuric —, $\text{Hg}_2\text{P}_2\text{S}_6$ . Slowly decomp. by boiling $\text{H}_2\text{O}$ , more rapidly by $\text{KOH} + \text{Aq}$ . (Friedel)
Yttrium sulphocyanide, $\text{Y}(\text{SCN})_3 + 6\text{H}_2\text{O}$ . Not deliquescent. Very sol. in $\text{H}_2\text{O}$ , alcohol, or ether.	Nickel —, $\text{Ni}_2\text{P}_2\text{S}_6$ . Not attacked by boiling $\text{H}_2\text{O}$ or hot or cold acids. Sl. attacked by aqua regia (Ferrand, A. ch. 1899, (7) 17. 416.)
	Silver —, $\text{Ag}_4\text{P}_2\text{S}_6$ . Ppt. (Friedel, C. R. 1894, 119. 263.)
	Tin (stannous) hypophosphate —, $\text{SnPS}_4$ . Decomp. by boiling $\text{H}_2\text{O}$ . Sol. in dil. $\text{KOH} + \text{Aq}$ . (Friedel, C. R. 1894, 119. 264.)
	Tin (stannic) —, $\text{SnP}_2\text{S}_6$ . Easily decomp. by boiling $\text{H}_2\text{O}$ . Sol. in dil. $\text{KOH} + \text{Aq}$ . (Friedel)

**Zinc sulphohypophosphate,  $Zn_2P_2S_4$ .**

Decomp. in moist air. Insol. in  $H_2O$ . Partially decomp. by boiling  $H_2O$ . Violently attacked by  $HNO_3$ . Sol. in aqua regia. Not attacked by  $HCl$ . (Ferrand, A. ch. 1899, (7) 17. 421.)

**Zinc —,  $Zn_2P_2S_8$ .**

Insol. in  $H_2O$ . Partly decomp. by boiling  $H_2O$ . Not decomp. by  $HCl$  or  $HNO_3$ , but by aqua regia (Ferrand, Bull. Soc. 1895, (3) 13. 115.)

**Sulphomolybdic acid.****Ammonium sulphomolybdate,  $(NH_4)_2MoS_4$ .**

Easily sol. in  $H_2O$ ; very sl. sol. in alcohol (Berzelius, Pogg. 83. 261)

**Ammonium cupric sulphomolybdate.**

Sl. sol. in  $H_2O$ . (Debray, C. R. 96. 1616.)

**Barium sulphomolybdate,  $BaMoS_4$ .**

More sol. in  $H_2O$  than  $BaMo_3S_{12}$ . Known only in solution. (Berzelius.)

$BaS$ ,  $3MoS_2 = BaMo_3S_{12}$ . Sl. sol. in cold, easily sol. in hot  $H_2O$ . Not decomp. by conc. cold  $HNO_3 + Aq$ , but more easily by dil.  $HNO_3 + Aq$ . (Berzelius.)

**Cadmium sulphomolybdate.**

Insol. in  $H_2O$ . (Berzelius)

**Cæsium sulphomolybdate,  $Cs_2S$ ,  $3MoS_4 + 7H_2O$ .**

As Rb comp. (Herschfinkel, Dissert 1907.)  $3Cs_2S$ ,  $5MoS_2$  (Herschfinkel.)

**Calcium sulphomolybdate,  $CaS$ ,  $3MoS_2$ .**

Sl. in  $H_2O$ . (Berzelius.)

$CaMoS_4$ . More sol. in  $H_2O$  than  $CaS$ ,  $3MoS_2$ . Known only in solution. (Berzelius.)

**Cerium sulphomolybdate.**

Precipitate. (Berzelius.)

**Cobalt sulphomolybdate,  $CoMoS_4$ .**

Sol. in  $K_2MoS_4 + Aq$ . (Berzelius.)

**Cupric sulphomolybdate.**

(Debray, C. R. 96. 1616.)

**Ferrous sulphomolybdate,  $FeMoS_4$ .**

Sol. in  $H_2O$ . (Berzelius.)

**Ferric sulphomolybdate,  $Fe_2(MoS_4)_3$ .**

Sol. in  $K_2MoS_4 + Aq$ .

**Lead sulphomolybdate.**

Ppt. (Berzelius.)

**Lithium sulphomolybdate.**

Not deliquescent, but very easily sol. in  $H_2O$ . (Berzelius.)

**Magnesium sulphomolybdate,  $MgMoS_4$ .**

Sol. in  $K_2MoS_4 + Aq$  (Berzelius)

**Manganous sulphomolybdate,  $MnMoS_4$ .**

Sol. in  $H_2O$ . (Berzelius.)

**Mercurous sulphomolybdate,  $Hg_2MoS_4$  (?)**

Ppt

**Mercuric sulphomolybdate,  $HgMoS_4$ .**

Insol. in  $K_2MoS_4 + Aq$ .

**Nickel sulphomolybdate,  $NiMoS_4$ .**

Sol. in  $K_2MoO_4 + Aq$ . (Berzelius.)

**Potassium sulphomolybdate, basic,  $K_2Mo_3S_2$ .**

Easily sol. in  $H_2O$ . Insol. in alcohol and ether. (Kruess, B. 16. 2050.)

**Potassium sulphomolybdate,  $K_2MoS_4$ .**

Sol. in  $H_2O$ , from which it is precipitated by alcohol. (Berzelius)

**Rubidium sulphomolybdate,  $3Rb_2S$ ,  $8MoS_4 + 30H_2O$** 

Very sl. sol. in  $H_2O$ . Sol. by addition of  $NH_3$ . (Herschfinkel, Dissert. 1907.)  $5Rb_2S$ ,  $6MoS_2$ . (Herschfinkel)

**Silver sulphomolybdate,  $Ag_3MoS_4$ .**

Ppt.

**Sodium sulphomolybdate,  $Na_2MoS_4$ .**

Sol. in  $H_2O$ , and not precipitated by alcohol from aqueous solution. (Berzelius.)

**Strontium sulphomolybdates.**

Exactly analogous to the Ba salts, which see (Berzelius.)

**Zinc sulphomolybdate.**

Ppt. Insol. in  $H_2O$ . (Berzelius.)

***Monosulphomolybdic acid.*****Sodium monosulphomolybdate,  $Na_2MoO_3S$ .**

Rather hygroscopic. Sol. in  $H_2O$ ; forms deep blue solution with  $H_2SO_4$ . Sol. in  $HC_2H_3O_2 + Aq$ . (Kruess, A. 225. 1.)

**Disulphomolybdic acid.****Ammonium disulphomolybdate,**

$(NH_4)_2MoO_3S_2$ .

Sl. sol. in cold, easily in hot  $H_2O$ . Insol. in sat.  $NH_4Cl + Aq$  and absolute alcohol.

Aqueous solution is decomp. by boiling. (Bodenstab, J. pr. 78. 186.)

Potassium disulphomolybdate,  $K_2MoO_4S_2$ .

Very sol. in  $H_2O$  and alcohol. Sol. in  $HC_2H_3O_2 + Aq$  (Kruss, B. 16. 2046.)

Trisulphomolybdic acid.

Ammonium hydrogen trisulphopyromolybdate,  $NH_4HMoO_4O_3S_3$ .

Precipitate. Insol. in alcohol or  $CS_2$ . (Kruss, B. 16. 2047.)

Potassium hydrogen trisulphopyromolybdate,  $KHMoO_4O_3S_3$ .

Very easily sol. in  $H_2O$ . (Kruss, B. 16. 2048.)

Sodium hydrogen trisulphopyromolybdate,  $NaHMoO_4O_3S_3$ .

Precipitate. Much more sol. in  $H_2O$  than the  $NH_4$  compound. (Kruss, B. 16. 2047.)

Potassium sulphomolybdate,  $K_2MoO_4S_2O_7$ .

Sol in  $H_2O$ ,  $HC_2H_3O_2$ , and  $H_2SO_4$ . (Kruss, B. 17. 1771.)

Pentasulphomolybdic acid.

Potassium pentasulphomolybdate,  $KMoS_5$ .

Sol. in warm  $H_2O$  (Hofmann, Z. anorg. 1896, 12. 62.)

Persulphomolybdic acid,  $H_2MoS_5$ .

Precipitate. Insol. in  $H_2O$ , alcohol, ether,  $CS_2$ , and acetic acid.

Decomp. slowly by hot  $H_2SO_4$ . Sol. in warm  $KOH + Aq$ , and cold  $K_2S + Aq$ . Not attacked by cold  $KSH + Aq$ , but dissolves on warming. (Kruss, B. 17. 1773.)

Ammonium persulphomolybdate,  $(NH_4)_2MoS_5$ .

Very sl sol. in cold, more easily in hot  $H_2O$ . Insol. in  $NH_4OH + Aq$ . (Berzelius.)

Barium —,  $BaMoS_5$ .

Insol. in boiling  $H_2O$  or dil  $HCl + Aq$ . (Berzelius.)

Calcium —.

Difficultly sol. in  $H_2O$ . (Berzelius.)

Cerium —.

Precipitate. (Berzelius.)

Ferrous —.

Insol. in  $Fe$  salts  $+ Aq$ , but sol. in  $K_2MoS_4 + Aq$ . (Berzelius.)

Ferric —.

Ppt.

Lithium persulphomolybdate.

Sl. sol. in cold, easily sol. in hot  $H_2O$ . (Berzelius.)

Magnesium —.

Insol. precipitate. (Berzelius.)

Nickel —.

Ppt. Sol. in  $K_2MoS_4 + Aq$ , from which it separates in 24 hours (Berzelius.)

Potassium —,  $K_2MoS_4$ .

Almost insol. in cold, more sol. in hot  $H_2O$ . Insol. in cold  $KOH + Aq$ . (Berzelius.)

Potassium hydrogen —,  $KHMoS_5$ .

Sol. in  $H_2O$ . (Kruss.)

Sodium —,  $Na_2MoS_4$ .

Sl. sol. in cold, easily in hot  $H_2O$ . (Berzelius.)

Sodium hydrogen —,  $NaHMoS_5$ .

(Kruss.)

Persulphomolybdic acid,  $HMoS_5$ .

Sol. in  $H_2O$ . (Hofmann, Z. anorg. 1896, 12. 59.)

Ammonium —,  $NH_4MoS_4 + H_2O$ .

Sl. sol. in  $H_2O$  and in alcohol with decomp. (Hofmann.)

Cæsium —,  $CsMoS_4$ .

Almost insol. in  $H_2O$ . (Hofmann.)

Potassium —,  $KMoS_4$ .

Sol. in  $H_2O$ . (Hofmann.)

Thallium —,  $TlMoS_4$ .

Insol. in  $H_2O$ . (Hofmann.)

Sulphonosmic acid.

Potassium sulphonosmate,

$7K_2O, 40SO_3, 10SO_2$ .

Sol. in  $H_2O$ . (Rosenheim, Z. anorg. 1899, 21. 127.)

$+ 3H_2O$ . Sol. in  $H_2O$ . (Rosenheim.)

$+ 7H_2O$  Easily sol. in  $H_2O$ ; decomp. in aq. solution at  $70^\circ$ . (Rosenheim.)

$11K_2O, 40SO_3, 14SO_2 + 7H_2O$ . Sol. in  $H_2O$ . (Rosenheim.)

Sodium sulphonosmate,

$3Na_2O, OsO_3, 4SO_2 + 5H_2O$ .

Easily sol. in  $H_2O$ ; decomp. in aq. solution. (Rosenheim.)

**Sulphopalladic acid.**

Potassium palladious sulphopalladate,  $K_2S$ ,  $Pd_2S$ ,  $PdS_2 = K_2Pd_2S_4$ .

Insol. in  $H_2O$ . Moderately conc.  $HCl + Aq$  dissolves out K without evolution of  $H_2S$ . (Schneider, Pogg. 141. 526.)

Silver sulphopalladate,  $Ag_2PdS_2$ .

(Schneider.)

Silver palladious sulphopalladate,  $Ag_2S$ ,  $Pd_2S$ ,  $PdS_2 = Ag_2Pd_2S_4$ .

Extraordinarily stable. (Schneider.)

Sodium sulphopalladate,  $Na_2PdS_2$ .

Slowly sol. in  $H_2O$ . Insol. in alcohol. (Schneider, Pogg. 141. 520.)

Sulphophosphide of M.

See M phosphosulphide.

Sulphophosphamic acid,  $PS \begin{smallmatrix} (OH) \\ NH_2 \end{smallmatrix} (?)$ .

See Thiophosphamic acid.

Sulphophosphodiamic acid,  $PS \begin{smallmatrix} OH \\ (NH_2)_2 \end{smallmatrix} (?)$ .

See Thiophosphodiamic acid.

Sulphophosphotriamide,  $PS(NH_2)_3$

See Thiophosphoryl triamide.

Sulphophosphoric acid,  $H_4PSO_4$

See Thiophosphoric acid.

$H_2PS_4$ . Known only in its salts.

Ammonium sulphophosphate,  $(NH_4)_2PS_4$ .

Stable in the air. (Ephraim, B. 1911, 44. 3408.)

Antimony sulphophosphate,  $SbPS_4$ .

Insol. in  $H_2O$ , alcohol, ether,  $CS_2$ ,  $HCl + Aq$ , dil.  $H_2SO_4 + Aq$ ,  $C_2H_6$ , or  $HC_2H_3O_2$ . Decomp. by boiling with conc.  $HNO_3 + Aq$ ,  $H_2SO_4$ , aqua regia,  $KOH$ ,  $NaOH$  or  $NH_4OH + Aq$ . (Glatzel, B. 24. 3886.)

Arsenic sulphophosphate,  $AsPS_4$ .

Insol. in  $H_2O$ , alcohol,  $HCl + Aq$ , etc. Decomp. by warm  $HNO_3$ , aqua regia, dil.  $H_2SO_4$ ; also sol in  $KOH$  or  $NH_4OH + Aq$ . (Glatzel, Z. anorg. 4. 186.)

Barium sulphophosphate,  $Ba_3(PS_4)_2 + xH_2O$ .

(Ephraim, B. 1911, 44. 3409.)

Bismuth sulphophosphate,  $BiPS_4$ .

Insol. in  $H_2O$ , alcohol, ether,  $CS_2$ , benzene,  $HC_2H_3O_2$ , or dil.  $H_2SO_4 + Aq$ . Decomp. by boiling  $HCl + Aq$ , conc.  $H_2SO_4$ ,  $HNO_3$ , or aqua regia; also by  $NaOH$ ,  $KOH$ , or  $NH_4OH + Aq$ . (Glatzel, Z. anorg. 4. 186.)

Cadmium sulphophosphate,  $Cd_2(PS_4)_2$ .

Insol. in  $H_2O$ , alcohol, ether, benzene,  $CS_2$ , and  $HC_2H_3O_2$ . Decomp. by hot  $HCl + Aq$ . Very sl. attacked by dil.  $H_2SO_4 + Aq$ . Slowly sol. in hot  $HNO_3$ , rapidly in aqua regia or hot conc.  $H_2SO_4$ . (Glatzel, Z. anorg. 4. 186.)

Cuprous sulphophosphate,  $Cu_2PS_4$ .

Insol. in  $H_2O$ , alcohol, etc.; also in  $HCl$  or dil.  $H_2SO_4 + Aq$ . Decomp. by  $HNO_3$ , aqua regia, etc., not by  $KOH$  or  $NaOH + Aq$ . (Glatzel.)

Ferrous sulphophosphate,  $Fe_2(PS_4)_2$ .

Insol. in  $H_2O$ , alcohol, ether, etc.; insol. in  $HCl$  or hot dil.  $H_2SO_4 + Aq$ . Decomp. by  $HNO_3$ , aqua regia, or conc.  $H_2SO_4$ . Not attacked by  $KOH$  or  $NH_4OH + Aq$ . (Glatzel.)

Lead sulphophosphate,  $Pb_2(PS_4)_2$ .

Insol. in  $H_2O$ , alcohol, etc. Decomp. by warm  $HCl + Aq$ , conc.  $HNO_3 + Aq$ ; not attacked by  $NH_4OH + Aq$ ; sl. decomp. by  $KOH + Aq$ . (Glatzel.)

Manganous sulphophosphate,  $Mn_2(PS_4)_2$ .

Insol. in  $H_2O$ , alcohol, ether, benzene,  $CS_2$ , or  $HC_2H_3O_2$ . Not attacked by  $HCl + Aq$ . Sol. in  $HNO_3$  or aqua regia, with separation of S. Not attacked by dil.  $H_2SO_4 + Aq$ . (Glatzel, Z. anorg. 4. 186.)

Mercuric sulphophosphate,  $Hg_2(PS_4)_2$ .

Insol. in  $H_2O$ , alcohol, etc.; also in  $HCl$ , dil.  $HNO_3$ , or  $H_2SO_4 + Aq$ . Not attacked by conc.  $HNO_3$  or aqua regia; easily sol. in  $HNO_3 + Br_2 + Aq$ . (Glatzel.)

Nickel sulphophosphate,  $Ni_2(PS_4)_2$ .

As the ferrous salt. (Glatzel.)

Potassium sulphophosphate,  $K_2PS_4 + H_2O$

Easily sol. in  $H_2O$ . (Ephraim, B. 1911, 44. 3407.)

Silver sulphophosphate,  $Ag_2PS_4$ .

Insol. in  $H_2O$ , alcohol, etc.; also in  $HCl$ ,  $HNO_3$ , or dil.  $H_2SO_4 + Aq$ . Decomp. by conc.  $H_2SO_4$ , and aqua regia. (Glatzel.)

Sodium sulphophosphate,  $Na_2PS_4 + 8H_2O$ .

Decomp. by  $H_2O$ .

Sol. in  $Na_2S + Aq$ . (Glatzel, Z. anorg. 1905, 44. 65.)

Thallous sulphophosphate,  $Tl_2PS_4$ .

Insol. in  $H_2O$ , alcohol, etc. Sol. in  $HCl$ , dil.  $H_2SO_4 + Aq$ , etc. Not attacked by  $NH_4OH + Aq$ ; sl. decomp. by conc.  $KOH + Aq$ . (Glatzel.)

**Tin (stannous) sulphophosphate,  $\text{Sn}_2(\text{PS}_4)_2$ .**  
Insol. in  $\text{H}_2\text{O}$ , alcohol, etc. Insol. in dil.  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$ . Decomp. by  $\text{HNO}_3 + \text{Aq}$ , aqua regia,  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . (Glatzel)

**Zinc sulphophosphate,  $\text{Zn}_2(\text{PS}_4)_2$ .**  
Insol. in  $\text{H}_2\text{O}$ , alcohol, ether, etc. Sol. in  $\text{HCl} + \text{Aq}$  or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily attacked by  $\text{KOH} + \text{Aq}$ ; sl. decomp. by  $\text{NH}_4\text{OH} + \text{Aq}$ . (Glatzel.)

### Sulphopyrophosphoric acid.

**Aluminum sulphopyrophosphate,  $\text{Al}_2\text{P}_2\text{S}_7$ .**

Decomp. in moist air.  
Violently decomp. by  $\text{H}_2\text{O}$  or acids. (Ferrand, A. ch. 1899, (7) 429.)

**Cadmium —,  $\text{Cd}_2\text{P}_2\text{S}_7$ .**

Decomp. in moist air.  
Not attacked by cold acids. (Ferrand)

**Chromium —,  $\text{Cr}_2\text{P}_2\text{S}_7$ .**

Decomp. in moist air.  
Not readily attacked by acids. (Ferrand.)

**Cuprous —,  $\text{Cu}_2\text{P}_2\text{S}_7$ .**

Not attacked by cold  $\text{H}_2\text{SO}_4$  or boiling  $\text{HCl}$ . (Ferrand)  
Sol. in hot conc.  $\text{HNO}_3$ . (Ferrand.)  
Sol. in alkalis, and in all acids except  $\text{HCl}$ . (Ferrand, C. R. 1896, 122. 886.)

**Ferrous —,  $\text{Fe}_2\text{P}_2\text{S}_7$ .**

Insol. in cold acids.  
Sl. attacked by boiling  $\text{HCl}$  or hot  $\text{KOH} + \text{Aq}$ .  
Decomp. by fused  $\text{KOH}$ . (Ferrand, A. ch. 1899, (7) 17. 410.)

**Lead —,  $\text{Pb}_2\text{P}_2\text{S}_7$ .**

Not attacked by cold  $\text{HNO}_3$ . (Ferrand.)

**Mercurous —,  $\text{Hg}_2\text{P}_2\text{S}_7$ .**

Decomp. by moist air or hot  $\text{HNO}_3$ . (Ferrand)  
Almost insol. in acids; decomp. by  $\text{H}_2\text{O}$  and moist air. (Ferrand, C. R. 1896, 122. 888)

**Nickel —,  $\text{Ni}_2\text{P}_2\text{S}_7$ .**

Decomp. by  $\text{H}_2\text{O}$  and by conc.  $\text{HNO}_3$  at  $150^\circ$  in a sealed tube. (Ferrand, A. ch. 1899, (7) 17. 418.)

**Silver —,  $\text{Ag}_2\text{P}_2\text{S}_7$ .**

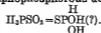
Not decomp. by  $\text{H}_2\text{O}$ .  
Decomp. by aqua regia.  
Not attacked by  $\text{HNO}_3$ . (Ferrand.)

**Zinc —,  $\text{Zn}_2\text{P}_2\text{S}_7$ .**

Decomp. in moist air.  
Decomp. by  $\text{H}_2\text{O}$ .

Violently attacked by cold  $\text{HNO}_3$ . (Ferrand)

### Sulphophosphorous acid,



See Thiophosphorous acid.  
 $\text{H}_2\text{PS}_2$  Known only in its salts.

**Aluminum sulphophosphite,  $\text{Al}_2(\text{PS}_2)_2$ .**

Very unstable.  
Decomp. in the air. (Ferrand, C. R. 1896, 122. 622.)

**Barium sulphophosphite,  $\text{Ba}_2(\text{PS}_2)_2 + x\text{H}_2\text{O}$ .**

Sol. in dil. acids.  
Insol. in alcohol (Ephraïm, B. 1911, 44. 3412)

**Chromous sulphophosphite,  $\text{Cr}_2(\text{PS}_2)_2$ .**

Easily attacked by hot conc.  $\text{HNO}_3$  or aqua regia  
Decomp. by boiling  $\text{NaOH} + \text{Aq}$ . (Ferrand, A. ch. 1899, (7) 17. 419)  
Quite stable in moist air, very slowly attacked by acids (Ferrand, C. R. 1896, 122. 622)

**Cuprous sulphophosphite,  $\text{Cu}_2\text{PS}_2$ .**

Not attacked by  $\text{H}_2\text{O}$  or hot conc.  $\text{HCl}$ .  
Sl. attacked by cold fuming  $\text{HNO}_3$ .  
Violently attacked by  $\text{HNO}_3$ , aqua regia and boiling conc.  $\text{H}_2\text{SO}_4$ .  
Not attacked by boiling  $\text{NaOH} + \text{Aq}$ . (Ferrand, A. ch. 1899, (7) 17. 398.)  
Fairly stable. decomp. by damp air. (Ferrand, C. R. 1896, 122. 621)

**Iron (ferrous) sulphophosphite,  $\text{Fe}_2(\text{PS}_2)_2$ .**

Very stable and resists the action of alkalis and acids. (Ferrand, C. R. 1896, 122. 622.)  
Insol. in cold acids or hot  $\text{NCl}$ .  
Sol. in hot fuming  $\text{HNO}_3$ .  
Insol. in hot 40%  $\text{KOH} + \text{Aq}$  (Ferrand, A. ch. 1899, (7) 17. 412.)

**Mercuric sulphophosphite,  $\text{Hg}_2(\text{PS}_2)_2$ .**

Decomp. in moist air.  
Not attacked by cold  $\text{HNO}_3$ . Decomp. by hot  $\text{HNO}_3$ . (Ferrand.)  
Unstable in the air  
Very slowly attacked by acids. (Ferrand, C. R. 1896, 122. 622.)

**Nickel sulphophosphite,  $\text{Ni}_2(\text{PS}_2)_2$ .**

Unstable in the air.  
Attacked slowly by  $\text{HNO}_3$ . (Ferrand.)

**Silver sulphophosphite,  $\text{Ag}_2\text{PS}_2$ .**

Insol. in most reagents. (Ferrand, C. R. 1896, 122. 622.)  
Not decomp. by  $\text{H}_2\text{O}$ .  
Not easily attacked by acids. (Ferrand, A. ch. 1899, (7) 17. 414)

Sodium sulphophosphite,  $\text{Na}_2\text{PS}_2 + x\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ , probably with decomp. (Ephraim, B. 1911, 44. 3410)

Zinc sulphophosphite,  $\text{Zn}_2(\text{PS}_2)_2$ .

Decomp. in moist air

Sl attacked by  $\text{H}_2\text{O}$ .

Decomp. by  $\text{HNO}_3$ . (Ferrand, A. ch. 1899, (7) 17. 422.)

Very unstable in the air, and attacked violently by acids. (Ferrand, C. R. 1896, 122. 622.)

Sulphoplatinic acid,  $\text{H}_2\text{Pt}_2\text{S}_4$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. on air. (Schneider, Pogg. 138. 604.)

$\text{H}_2\text{Pt}_2\text{S}_6$  Insol. in  $\text{H}_2\text{O}$ , but decomp. very rapidly on air. (Schneider.)

Copper sulphoplatinate,  $2\text{CuS}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ .

Insol. in  $\text{H}_2\text{O}$ .  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia dissolve out part of the Cu (Schneider, Pogg. 139. 661.)

Lead sulphoplatinate,  $2\text{PbS}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ .

Insol. in hot or cold  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ .  $\text{HNO}_3 + \text{Aq}$  dissolves out Pb partly; aqua regia dissolves completely with difficulty. (Schneider, Pogg. 139. 662.)

Mercuric sulphoplatinate chloride,  $2\text{HgS}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ ,  $2\text{HgCl}_2$

Insol. in  $\text{H}_2\text{O}$ ; not attacked by  $\text{HCl} + \text{Aq}$ , and only partially sol. in boiling aqua regia. (Schneider.)

Potassium sulphoplatinate,  $\text{K}_2\text{Pt}_2\text{S}_4$ .

Insol. in  $\text{H}_2\text{O}$ .  $\text{HCl} + \text{Aq}$  dissolves out K without evolution of  $\text{H}_2\text{S}$ .

Composition its potassium platinous sulphoplatinate,  $\text{K}_2\text{S}$ ,  $3\text{PtS}$ ,  $\text{PtS}_2$ . (Schneider, Pogg. 138. 604.)

$\text{K}_2\text{PtS}_2$ .

Silver sulphoplatinate,  $2\text{Ag}_2\text{S}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ .  $\text{HNO}_3 + \text{Aq}$  dissolves out Ag on warming. Aqua regia decomp. with formation of  $\text{AgCl}$ . (Schneider, Pogg. 138. 664.)

Sodium sulphoplatinate,  $\text{Na}_4\text{Pt}_2\text{S}_4 = 2\text{Na}_2\text{S}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ .

Decomp. by hot  $\text{H}_2\text{O}$ , with residue of  $\text{PtS}_2$ . (Schneider.)

$\text{Na}_2\text{Pt}_2\text{S}_4 = \text{Na}_2\text{S}$ ,  $\text{PtS}$ ,  $2\text{PtS}_2$ . Insol. in  $\text{H}_2\text{O}$ . (Schneider, J. pr. (2) 48. 418.)

Thallium sulphoplatinate,  $2\text{Tl}_2\text{S}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ .

Insol. in cold  $\text{H}_2\text{O}$ . Dil. acids dissolve out all the thallium. (Schneider, Pogg. 138. 626.)

Sulphoplatinous acid,  $\text{H}_2\text{PtS}_2$

Known only in solution in  $\text{H}_2\text{O}$ , which soon decomposes. (Schneider, J. pr. (2) 48. 424.)

Sodium sulphoplatinite,  $\text{Na}_2\text{PtS}_2$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Schneider, J. pr. (2) 48. 420)

$\text{H}_4\text{Na}_2(\text{PtS}_2)_2$ . Sol in  $\text{H}_2\text{O}$ , from which it is pptd. by alcohol. (Schneider.)

Sulphoselenantimonous acid.

See Selenosulphantimonous acid.

Sulphoselenarsenic acid.

See Selenosulpharsenic acid.

Sulphoselenostannic acid.

See Selenosulphostannic acid.

Sulphoselenoxyarsenic acid.

See Selenosulphoxyarsenic acid.

Sulphoselenyl chloride,  $\text{SSeO}_2\text{Cl}_2$

Deliquescent; decomposed by  $\text{H}_2\text{O}$ . (Clausnitzer, B. 11. 2007.)

Metasulphosilicic acid.

Sodium metasulphosilicate,  $\text{Na}_2\text{SiS}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Hempel, Z. anorg. 1900, 23. 41.)

Sulphostannic acid,  $\text{H}_2\text{SnS}_2$ .

Ppt (Kühn, A. 84. 110.)

Does not exist. (Storch, W. A. B. 98. 2b. 236)

Ammonium sulphostannate,  $(\text{NH}_4)_2\text{S}$ ,  $3\text{SnS}_2 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ , and easily decomp. (Ditte, C. R. 95. 641.)

$(\text{NH}_4)_2\text{SnS}_2 + 3\text{H}_2\text{O}$ , and  $+7\text{H}_2\text{O}$ . Decomp. by acid. (Stanek, Z. anorg. 1898, 17. 124)

Barium sulphostannate,  $\text{BaSnS}_2 + 8\text{H}_2\text{O}$ .

Sol. in cold  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

Calcium sulphostannate,  $2\text{CaS}$ ,  $\text{SnS}_2 + 14\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

Tetraplatinous sulphostannate,  $4\text{PtS}$ ,  $\text{SnS}_2$ .

Not decomp. by acids. (Schneider, J. pr. (2) 7. 214.)

Platinum potassium sulphostannate,  $3\text{PtS}$ ,  $\text{K}_2\text{S}$ ,  $\text{SnS}_2$ .

Insol. in cold  $\text{H}_2\text{O}$ . Dil.  $\text{HCl}$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  dissolves out all the potassium. (Schneider, Pogg. 136. 109.)

Platinum sodium sulphostannate, $3\text{PtS}$ , $\text{Na}_2\text{S}$ , $\text{SnS}_2$ . Insol in cold $\text{H}_2\text{O}$ . (Schneider, Pogg. 136. 109.)	Cobalt sulphotellurite, $\text{Co}_3\text{TeS}_4$ . Ppt
Potassium sulphostannate, $\text{K}_2\text{SnS}_2$ . Sol in $\text{H}_2\text{O}$ . (Kühn, A. 84. 110.) + $3\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.) $\text{K}_2\text{SnS}_2 + 4\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ pptd by alcohol. (Weinland, Z anorg. 1898, 17. 419.)	Copper —, $\text{Cu}_2\text{TeS}_4$ . Ppt.
Sodium sulphostannate, $\text{Na}_2\text{SnS}_2 + 2\text{H}_2\text{O}$ . Sl. sol. in $\text{H}_2\text{O}$ . (Kühn, A. 84. 110.) + $3\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.) + $7\text{H}_2\text{O}$ . Sol. in $\text{H}_2\text{O}$ . (Hering, Zeitsch. Pharm. 1851. 120.) $\text{Na}_2\text{SnS}_2 + 12\text{H}_2\text{O}$ . Melts in crystal $\text{H}_2\text{O}$ on heating. Very sol. in $\text{H}_2\text{O}$ . (Kühn.)	Ferrous —. Ppt.
Strontium sulphostannate, $\text{SrSnS}_2 + 12\text{H}_2\text{O}$ . Sol in $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)	Ferric —. Ppt.
Thallium sulphostannate, $\text{Tl}_4\text{SnS}_4$ . Ppt. Practically insol. in $\text{H}_2\text{O}$ . (Hawley, J. Am. Chem Soc 1907, 29. 1011.)	Lead —. Ppt.
Disulphopersulphuric acid.	Lithium —. Sol. in $\text{H}_2\text{O}$ .
Sodium disulphopersulphate, $\text{Na}_2\text{S}_2\text{O}_8$ . Sol. in $\text{H}_2\text{O}$ . Cryst. in cold with $2\text{H}_2\text{O}$ . (Villiers, C. R. 106. 851, 1354.) Contains $4\text{H}$ more and is sodium tetrathionate, $\text{Na}_2\text{S}_4\text{O}_{10}$ , $2\text{H}_2\text{O}$ . (Villiers, C. R. 108. 402.)	Magnesium —. Sol. in $\text{H}_2\text{O}$ and alcohol.
Sulphotelluric acid.	Manganous —. Ppt.
Mercurous sulphotellurate, $3\text{Hg}_2\text{S}$ , $\text{TeS}_2$ . Ppt.	Potassium —, $3\text{K}_2\text{S}$ , $\text{TeS}_2$ . Sol. in $\text{H}_2\text{O}$
Mercuric —, $3\text{HgS}$ , $\text{TeS}_2$ . Ppt. (Berzelius.)	Silver —, $3\text{Ag}_2\text{S}$ , $\text{TeS}_2$ . (Berzelius.)
Potassium —, $\text{K}_2\text{TeS}_4$ . Sol. in $\text{H}_2\text{O}$ . (Oppenheim, J. pr 71. 279.)	Sodium —. Sol. in $\text{H}_2\text{O}$
Sodium —. Sol. in $\text{H}_2\text{O}$ . (Oppenheim.)	Strontium —. Sol. in $\text{H}_2\text{O}$ .
Sulphotellurous acid.	Zinc —, $3\text{ZnS}$ , $\text{TeS}_2$ . Ppt. (Berzelius.)
Ammonium sulphotellurite, $3(\text{NH}_4)_2\text{S}$ , $\text{TeS}_2$ . Decomp. on air. Sol. in $\text{H}_2\text{O}$ .	Sulphotungstic acid.
Barium —. Very slowly sol. in $\text{H}_2\text{O}$ .	Ammonium sulphotungstate, $(\text{NH}_4)_4\text{WS}_4$ . Very deliquescent. Easily sol. in $\text{H}_2\text{O}$ , and still more easily in $\text{NH}_4\text{OH} + \text{Aq}$ . (Corleis, A. 232. 244.) More sol. in pure $\text{H}_2\text{O}$ than in $\text{H}_2\text{O}$ acidified with $\text{HCl}$ . Decomp. slowly on air. (Berzelius.)
Calcium —. Somewhat sol. in $\text{H}_2\text{O}$ .	Barium —. Sol. in $\text{BaS} + \text{Aq}$ .
Cerium —. Insol ppt.	Cadmium —, $\text{CdWS}_4$ . Ppt. (Berzelius.)
	Calcium —. Sol. in $\text{H}_2\text{O}$ and alcohol (Berzelius.)
	Cobalt —, $\text{CoWS}_4$ . Sl. sol. in $\text{H}_2\text{O}$ .

Copper sulphotungstate,  $\text{CuWS}_4$ .

Ppt.

Glucinum —,  $\text{GlWS}_4$ .

Sol in  $\text{H}_2\text{O}$  (?).

Ferrous —,  $\text{FeWS}_4$ .

Sol in  $\text{H}_2\text{O}$ .

Ferric —.

Ppt.

Lead —,  $\text{PbWS}_4$ .

Ppt. (Berzelius.)

Magnesium —,  $\text{MgWS}_4$ .

Easily sol in  $\text{H}_2\text{O}$  or alcohol.

Manganous —,  $\text{MnWS}_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

Mercurous —.

Ppt (Berzelius)

Mercuric —,  $\text{HgWS}_4$ .

Ppt (Berzelius.)

Nickel —,  $\text{NiWS}_4$ .

Ppt. (Berzelius)

Potassium —,  $\text{K}_2\text{WS}_4$ .

Sol. in  $\text{H}_2\text{O}$  Alcohol precipitates from aqueous solutions, but is not entirely insol in alcohol (Berzelius.)

Very sol. in  $\text{H}_2\text{O}$ . (Corleis, A. 232. 264.)

Potassium — nitrate,  $\text{K}_2\text{WS}_4 \cdot \text{KNO}_3$ .

Very sol. in cold or hot  $\text{H}_2\text{O}$ , from which it is precipitated by alcohol. (Berzelius)

Potassium — tungstate,  $\text{K}_2\text{WO}_3\text{S}_2 = \text{K}_2\text{WS}_4 \cdot \text{K}_2\text{WO}_4$ .

Easily sol. in  $\text{H}_2\text{O}$ . Not precipitated by alcohol. (Berzelius.)

Is potassium trisulphotungstate,  $\text{K}_2\text{WOS}_3$ , which see (Corleis, A. 232. 244.)

Silver —,  $\text{Ag}_2\text{WS}_4$ .

Ppt. (Berzelius)

Sodium —,  $\text{Na}_2\text{WS}_4$ .

Very sol in  $\text{H}_2\text{O}$ ; less sol. in alcohol. (Berzelius.)

Very deliquescent (Corleis, A. 232. 264.)

Strontium —.

Sol. in  $\text{H}_2\text{O}$ , and in  $\text{SrS} + \text{Aq}$ .

Stannous —,  $\text{SnWS}_4$ .

Ppt. (Berzelius.)

Stannic —,  $\text{SnWS}_4$ .

Ppt. (Berzelius.)

Zinc sulphotungstate,  $\text{ZnWS}_4$ .

Sol in  $\text{H}_2\text{O}$  with subsequent pptn (Berzelius.)

*Monosulphotungstic acid.*

Potassium monosulphotungstate,

$\text{K}_2\text{WOS} + \text{H}_2\text{O}$ .

Deliquescent in moist air. Very sol. in  $\text{H}_2\text{O}$ . (Corleis, A. 232. 244.)

*Disulphotungstic acid.*

Ammonium disulphotungstate,  $(\text{NH}_4)_2\text{WO}_3\text{S}_2$ .

Sol in  $\text{H}_2\text{O}$  and alcohol (Berzelius.)

Decomp easily when moist (Corleis, A. 232. 264.)

*Trisulphotungstic acid.*

Potassium trisulphotungstate,  $\text{K}_2\text{WOS}_3 + \text{H}_2\text{O}$

Hygroscopic Effloresces on dry air and easily decomposed. Easily sol. in  $\text{H}_2\text{O}$  (Corleis, A. 232. 244.)

Sulphovanadic acid,  $\text{V}_2\text{O}_5 \cdot 3\text{SO}_3 + 3\text{H}_2\text{O}$ .

See Vanadiousulphuric acid, and Sulphate, vanadium.

*Sulphovanadates.*

Alkali sulphovanadates are sol. in  $\text{H}_2\text{O}$  Ca, Sr, and Ba sulphovanadates are sl. sol. in  $\text{H}_2\text{O}$ , and all other sulphovanadates are insol. in  $\text{H}_2\text{O}$  (Berzelius.)

Ammonium sulphovanadate,  $(\text{NH}_4)_2\text{VS}_4$

Easily sol. in  $\text{H}_2\text{O}$ . Very sl sol in conc.  $\text{NH}_4\text{SH} + \text{Aq}$ . Insol. in ether,  $\text{CS}_2$ , or  $\text{CHCl}_3$ . (Kriess and Ohnmaus, A. 263. 46.)

See also Sulphoxyvanadic acid.

Sodium pentasulphoxyvanadate,  $\text{Na}_4\text{V}_2\text{O}_5\text{S}_5$ .

Hydroscopic; sol. in  $\text{H}_2\text{O}$  with rapid decomp. (Locke, Am. Ch. J. 1898, 20. 375.)

*Sulphoxyantimonic acid.*

Potassium sulphonyantimonate,  $\text{K}_2\text{HSbO}_3\text{S}_2 + 2\text{H}_2\text{O}$ .

Sol. in hot, less sol in cold  $\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . (Weinland and Gutmann, Z. anorg. 1898, 17. 414.)

*Sulphoxyarsenic acid,  $\text{H}_2\text{AsO}_3\text{S}$ .*

Known only in aqueous solution. (McCay, Am. Ch. J. 10. 459.)

Ammonium monosulphoxyarsenate,

$(\text{NH}_4)_2\text{AsSO}_3 + 3\text{H}_2\text{O}$ .

Decomp. in the air; sol in  $\text{H}_2\text{O}$ , decomp. on boiling. (Weinland, B. 1896, 29. 1009.)

Very sol. in  $H_2O$ ; insol. in alcohol; decomp in aq. solution and also in the air (Weinland, Z. anorg. 1897, 14. 53.)  
Decomp. in the air. (McLaughlan, B 1901, 34. 2166.)

Ammonium hydrogen monosulphoxyarsenate,  $(NH_4)_2HASO_4$ .

Ppt. (McLaughlan, B 1901, 34. 2168.)

Barium monosulphoxyarsenate,  $BaHASO_4 + 10H_2O$ .

(Preis, A. 257. 184.)

$Ba_3(AsSO_4)_2 + 6H_2O$ . Ppt. (Weinland, Z. anorg. 1897, 14. 54.)

Barium disulphoxyarsenate,  $Ba_2(AsS_2O_4)_2 + 4H_2O$ .

Ppt. (Preis, A. 257. 185.)

$+6H_2O$  (Weinland and Rumpf, Z. anorg. 1897, 14. 64.)

Barium potassium trisulphoxyarsenate,  $KBaAsS_3O + 7H_2O$ .

Ppt (McCay, Z. anorg. 1904, 41. 469.)

Barium sodium monosulphoxyarsenate,  $BaNaAsSO_4 + 9H_2O$ .

Ppt. (Weinland, Z. anorg. 1897, 14. 55.)

Barium sodium sulphoxyarsenate,  $Ba_2Na_2As_2O_7Si_4 + 12H_2O$ .

(McCay and Foster, Z. anorg. 1904, 41. 467.)

Calcium trisulphoxyarsenate,  $Ca_2(AsS_2O_4)_2 + 20H_2O$ .

Ppt. (McCay and Foster, Z. anorg. 1904, 41. 463.)

Potassium monosulphoxyarsenate,  $K_2AsSO_4$ .  
Hygroscopic (Weinland, B. 1896, 29. 109.)

Sol. in conc.  $KOH + Aq.$  free from carbonate; very hygroscopic. (Weinland, Z. anorg. 1897, 14. 51.)

Potassium hydrogen monosulphoxyarsenate,  $K_2HASO_4 + 2\frac{1}{2}H_2O$

Very hygroscopic. (Weinland and Rumpf, Z. anorg. 1897, 14. 59.)

$KH_2AsSO_4$ . Sol in  $H_2O$ ; solution slowly decomp on standing. (McCay, Am. Ch. J. 10. 459.)

Formula given by Bouquet and Cloez (A. ch. (3) 13. 44) is  $K_2H_4As_2S_4O_{11}$ .

Potassium disulphoxyarsenate,  $K_2AsS_2O_4 + 10H_2O$ .

Very hygroscopic; decomp. by  $H_2O$ . (Weinland, Z. anorg. 1897, 14. 63.)

Potassium trisulphoxyarsenate,  $K_3AsS_3O + 7H_2O$ .

Yellow oil which cryst. at  $-20^\circ$  (McCay and Foster, Z. anorg. 1904, 41. 468.)

Sodium monosulphoxyarsenate,  $Na_2AsSO_4 + 12H_2O$ .

Easily sol. in  $H_2O$ . (Preis, A. 257. 180.) (McLaughlan, B 1901, 34. 2170.)

Sol. in  $H_2O$ . (Weinland, B. 1896, 29. 1009.)

Sl efflorescent. Insol in alcohol. (McCay, Z. anorg. 1902, 29. 42.)

Sol. in  $NaOH + Aq.$ ; decomp. by boiling with conc.  $NaOH$  (Weinland, Z. anorg. 1897, 14. 49.)

Sodium hydrogen monosulphoxyarsenate,  $NaHASO_4$ .

Decomp. by  $H_2O$ ; insol. in alcohol. (Weinland, Z. anorg. 1897, 14. 58.)

$Na_2HASO_4 + 8H_2O$ . Easily sol. in  $H_2O$ . (Preis.)

Sodium disulphoxyarsenate,  $Na_2AsS_2O_4 + 10H_2O$ .

Easily sol. in  $H_2O$ . (Preis.)

Sol. in  $H_2O$ ; pptd. by alcohol. (McCay, B. 1899, 32. 2472.)

Not decomp. by boiling  $NaOH + Aq.$  (Weinland, Z. anorg. 1897, 14. 62.)

Insol. in alcohol (McCay, Z. anorg. 1900, 26. 461.)

$+11H_2O$ . (McLaughlan, B. 1901, 34. 2170.)

Insol. in alcohol. (McCay, Z. anorg. 1902, 29. 46.)

Sodium trisulphoxyarsenate,  $Na_3AsS_3O + 11H_2O$ .

Decomp. by  $H_2O$ . (McCay and Foster, Z. anorg. 1904, 41. 454.)

Sodium trisulphoxydiarsenate,  $As_2O_3S_3, 3Na_2O + 24H_2O$ .

Easily sol. in  $H_2O$ . (Geuther, A. 240. 208.)

$2As_2O_3S_3, Na_2O + 7H_2O$ . Sol. in  $H_2O$ . (Nilson, J. pr. (2) 14. 14.)

Correct composition is  $Na_4As_2S_3O_7 + 30H_2O$ . (Preis.)

Sodium sulphoxyarsenate,  $Na_3AsS_2O_7 + 30H_2O = 4Na_2O, 6As_2S_3, 3As_2S_4O_7 + 30H_2O$ .

Decomp. by  $H_2O$ . Sol in  $NH_4OH$  or  $KOH + Aq.$  (Preis, A. 257. 187.)

= Sodium oxytrisulpharsenate of Nilson.

Sodium pentasulphoxytetraarsenate,  $Na_{12}As_4S_4O_{11} + 48H_2O$ .

Less sol. in  $H_2O$  than other sulphoxyarsenates (Preis.)

Sodium strontium trisulphoxyarsenate,  $NaSrAsS_3O + 10H_2O$ .

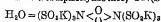
Unstable. (McCay and Foster, Z. anorg. 1904, 41. 462.)

**Trisulphoxyazotic acid**,  $\text{ON}(\text{SO}_2\text{H})_3$

Known only in its salts. (Claus, A. 158. 52 and 194.)

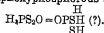
Has the formula  $(\text{SO}_2\text{H})_3\text{N} < \overset{\text{O}}{\underset{\text{O}}{\text{O}}} > \text{N}(\text{SO}_2\text{H})_3$ .  
(Raschig, A. 241. 161.)

**Potassium trisulphoxyazotate**,  $\text{ON}(\text{SO}_2\text{K})_3 +$



Easily sol. in  $\text{H}_2\text{O}$  without decomp., even on boiling. (Claus, A. 157. 210.)

**Sulphoxyphosphorous acid**,



See Thiophosphorous acid.

**Sulphoxyvanadic acid**.

**Ammonium pyrohexasulphoxyvanadate**,  
 $(\text{NH}_4)_4\text{V}_6\text{S}_{12}\text{O}_{42}$

Sol. in  $\text{H}_2\text{O}$ . (Krüss and Ohnmais, A. 263. 53.)

**Potassium pyrohexasulphoxyvanadate**,  
 $\text{K}_4\text{V}_6\text{S}_{12}\text{O}_{42} + 3\text{H}_2\text{O}$ .

Melts in crystal  $\text{H}_2\text{O}$ . (Krüss and Ohnmais.)

$\text{K}_4\text{V}_6\text{S}_{12}\text{O}_{42} + 3\text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{O}$  than preceding comp. (K. and O.)

**Sodium orthotrisulphoxyvanadate**,  $\text{Na}_3\text{VS}_3\text{O}_{10} + 5\text{H}_2\text{O}$ .

Very deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . Somewhat sol. in alcohol (Krüss and Ohnmais.)

**Sodium orthomonosulphoxyvanadate**,  
 $\text{Na}_3\text{VSO}_4 + 10\text{H}_2\text{O}$ .

Less sol. in  $\text{H}_2\text{O}$  than other sulphoxyvanadates. (K. and O.)

**Sulphur, S.**

The various modifications of sulphur have been classified in many different ways, and there is a difference of opinion as to whether certain forms are true allotropic modifications or not.

The data, as far as concerns the solubility, may be arranged as follows—

A. Sol. in  $\text{CS}_2$ . 1. Rhombic, octahedral, or alpha sulphur, ordinary sulphur. Easily sol. in  $\text{CS}_2$ , etc. See below for solubility in various solvents.

2. Prismatic, monoclinic, or beta sulphur. Sol. in  $\text{CS}_2$ , but is converted into A, 1. Prismatic sulphur obtained by melting brimstone is not wholly sol. in  $\text{CS}_2$  on account of admixture of gamma sulphur.

Monoclinic modification is more sol. than rhombic in  $\text{CHCl}_3$ , ether and benzene. (Meyer C. C. 1903, II. 481.)

3. Soft sulphur, milk of sulphur.

4. Amorphous sol. sulphur is also a separate modification, according to Berthollet.

B. Soft sulphur, obtained by strongly heating and quickly cooling, is sol. in  $\text{CS}_2$ , but becomes insol. therein by repeatedly dissolving and evaporating. More easily sol. in  $\text{CS}_2$  than A, 1.

C. Insol. in  $\text{CS}_2$ . 1. By action of strong light on S in  $\text{CS}_2$ .

2. By heating to b.-pt., cooling suddenly, and allowing to stand until hard. Has been called gamma sulphur, but is a mixture of  $\frac{2}{3}$  A, 4 and  $\frac{1}{3}$  insol. S.

3. Insol. S in flowers of sulphur. Converted into A, 1 by standing 3 days with alcohol.

According to Berthollet (A. ch. (3) 49. 430) there are only two varieties of S. I. "Octahedral," II. "Amorphous."

I. Octahedral. Sol. in  $\text{CS}_2$ . Scarcely acted upon by  $\text{KHSO}_4 + \text{Aq}$ . Converted by oxidising agents into II.

II. Amorphous. Insol. in neutral solvents, viz.  $\text{H}_2\text{O}$ , alcohol, ether,  $\text{CS}_2$ , etc.

Sol. with tolerable rapidity in  $\text{KHSO}_4 + \text{Aq}$ .

By long action of  $\text{Na}_2\text{S} + \text{Aq}$ , a portion is dissolved, and the remainder converted into I.

Less easily oxidised by  $\text{HNO}_3 + \text{Aq}$  than I. Some varieties of this modification are sol. to a certain extent in alcohol and ether,

and by boiling the rest of the sulphur is converted into I; also by long-continued contact with cold alcohol. Berthollet holds that the modification is changed before dissolving. Solutions of the alkalis, alkali salts, and alkali sulphides change insol. into sol. sulphur. (Berthollet.)

Elastic sulphur obtained by pouring molten sulphur at a temp. of over  $260^\circ$  into  $\text{H}_2\text{O}$  contains 35% or more of a modification of S which is insol. in  $\text{CS}_2$ , hot or cold, but sol. in absolute alcohol, this modification can be converted back into ord. sulphur by heating to  $100^\circ$ . (Pelouze and Fremy) (See C. 2.)

This modification can be obtained also by action of  $\text{HCl}$  on thiosulphates (Fordos and Gélis.)

The soft pasty sulphur obtained by decomposition of  $\text{H}_2\text{S}$  by  $\text{SO}_2$  forms an almost clear emulsion (pseudo-solution) with  $\text{H}_2\text{O}$ , from which it is pptd. by various salts and substances which have no chemical affinity for it. 23 pts S combine in this way with 100 pts  $\text{H}_2\text{O}$ . When pptd. by saline solutions, some of the S remains in solution. When solution is exposed to the light, S gradually separates out; also on boiling the same takes place. The above pseudo-solution is pptd. by mineral acids, and the pptd. S may still be dissolved in fresh water, if not left in contact for some time with the acid. Also pptd. by K salts, with loss of power of forming pseudo-solutions. Pptd. by  $\text{NH}_4$  and Na salts without losing that power.

Alkali hydrates, carbonates, or sulphides convert it into insol. S.

The solution may be mixed with alcohol without change. Decomp. by long shaking with naphtha or oil of turpentine. The pseudo-solution combines with  $\text{CS}_2$ , forming an emulsion which subsequently decomposes. The S itself is only partially sol. in  $\text{CS}_2$ . (Selmi, J. pr. 57. 49.)

By treatment of amorphous "insoluble" S with  $\text{CS}_2$  or  $\text{CCl}_4$ , a small part goes into solution, the amount being dependent on the time of contact with the temp., and nature of the solvent, but independent of the amount of the solvent. It is assumed that this is due to a partial change of the "insoluble" into soluble S. (Wigand, Z. phys. Ch. 1910, 75. 235.)

"Delta" sulphur. Partly sol. in  $\text{H}_2\text{O}$ . (Debus, Chem. Soc. 53. 18.)

A colloidal form wholly sol. in  $\text{H}_2\text{O}$  exists, which, however, decomposes very easily. (Engel, C. R. 112. 866.)

Black sulphur. Insol. in alcohol, ether,  $\text{CS}_2$ , fatty oils even at  $200^\circ$ , cold alkali hydroxides + Aq,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or aqua regia. (Knapp, J. pr. (2) 43. 305.)

Green modification. Five times more sol. than ordinary sublimed sulphur in a mixture of salicylaldehyde and benzene. (Orloff, C. C. 1902, 1. 1264.)

The following data relate to octahedral or ordinary sulphur (A. 1).—

Sol. in warm liquid  $\text{H}_2\text{S}$  (Niemann); warm  $\text{P}_2\text{S}_5$ ,  $\text{SBr}_2$ ,  $\text{SCl}_2$ ,  $\text{Br}_2$ ,  $\text{NCl}_3$ ,  $\text{BaS}$  + Aq (Dumas); in alcoholic solution of  $\text{K}_2\text{S}_2$ , but is reprecipitated by addition of  $\text{H}_2\text{O}$  to sat. solution.

Sol. in liquid  $\text{SO}_2$ .

Sol. in aqueous solution of alkali sulphates, especially when hot. Sl. sol. in boiling conc  $\text{HSCN}$  + Aq, from which it mostly separates on cooling.

$\text{Na}_2\text{CO}_3$  + Aq (5.6%  $\text{Na}_2\text{CO}_3$ ) dissolves no S at  $20^\circ$ ; 0.06775% at  $100^\circ$ . (Pohl, Dingl. 197. 508.)

The solubility of S in  $\text{Na}_2\text{S}$  + Aq between  $0^\circ$  and  $50^\circ$  diminishes slightly with increase in temp., but increases with dilution of the solution, having its largest value in a N/16 solution of  $\text{Na}_2\text{S}$  + Aq when the relation of  $\text{Na}_2\text{S}$  to dissolved S equals about 1.4. (Kuster, Z. anorg. 1905, 43. 56.)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84. 27.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 874.)

Sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 822.)

Sol. in liquid  $\text{NH}_3$ . 1 gr S is sol. in 3-4 cc. liquid  $\text{NH}_3$ . (Hugot, A. ch. 1900, (7) 21. 32.)

The solubility of S in liquid  $\text{NH}_3$  is constant from  $-23^\circ$  to  $-84^\circ$  and equals 39%. (Ruff, Z. anorg. Ch. 1910, 23. 1830.)

Solubility in liquid  $\text{NH}_3$   
(g S in 100 g. solution.)

$t^\circ$	S <sup>1</sup>	$t^\circ$	S
-78	38.6	16.4	25.65
-20.5	38.1	30	21.0
0	32.34	40	18.5

(Ruff and Hecht, Z. anorg. 1913, 70. 62.)

Sl. sol. in liquid  $\text{NO}_2$ . (Frankland, Chem. Soc. 1901, 79. 1361.)

$\text{S}_2\text{Cl}_2$  dissolves 86.74% S at ord. temp. to form a liquid of 1.7 sp. gr. (Rose.)

Solubility of S in  $\text{S}_2\text{Cl}_2$  varies according to the variety of sulphur used. Aten has published an extended investigation on the subject, which see for details. (Z. phys. Ch. 1905-14, 54. 86, 124; 81. 268; 83. 443; 86. 1; 88. 321.)

Solubility in  $\text{SnCl}_4$ .

100 g.  $\text{SnCl}_4$  dissolve at.

$99^\circ$	$101^\circ$	$110^\circ$	
5.8	6.2	8.7	9.1 pts. solid S,
$112^\circ$	$112^\circ$	$121^\circ$	
9.4	9.9	17.0	pts. liquid S.

(Gerardin.)

Sol. in alkalis + Aq with decomp.

Sol. in 1926.7 pts. absolute alcohol at  $15^\circ$ . (Pohl, W. A. B. 6. 600.)

Sol. in 20 pts. hot nearly absolute alcohol, less sol. in weaker alcohol. (Laurigay.)

Sol. in 600 pts. boiling alcohol of  $40^\circ$  B. (Chevalier, J. ch. med. 2. 587); in 500 pts. alcohol (Meissner), 200 pts. alcohol (Pelouze and Fremy.)

100 pts. absolute alcohol dissolve 0.42 pt. at b.-pt., and 0.12 pt. S at  $16^\circ$ ; 100 pts. ether dissolve 0.54 pt. at b.-pt., and 0.19 pt. S at  $16^\circ$ ; 100 pts. benzene dissolve 17.04 pts. at b.-pt., and 1.79 pts. S at  $16^\circ$ ; 100 pts. oil of turpentine dissolve 16.16 pts. at b.-pt., and 1.35 pts. S at  $16^\circ$ ; 100 pts.  $\text{CS}_2$  dissolve 78.46 pts. at b.-pt., and 33.70 pts. S at  $16^\circ$ ; 100 pts. naphtha dissolve 10.56 pts. at b.-pt., and 2.77 pts. S at  $16^\circ$ ; 100 pts. tar-oil dissolve 26.68 pts. at b.-pt., and 1.51 pts. S at  $16^\circ$ . (Payen, C. R. 34. 456.)

100 pts. absolute methyl alcohol dissolve 0.028 pt. at  $18.5^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 0.053 pt. at  $18.5^\circ$ . (de Bruyn, Z. phys. Ch. 10. 781.)

Solubility in amyl alcohol.

$95^\circ$	$110^\circ$	$110^\circ$	
1.5	2.1	2.3	pts. solid S,
$112^\circ$	$112^\circ$	$120^\circ$	$131^\circ$
2.6	2.7	3.0	5.3 pts. liquid S.

(Gerardin, A. ch. (4) 6. 134.)

Quickly sol. in 12.5 pts. ether. (Favre.)

100 pts. benzene dissolve 0.965 pt. S at  $26^\circ$ ; 100 pts. benzene dissolve 4.377 pts. S at  $71^\circ$ ; 100 pts. toluene dissolve 1.479 pts. S at  $23^\circ$ ; 100 pts. ethyl ether dissolve 0.972 pt. S at

23.5°; 100 pts. chloroform dissolve 1 205 pts. S at 22°; 100 pts. phenol dissolve 16 35 pts. S at 174°; 100 pts. aniline dissolve 85 27 pts. S at 130°. (Cossa, B. 1. 139.)

Solubility in benzene at t°.

t°	g S in 10 g. of solution
15.17	0 1480
19.29	0 1692

(Bronsted, Z. phys. Ch. 1906, 55. 377.)

A mixture of S and toluene separates into two layers, containing 33 and 92.5% S respectively. (Haywood, J. phys. Ch 1897, 1. 232.)

CS<sub>2</sub> dissolves 0 35 pt ordinary sulphur; some varieties of S, however, are not entirely sol in CS<sub>2</sub>, thus—

Variety of Sulphur	Pts sol in 1 pt CS <sub>2</sub>	Fraction of original wt. insol in CS <sub>2</sub>
Octahedral, from Sicily	0 335	0 000
Crystallised in dry way, recently prepared	0 415	0 029
Do., prepared 8 years	0 33	0 004
Do., prepared 9 years		0 020
Do., prepared 15 years		0.051
Red needles, recently prepared	0 382	0 023
Soft yellow, do		0 353
Do., prepared 2 years	0.315	0 157
Soft red, recently prepared	0.374	0 157
Do., prepared 5 years		0 181
Flowers of sulphur	0 351	0 113
Do., another sample		0 234
Roll brunstone, outside		0 029
Do., inside		0 073

(Deville, A. ch (3) 47. 99.)

The pt. insol in CS<sub>2</sub> is sol in hot absolute alcohol, crystallising on cooling; less sol. in chloroform or ether (Deville)

100 pts pure CS<sub>2</sub> dissolve pts S at t°

t°	Pts S	t°	Pts S
-11	16 54	22	46 05
-6	18 75	38	94 57
0	23 99	48 5	146 21
+15	37 15	55	181 34
18 5	41 65		

(Cossa, B. 1. 138.)

Neither ordinary stick S nor flowers of S is completely sol. in CS<sub>2</sub>. Pptd. S is completely sol. in 5 pts. CS<sub>2</sub>. (Tittenger, C. C. 1894, II. 287.)

2.99 g. S are sol in 100 grams CS<sub>2</sub> at -116°. (Arcetowski, C. R. 1895, 121. 124.)

Solubility in CS<sub>2</sub>.

100 g. of the sat. solution contain at.

-77°	-84.5°	-89°	-116°
4.84	4.46	4.29	2.99 g S.

(Arcetowski, Z. anorg. 1896, 11. 274.)

When 20 pts S dissolve in 50 pts. CS<sub>2</sub> at 22° the temp. is lowered 5°. (Cossa.)

Sat. solution of S in CS<sub>2</sub> boils at 55°. (Cossa.)

Sp. gr. of S dissolved in CS<sub>2</sub> at 15°.

(Pts S per 100 pts CS<sub>2</sub>.)

Sp gr.	Pts S	Sp gr.	Pts S	Sp gr.	Pts S
1 271	0 0	1 312	9 9	1 352	19 6
1 272	0 2	1 313	10 2	1 353	19 9
1 273	0 4	1 314	10 4	1 354	20 1
1 274	0 6	1 315	10 6	1 355	20 4
1 275	0 9	1 316	10 9	1 356	20 6
1 276	1 2	1 317	11 1	1 357	21 0
1 277	1 4	1 318	11 3	1 358	21 2
1 278	1 6	1 319	11 6	1 359	21 5
1 279	1 9	1 320	11 8	1 360	21 8
1 280	2 1	1 321	12 1	1 361	22 1
1 281	2 4	1 322	12 3	1 362	22 3
1 282	2 6	1 323	12 6	1 363	22 7
1 283	2 9	1 324	12 8	1 364	23 0
1 284	3 1	1 325	13 1	1 365	23 2
1 285	3 4	1 326	13 3	1 366	23 6
1 286	3 6	1 327	13 5	1 367	24 0
1 287	3 9	1 328	13 8	1 368	24 3
1 288	4 1	1 329	14 0	1 369	24 8
1 289	4 4	1 330	14 2	1 370	25 1
1 290	4 6	1 331	14 5	1 371	25 6
1 291	4 8	1 332	14 7	1 372	26 0
1 292	5 1	1 333	15 0	1 373	26 5
1 293	5 3	1 334	15 2	1 374	26 9
1 294	5 6	1 335	15 4	1 375	27 4
1 295	5 8	1 336	15 6	1 376	28 1
1 296	6 0	1 337	15 9	1 377	28 5
1 297	6 3	1 338	16 1	1 378	29 0
1 298	6 5	1 339	16 4	1 379	29 7
1 299	6 7	1 340	16 6	1 380	30 2
1 300	7 0	1 341	16 9	1 381	30 8
1 301	7 2	1 342	17 1	1 382	31 4
1 302	7 5	1 343	17 4	1 383	31 9
1 303	7 8	1 344	17 6	1 384	32 6
1 304	8 0	1 345	17 9	1 385	33 2
1 305	8 2	1 346	18 1	1 386	33 8
1 306	8 5	1 347	18 4	1 387	34 5
1 307	8 7	1 348	18 6	1 388	35 2
1 308	8 9	1 349	18 9	1 389	36 1
1 309	9 2	1 350	19 0	1 390	36 7
1 310	9 4	1 351	19 3	1 391	37 2
1 311	9 7	..			

(Mascagno, C. N. 43. 192.)

Sp. gr. of S dissolved in CS<sub>2</sub> at 15°. Water at 4°=1

Sp gr	% S	Sp gr.	% S	Sp gr.	% S
1.2708	0 0	1 2736	0 6	1.2764	1 2
1 2717	0 2	1 2745	0 8	1.2774	1 4
1.2727	0 4	1 2755	1 0	1 2783	1 6
1.2792	1 8	1 3096	8 0	1 3409	14 2
1.2802	2 0	1 3105	8 2	1 3419	14 4
1 2812	2 2	1.3115	8 4	1 3430	14 6
1.2822	2 4	1.3125	8 6	1.3440	14 8
1 2832	2 6	1.3135	8 8	1 3450	15 0
1.2842	2 8	1.3145	9 0	1 3460	15 2
1.2852	3 0	1 3155	9 2	1 3471	15 4
1.2862	3 2	1 3165	9 4	1.3481	15 6
1 2872	3 4	1 3175	9 6	1 3491	15 8
1.2882	3 6	1 3185	9 8	1 3502	16 0
1 2892	3 8	1 3195	10 0	1.3512	16 2
1 2901	4 0	1 3205	10 2	1 3522	16 4
1 2911	4 2	1 3215	10 4	1 3532	16 6
1.2921	4 4	1 3226	10 6	1 3543	16 8
1.2930	4 6	1 3236	10 8	1 3553	17 0
1.2940	4 8	1 3246	11 0	1 3563	17 2
1.2949	5 0	1.3256	11 2	1 3573	17 4
1 2959	5 2	1.3266	11 4	1 3584	17 6
1 2969	5 4	1 3277	11 6	1 3594	17 8
1 2978	5 6	1.3287	11 8	1 3604	18 0
1 2988	5 8	1 3297	12 0	1 3615	18 2
1 2998	6 0	1 3307	12 2	1 3625	18 4
1 3008	6 2	1 3317	12 4	1 3635	18 6
1 3017	6 4	1 3328	12 6	1 3646	18 8
1 3027	6 6	1 3338	12 8	1 3656	19 0
1 3037	6 8	1 3348	13 0	1 3667	19 2
1 3047	7 0	1 3358	13 2	1 3677	19 4
1.3056	7 2	1.3368	13 4	1 3688	19 6
1 3066	7 4	1 3379	13 6	1 3698	19 8
1 3076	7 6	1 3389	13 8	1 3709	20 0
1.3086	7 8	1 3399	14 0		

(Pfeiffer, Z anorg. 1897, 15. 200.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Solubility of S in acetone+Δq at 25°.

S=millimols. g S in 100 cc. of the solution.  
A=g. acetone in 100 g. acetone+Δq

A	S	Sp gr
100	65 0	0 78540
95 36	45 0	0 79114
90 62	33 0	0 81054
85 38	25 3	0 82958

(Herz and Knoch, Z. anorg. 1905, 45. 263.)

# Solubility in organic solvents.

Solvent	°	Sat solution contains % S
CS <sub>2</sub>	-61	3.6
	-55	4.4
	-19	10.6
	-18	10.8
	-17	11.5
	-13	12.4
	-11	13 3
	-11	13 5
	-2	17 2
	+ 3	19 5
	9	23 1
	11	23 7
	14	25 9
	17	27 2
	19	28 9
	20	28 5
	21	29 7
	26	33 4
	27	34 6
	29	37 8
	30 5	39 7
Ethylene dibromide	33	42 2
	40	48 7
	44	53 2
	46	56 2
	48	57 5
	53	60 0
	54	60 6
	65	67 9
	77 5	70 4
	81 0	79 4
Benzene	92 0	87 8
	98 0	90 1
	9	1 7
	22	2 4
	40	4 4
	50	6 4
	72	12 4
	95	30 2
	108	60 0
	8	1 2
Hexane	10	1 3
	21	1 8
	30	2 6
	39	3 3
	47	4 0
	54	4 9
	65	6 8
	72	8 6
	100	17 5
	123	31 9
	127	34 0
	150	38 8
	-20	0 07
	0	0 16
	+26	0 41
	+68	1 2
	+130	5 2
	+142	6 2
	+184	8 3

(Étard, A. ch. 1894, (7) 2. 571.)

Solubility in  $\text{CHCl}_3$  at  $t^\circ$ .

$t^\circ$	g S in 10 g of solution
12 25	0.0744
19.29	0.0918

(Brönsted, Z. phys. Ch. 1906, 55. 377.)

Solubility of octahedral and prismatic S in organic solvents at  $t^\circ$ .

Solvent	$t^\circ$	% prismatic S	% octahedral S
Benzene	18.6	2 004	1 512
	25.3	2 335	1 835
Chloroform	0	1 101	0 788
	15 5	1.658	1.253
	40	2 9	2.4
Ethyl ether	0	0.113	0 080
	25 3	0.253	0 200
Ethyl bromide	0	0.852	0 611
	25.3	1 676	1 307
Ethyl formate	0	0 028	0.019
Ethyl alcohol	25 3	0 066	0.052

(Brönsted, Z. phys. Ch. 1906, 55. 377.)

Solubility in organic solvents at  $25^\circ$ . (G. S dissolved in 1 g. mol. of solvent.)

Solvent	g S
Ethylene chloride	0 831
Tetrachlorethane	2 063
Dichlorethylene	1 237
Pentachlorethane	2.421
Trichlorethylene	2.43
Perchlorethylene	2.537
Carbon tetrachloride	1.354

(Hoffmann et al. 1910, B. 43. 188.)

100 g. trichlorethylene dissolve 1.19 g. S at  $15^\circ$ . (Wester and Bruins, Pharm. Weekbl. 1914, 51. 1443.)

Solubility in benzyl chloride at  $t^\circ$ 

$t^\circ$	g. S per 100 g of solution	
	in upper layer	in lower layer
0	0.99	
17	1 78	
35	2 57	
46 1	3.61	
63.3	6.15	
78.0	9 88	
99.1	19.89	
109.6		90 62
114.6		87.99
118.8	37.29	
121.4	40.04	85.02
130.0	49.71	80.07
134.2	58.20	72 23

Above  $134.2^\circ$  sulphur is miscible with

benzyl chloride in all proportions, below this temp. two layers are formed

(Bogusky, J Russ Phys. Chem. Soc. 1905, 37. 92-99; C. C. 1906, I. 1207)

Easily sol. in boiling acetic anhydride. (Rosenfeld, B. 13. 1475.)

Sol. in considerable amount in warm conc.  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$  + Aq, but very sl. sol. if dil. (Liebermann, B. 10. 866.)

Sol. in stearic acid + Aq. (Vulpius, Arch. Pharm. (3) 13. 38)

Acetic ether dissolves 6% S (Favre.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Sol. in ethyl acetate. (Naumann, B. 1904, 37. 3601)

Sl. sol. in benzonitrile at ord. temp., much more sol. at higher temp. (Naumann, B. 1914, 47. 1369.)

Sol. in 12 pts. hot petroleum from Amiano, but nearly insol. in cold. (de Saussure.)

100 pts. nicotine at  $100^\circ$  dissolve 10.58 pts. S, but this separates out as the solution cools. (Klever, C. C. 1872. 434.)

Sol. in warm aniline. (Barral, A. ch. (3) 20. 352)

Easily sol. in hot, less sol. in cold aniline. (Fritzsche)

Very sol. in aniline and quinoline, especially when warm. (Hofmann.)

Sol. in quinoline but reacts with the solvent with evolution of H. (Beckmann and Gabel, Z. anorg. 1906, 51. 238.)

 $\frac{1}{2}$  ccm. oleic acid dissolves 0.0335 g. S in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

Sol. in 2.6 pts. of boiling, sl. sol. in cold creosote.

Sol. by digestion in 2 pts. oil of turpentine.

Sol. in hot oil of copaiba, crystallising on cooling

Sol. in hot oil of mandarin, crystallising on cooling

Sol. in hot oil of caraway, crystallising on cooling.

Somewhat sol. in hot, less in cold wood-spirit.

Sl. sol. in lignone, bromoform, cold benzene, but easily in hot benzene. (Mansfield, Chem. Soc. 1. 262.)

Sol. in ethyl sulphide, and carbon chloride (Rathke, A. 162. 187.)

Sol. in mercuric methyl.

Sol. in 20 pts. ethyl nitrate, from which is is not pptd. by  $\text{H}_2\text{O}$ .

Sol. in naphtha, aldehyde, iodol, bromal, chloroform, warm chloral, sinkaline + Aq, ethyl chloride, warm benzoyl chloride.

100 pts. methylene iodide dissolve 10 pts. S at  $10^\circ$ . Melted sulphur is miscible with hot methylene iodide. (Retgers, Z. anorg. 3. 343.)

S dissolves in 2000 pts. glycerine. (Cap and Garot, J. Pharm. (3) 26. 81.)

Glycerine dissolves 0.10% S (Klever, C. C. 1872. 434.)

100 g. glycerine dissolve 0.14 g. at 15.5° (Ossendowski, Pharm. J. 1907, 79, 575.)

Sol in butyl sulphhydrate, and warm retanole.

Sol in ethyl sulphhydrate.

Very sol. in conine, hexyl alcohol, warm allyl sulphocyanide, caecodyl oxide. Somewhat sol. in hot styrene, separating out on cooling.

Readily sol. in warm, less readily in cold toluene or rean-oil.

Sol. in olive oil at 115°, from which it mostly separates on cooling.

Sol. in hot oil of amber, crystallising upon cooling. Sol. in 2 pts. hot, sl. sol. in cold castor-oil.

Insol. in valerianic acid, amyl valerate, valeryl hydride.

Lancet oil dissolves % S at t°

t°	% S	t°	% S	t°	% S
25	0.630	95	2.587	160	9.129
60	1.852	130	4.935		

(Pohl.)

Solubility in olive oil (sp. gr. = 0.885)

100 pts. dissolve pts. S at t°.

t°	Pts. S	t°	Pts. S	t°	Pts. S
15	2.3	65	20.6	110	30.3
40	5.6	100	25.0	130	43.2

(Pelouze, C. R. 68, 1179.)

Solubility in 100 pts. coal-tar oil at t°

t°	Pts. S in		
	Oil of 0.870 sp. gr. B-pt. 80-100°	Oil of 0.880 sp. gr. B-pt. 85-120°	Oil of 0.882 sp. gr. B-pt. 120-200°
15	2.1	2.3	2.5
30	3.0	4.0	5.3
50	5.2	6.1	8.3
80	11.8	13.7	15.2
100	15.2	18.7	23.0
110		23.0	26.2
120		27.0	32.0
130			38.7

t°	Pts. S in		
	Oil of 0.885 sp. gr. B-pt. 160-200°	Oil of 1.010 sp. gr. B-pt. 210-300°	Oil of 1.020 sp. gr. B-pt. 220-300°
15	2.6	6.0	7.0
30	5.8	8.5	8.5
50	8.7	10.0	12.0
80	21.0	37.0	41.0
100	26.4	52.5	54.0
110	31.0	105.0	115.0
120	38.0	∞	∞
130	43.8	∞	∞

(Pelouze, C. R. 69, 56.)

Sulphur bromide, S<sub>2</sub>Br<sub>2</sub>.

Decomp. gradually with H<sub>2</sub>O. Dissolves S on warming, which crystallises out on cooling. Sol. in CS<sub>2</sub>.

Decomp. by current of dry air into S and Br. (Hannay, Chem. Soc. 35, 18.)

Decomp. slowly by cold H<sub>2</sub>O, rapidly by hot H<sub>2</sub>O. Decomp. by dil. KOH + Aq. or NaHCO<sub>3</sub> + Aq. (Korndorfer, Arch. Pharm. 1904, 242, 154.)

A study of the mpt. curve of a series of mixtures of sulphur and bromine gave no evidence for the existence of the compounds SBr<sub>2</sub> and SBr<sub>4</sub>. (Ruff, B. 1903, 36, 2446.)

Sulphur monochloride, S<sub>2</sub>Cl<sub>2</sub>.

Slowly decomp. with H<sub>2</sub>O. Miscible with CS<sub>2</sub> and C<sub>2</sub>H<sub>4</sub>. Sol. in alcohol and ether with subsequent decomposition. Sol. in oil of turpentine.

Moderately sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20, 830.)

Sol. in CCl<sub>4</sub> and C<sub>6</sub>H<sub>6</sub>. (Oddo, Gazz. ch. it. 1899, 29, (2) 318.)

Sulphur dichloride, SCl<sub>2</sub>.

Decomp. slowly with H<sub>2</sub>O, immediately by alcohol or ether.

Sulphur tetrachloride, SCl<sub>4</sub>.

Violently decomp. by H<sub>2</sub>O. Decomp. at temperatures above -22°. (Michaelis, A. 170, 1.)

Sulphur stannic chloride, 2SnCl<sub>4</sub>, SnCl<sub>2</sub>.

Decomp. by H<sub>2</sub>O. Sol. in dil. HNO<sub>3</sub> + Aq. Forms a mass with fuming HNO<sub>3</sub>, which is sol. in HNO<sub>3</sub> + Aq. Sol. in POCl<sub>3</sub>. (Casselmann.)

Very hygroscopic. Fumes in moist air. Very easily sol. in dry abs. ether and in benzene. Sol. in CHCl<sub>3</sub>, SO<sub>2</sub>Cl<sub>2</sub>, CS<sub>2</sub>, POCl<sub>3</sub>, ligrom and petroleum ether. (Ruff, B. 1904, 37, 4517.)

Sulphur titanium chloride, SCl<sub>4</sub>, 2TiCl<sub>4</sub>.

Very deliquescent. Easily sol. in dil. HNO<sub>3</sub> + Aq. (Weber, Pogg. 132, 454.)

SCl<sub>4</sub>, TiCl<sub>4</sub>. Sol. in SO<sub>2</sub>Cl<sub>2</sub>, CHCl<sub>3</sub>, CS<sub>2</sub>, and petroleum ether. (Ruff, B. 1904, 37, 4516.)

Sulphur chloride ammonia, S<sub>2</sub>Cl<sub>2</sub>, 4NH<sub>3</sub>.

Insol. in H<sub>2</sub>O, but gradually decomp. thereby; sol. without decomp. in absolute alcohol, from which it is pptd. by H<sub>2</sub>O. (Mertens.)

Does not exist. (Fordos and Gélis, C. R. 31, 702.)

SCl<sub>2</sub>, 2NH<sub>3</sub>. Decomp. by H<sub>2</sub>O. Sol. in alcohol or ether. (Soubeiran, A. ch. 67, 71.) Not a true chemical compound, but a mixture. (Fordos and Gélis, C. R. 31, 702.)

$\text{SCl}_2, 4\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in absolute alcohol and ether (Soubeiran, A. ch. 67. 71); mixture (Fardos and Gélis).

### Sulphur chloride nitrogen sulphide.

See Nitrogen sulphochloride.

### Sulphur perfluoride, $\text{SF}_6$ .

Very sl. sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol. (Moissan, C. R. 1900, 130. 868.)

### Sulphur moniodide, $\text{S}_2\text{I}_2$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol, which dissolves out  $\text{I}_2$ . Sl. sol. in cold caoutchou, the solution decomposing when boiled. Freely sol. in glycerine. Sol. in 60 pts. glycerine, and 82 pts. olive oil. (Cap and Garot, J. Pharm. (3) 26. 81.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Sol. in  $\text{CS}_2$ . (Limebarger, Am. Ch. J. 1895, 17. 58.)

### Sulphur hexiodide, $\text{SI}_6$ .

Decomp. on air. Alcohol or alkalis dissolve out iodine. (vom Rath, Pogg. 110. 116.)

Does not exist. (M'Leod, Rep. Brit. Assn. Advn. Sci. 1892. 690.)

### Sulphur stannic iodide.

See Tin sulphur iodide.

### Sulphur sesquioxide, $\text{S}_2\text{O}_3$ .

Deliquescent. Violently decomp. by  $\text{H}_2\text{O}$  at ordinary temp. Sol. in fuming  $\text{H}_2\text{SO}_4$ . Insol. in  $\text{SO}_2$ . Decomp. by alcohol or ether. (Weber, Pogg. 156. 531.)

### Sulphur dioxide, $\text{SO}_2$ .

Liquid. Insol. in  $\text{H}_2\text{O}$  if brought in contact therewith below the b-pt of  $\text{SO}_2$ .

Sol. in 3 vols  $\text{CS}_2$  on warming, separating out on cooling. Dissolves some P, little S, and no sulphuric or phosphoric acids.

Dissolves ether, chloroform, P, Br, S, I,  $\text{CS}_2$ , colophonium, and other gums; also benzene when warmed. (Sestini, Bull. Soc. (2) 10. 226.)

Miscible with liquid  $\text{SO}_2$ , but not with  $\text{H}_2\text{SO}_4$ .

#### Gas

1 vol.  $\text{H}_2\text{O}$  absorbs 30 vols  $\text{SO}_2$  gas at  $18^\circ$  (Davy), 20 vols at ord temp. (Dalton), 43.78 vols at ord temp. (de Saussure), 50 vols at  $20^\circ$  and 760 mm (Pelouze and Fremy), 33 vols at ord temp (Thomson).

1 pt.  $\text{SO}_2$  (by weight) is sol in 0.1420 pt  $\text{H}_2\text{O}$  at  $5^\circ$ , and the solution has 1.020 sp. gr.

1 pt.  $\text{SO}_2$  is sol in 0.0400 pt.  $\text{H}_2\text{O}$  at ord. temp. (Priestley), in 0.0809 pt.  $\text{H}_2\text{O}$  at  $10^\circ$ , and sp. gr. of the solution = 1.0513 (Thomson).

Sol in 2 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ . (Pierre, A. ch. (3) 23. 421.) 100 vols  $\text{H}_2\text{O}$  at  $18^\circ$  and 760 mm. absorb 4378 vols.  $\text{SO}_2$  gas, 100 vols alcohol of 0.84 sp. gr at 760 mm. absorb 11,577 vols. (de Saussure, 1814.)

Solubility of  $\text{SO}_2$  gas in  $\text{H}_2\text{O}$   $t^\circ$  = temp,  $V$  = vols.  $\text{SO}_2$  reduced to  $0^\circ$  and 760 mm. contained in 1 vol. sat.  $\text{SO}_2 + \text{Aq}$ ,  $V_1$  = vols.  $\text{SO}_2$  gas reduced to  $0^\circ$  and 760 mm. dissolved by 1 vol  $\text{H}_2\text{O}$  under 760 mm. pressure

$t^\circ$	V	$V_1$	$t^\circ$	V	$V_1$
0	68 861	79.789	21	34 980	37 970
1	67 008	77 210	22	33 910	36 617
2	65 169	74 691	23	32 847	35 302
3	63 360	72 230	24	31 800	34 026
4	61 576	69 828	25	30 766	32 786
5	59 816	67 455	26	29 748	31 584
6	58 080	65 200	27	28 744	30 422
7	56 369	62 973	28	27 754	29 314
8	54 678	60 805	29	26 788	28 210
9	53 021	58 697	30	25 819	27 161
10	51 383	56 647	31	24 873	26 151
11	49 770	54 655	32	23 942	25 178
12	48 182	52 723	33	23 025	24 244
13	46 618	50 849	34	22 122	23 347
14	45 079	49 033	35	21 234	22 489
15	43 564	47 276	36	20 361	21 668
16	42 073	45 578	37	19 502	20 886
17	40 608	43 939	38	18 658	20 141
18	39 165	42 360	39	17 827	19 435
19	37 749	40 838	40	17 013	18 766
20	36 206	39 374			

(Schönfeld, A. 95. 5)

This table may be formulated as follows.

1 vol.  $\text{H}_2\text{O}$  absorbs 79 789—2 6077t+0.029349t<sup>2</sup> vols  $\text{SO}_2$  at temp. between  $0^\circ$  and  $20^\circ$ , or 1 vol. sat. solution contains 68 861—1.87025t+0.01225t<sup>2</sup> vols.  $\text{SO}_2$ . Coefficient of absorption between  $21^\circ$  and  $40^\circ$  = 75.182—2.1716t+0.01903t<sup>2</sup> vols  $\text{SO}_2$ , or 1 vol. sat. solution between  $21^\circ$  and  $40^\circ$  contains 80.952—1.38898t+0.00726t<sup>2</sup> vols.  $\text{SO}_2$ .

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{O}$  at various temps and 760 mm.  $t^\circ$  = temp, G = grammes  $\text{SO}_2$  dissolved in 1 g  $\text{H}_2\text{O}$ ; V = vols  $\text{SO}_2$  dissolved in 1 g  $\text{H}_2\text{O}$

$t^\circ$	G	V	$t^\circ$	G	V
8	0 168	58.7	30	0 078	27.3
10	0 154	53 9	32	0 073	25 7
12	0 142	49 6	34	0 069	24 3
14	0 130	45 6	36	0 065	22 8
16	0 121	42 2	38	0 062	21 6
18	0 112	39 3	40	0 058	20 4
20	0 104	36 4	42	0 055	19 3
22	0 098	34 2	44	0 053	18 4
24	0 092	32 3	46	0 050	17 4
26	0 087	30 5	48	0 047	16 4
28	0 083	28 9	50	0 045	15 6

(Sims, A. 118. 340)

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{O}$  at various pressures  
 $P$  = "partial pressure," i. e. the total pressure minus the tension of aqueous vapour at given temp.,  $G$  at  $P$  = weight  $\text{SO}_2$  in grammes, which is dissolved in 1 g  $\text{H}_2\text{O}$  at pressure  $P$ ,  $G$  at 760 = calculated weight  $\text{SO}_2$  that would be contained in 1 g.  $\text{H}_2\text{O}$  at 760 mm. if the absorption were proportional to the pressure;  $V$  = the volume of  $G$  grammes of  $\text{SO}_2$  at  $0^\circ$  and 760 mm.

P	7°			
	G at P	G at 760	V at P	V at 760
30	0 010	0.263	3 634	92 06
40	0 013	0.242	4.451	84 65
50	0 015	0.223	5 129	77 95
60	0 017	0 818	6 024	76 28
70	0 020	0 213	6 868	74 55
80	0 022	0 210	7 743	73 55
90	0 025	0 208	8 598	72.02
100	0 027	0 205	9 421	71.60
120	0 032	0.201	11 09	70 20
140	0 036	0 197	12 71	69 00
160	0 041	0 195	14 34	68 15
180	0 046	0.193	15.97	67.40
200	0 050	0 191	17 59	66 83
220	0 055	0 190	19 19	66 30
240	0 059	0 188	20 79	65 84
260	0 064	0 187	22 40	65 44
280	0 069	0 186	23 99	65 10
300	0 073	0 185	25 59	64 81
350	0 085	0 184	29.55	64 16
400	0 096	0 182	33 51	63 65
450	0 107	0 181	37 44	63.25
500	0 118	0 180	41.42	62 94
550	0 130	0 179	45 31	62.60
600	0 141	0 178	49 20	62 32
650	0 152	0 178	53 10	62 09
700	0 163	0 177	56 98	61 86
750	0 174	0 176	60.88	61 69
760	0 176	0 176	61.65	61.65
800	0 185	0 176	64 74	61.50
850	0 196	0 175	68 57	61.30
900	0 207	0 175	72 41	61 15
950	0 218	0 175	76 25	61 00
1000	0 229	0 174	80 01	60 88
1050	0 240	0 174	83 97	60 77
1100	0 251	0 174	87 80	60 65
1200	0 273	0 173	95 45	60.45
1300	0 295	0 172	103.00	60 25

P	20°			
	G at P	G at 760	V at P	V at 760
40	0 007	0 143	2 637	50 09
50	0 009	0 138	3 171	48 20
60	0 011	0 135	3 718	47 10
70	0 012	0 131	4 205	45 64
80	0 013	0 127	4 663	44 30
90	0 015	0 125	5.169	43 65
100	0 016	0 124	5.692	43 25
120	0 019	0 121	6 683	42.33
140	0 022	0 119	7.690	41.75
160	0 025	0 118	8.666	41.17
180	0 028	0 117	9 652	40.75
200	0 030	0 116	10 62	40.35
220	0 033	0 115	11 59	40.03
240	0 036	0 114	12 54	39.70
260	0 038	0 112	13 45	39 30
280	0 041	0 112	14 41	39.10
300	0 044	0 111	15 34	38.87
350	0 050	0 110	17.06	38.35
400	0 059	0 109	20 56	38 10
450	0 064	0 108	22 37	37 77
500	0 071	0 107	24 67	37 50
550	0 077	0 106	26 93	37 20
600	0 083	0 105	29 14	36 90
650	0 090	0 105	31 39	36 70
700	0 096	0 105	33 62	36 50
750	0 103	0 104	35.94	36 43
760	0 104	0 104	36.43	36 43
800	0 110	0 104	38.32	36 40
1000	0 137	0 104	47 85	36 37
1300	0 178	0 104	62 10	36 31
1600	0 218	0 104	76 35	36 27
1900	0 259	0 104	90 53	36 21

P	30.3°			
	G at P	G at 760	V at P	V at 760
200	0 016	0.062	5.675	21.57
300	0 024	0 061	8 368	21 20
400	0 031	0 060	11 03	20 95
500	0 039	0 059	13 67	20 77
600	0 047	0 059	16 29	20 64
760	0 059	0 059	20 50	20 50
800	0 062	0 059	21 58	20 50
1000	0 077	0 058	26 54	20 40
1500	0 113	0 057	39.05	20 09
2000	0 149	0 057	52 11	19 80

P	50°			
	G at P	G at 760	V at P	V at 760
200	0 012	0 045	4 156	15 97
400	0 024	0 045	8 275	15 72
600	0 035	0 045	12 36	15 65
760	0 045	0 045	15 62	15 62
800	0 047	0 045	16 43	15 60
1000	0 059	0 045	20 51	15 59
1500	0 088	0 044	30 73	15 57
2000	0 012	0 044	39 07	15.55

(Sims, A. 118. 340.)

1 g. H<sub>2</sub>O dissolves 0.0909 g SO<sub>2</sub> = 34.73 cc. (at 25°) at 25° and 748 mm. pressure. (Walden and Centnerszwer, Z. phys. Ch 1901, 42. 402.)

Solubility of SO<sub>2</sub> in H<sub>2</sub>O at t° and 760 mm. pressure.

t°	G SO <sub>2</sub> per 1 g H <sub>2</sub> O	t°	G SO <sub>2</sub> per 1 g H <sub>2</sub> O
0	0.236	7	0.176
2	0.218	8	0.168
4	0.201	10	0.154
6	0.184	12	0.142

(Roozeboom, R. t. c 1884, 3. 29)

From a gas containing 10% by vol. of SO<sub>2</sub> at 10°, 1.63% by wt. is dissolved by 1 litre of H<sub>2</sub>O; if the pressure is increased to 5 atmospheres, 8.14% by wt is dissolved. (Harpf, Chem. Zeitsch., 1905, 4. 136)

Solubility of SO<sub>2</sub> in H<sub>2</sub>O at t°.

C = g. SO<sub>2</sub> in 1 cc of the solution.

P = Pressure in mm of Hg

t°	C	P	$\frac{C}{P} \times 10^4$
0	0.000537	0.4	13.4
"	0.00237	3.5	6.78
"	0.01227	29.4	4.17
"	0.03804	109.4	3.48
25	0.000534	1.4	3.81
"	0.00234	11.75	2.00
"	0.01212	87.9	1.379
"	0.03750	313.0	1.198
50	0.000525	4.9	1.07
"	0.002276	30.5	0.746
"	0.01181	204.5	0.577
"	0.03628	696.0	0.521

(Lindner, M. 1912, 33. 645.)

Sp. gr. of sat solution at—

0° 10° 20° 40°

1.06091 1.05472 1.02386 0.95548

(Bunsen and Schönfeld, A. 95. 2.)

Sat. SO<sub>2</sub>+Aq has sp. gr.=1.0040. (Berthollet.)

Sp. gr of sat. SO<sub>2</sub>+Aq at t°.

t°	Sp. gr	t°	Sp. gr	t°	Sp. gr
0	1.0609	9	1.0548	17	1.0358
1	1.0596	10	1.0547	18	1.0321
2	1.0585	11	1.0528	19	1.0281
3	1.0576	12	1.0505	20	1.0239
4	1.0569	13	1.0481	21	1.0195
5	1.0562	14	1.0454	22	1.0147
6	1.0557	15	1.0424	23	1.0099
7	1.0552	16	1.0392	24	0.9991
8	1.0549	..	..	..	..

(Schiff, A. 107. 312.)

Sp. gr. of SO<sub>2</sub>+Aq at 4°.

% SO <sub>2</sub>	Sp. gr.	% SO <sub>2</sub>	Sp. gr.	% SO <sub>2</sub>	Sp. gr.
1	1.0024	8	1.0217	15	1.0445
2	1.0049	9	1.0247	16	1.0480
3	1.0075	10	1.0278	17	1.0517
4	1.0102	11	1.0311	18	1.0553
5	1.0130	12	1.0343	19	1.0591
6	1.0158	13	1.0376	20	1.0629
7	1.0187	14	1.0410	21	1.0667

(Schiff, calculated by Gerlach, Z. anal. 8. 292)

Sp gr of SO<sub>2</sub>+Aq.

% SO <sub>2</sub>	Temp	Sp. gr
0.99	15.5°	1.0051
2.05	"	1.0102
2.87	"	1.0148
4.01	"	1.0204
4.99	"	1.0252
5.89	"	1.0297
7.01	"	1.0353
8.08	"	1.0399
8.68	"	1.0438
9.80	"	1.0492
10.75	"	1.0541
11.65	12.5°	1.0597
13.09	11.0°	1.0668

(Giles and Scheerer, Jour. Soc. Ch. Ind 4. 303.)

Sp gr of SO<sub>2</sub>+Aq

% SO <sub>2</sub>	Sp. gr.	% SO <sub>2</sub>	Sp. gr.	% SO <sub>2</sub>	Sp. gr.
1	1.0052	4	1.0167	7	1.0283
2	1.0094	5	1.0208	8	1.0329
3	1.0134	6	1.0242	9	1.0402

(Anthon.)

Sp gr. of SO<sub>2</sub>+Aq.

% SO <sub>2</sub>	Sp. gr	% SO <sub>2</sub>	Sp. gr	% SO <sub>2</sub>	Sp. gr.
1	1.0042	5	1.0210	8	1.0348
2	1.0083	6	1.0252	9	1.0392
3	1.0125	7	1.0295	10	1.0438
4	1.0167	.	.	.	.

(Hager, Adjumenta varia, Leipzig, 1876. 146)

Sp. gr. of  $\text{SO}_2 + \text{Aq}$  at  $15^\circ$ 

$\text{SO}_2$	Sp. gr.	% $\text{SO}_2$	Sp. gr.	% $\text{SO}_2$	Sp. gr.
0.5	1.0028	4.0	1.0221	7.5	1.0401
1.0	1.0056	4.5	1.0248	8.0	1.0426
1.5	1.0085	5.0	1.0275	8.5	1.0450
2.0	1.0113	5.5	1.0302	9.0	1.0474
2.5	1.0141	6.0	1.0328	9.5	1.0497
3.0	1.0168	6.5	1.0353	10.0	1.0520
3.5	1.0194	7.0	1.0377		

(Scott, Polyt. Centralbl. 1873. 826.)

Conc.  $\text{H}_2\text{SO}_4$  absorbs 0.009 pt. by weight (58 vols.), and  $\text{SO}_2$  is more soluble in dilute  $\text{H}_2\text{SO}_4 + \text{Aq}$ , the more  $\text{H}_2\text{O}$  there is present. (Kolb, Dmgl. 209. 270.)

Solubility in  $\text{H}_2\text{SO}_4$ 

Sp. gr. of $\text{H}_2\text{SO}_4$	Absorbs $\text{SO}_2$ per kg.	Absorbs $\text{SO}_2$ per litre
1.841	0.009	5.8
1.839	0.014	8.9
1.840	0.021	11.2
1.407	0.032	15.9
1.227	0.068	20.7
1.020	0.135	49.0

(Kolb, Bull. Soc. Ind. Mulhouse, 1872. 224.)

Coefficient of absorption for  $\text{H}_2\text{SO}_4$  (1.841 sp. gr. at  $15^\circ$  and 760 mm.) is 23.14 at  $17^\circ$ , and 28.86 at  $16^\circ$ . (Dunn, C. N. 43. 121.)

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{SO}_4$  of 1.84 sp. gr.

$t^\circ$	Sp. gr. solution	Coeff. of absorption (760 mm.)	$t^\circ$	Sp. gr. solution	Coeff. of absorption (760 mm.)
0		53	50	1.8186	9.5
10	1.8232	35.0	60	1.8165	7.0
20	1.8225	25.0	70	1.8140	5.5
25	1.8221	21.0	80	1.8112	4.5
30	1.8216	18.0	90	1.8080	4.0
40	1.8205	13.0			...

(Dunn, C. N. 1882. 45. 272. Calc. by Seidell, Solubilities, 1st Ed.)

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$ 

$t^\circ$	Sp. gr. of $\text{H}_2\text{SO}_4$ solution	Approx. % $\text{H}_2\text{SO}_4$	Coeff. of absorption	$t^\circ$	Sp. gr. of $\text{H}_2\text{SO}_4$ solution	Approx. % $\text{H}_2\text{SO}_4$	Coeff. of absorption
6.9	1.139	20	48.67	15.2	1.173	25	31.82
6.9	1.300	40	45.38	16.8	1.151	21	31.66
8.6	1.482	58	39.91	14.8	1.277	36	30.41
9.8	1.703	78	29.03	15.1	1.458	56	29.87
5.5	0.67	10	36.78	15.6	1.609	70	25.17
6.6	1.102	15	34.08	15.0	1.739	81	20.83

(Dunn, C. N. 1882. 45. 272. Seidell, Solubilities, 1st Ed.)

Coefficient of absorption in  $\text{H}_2\text{SO}_4$  (sp. gr. = 1.841) = 5.8; (sp. gr. = 1.839) = 8.9. (Lunge.)

Solubility in salts + Aq at  $35^\circ$ .l = coefficient of absorption of  $\text{SO}_2$  in the given salt solution at  $35^\circ$ .lo = coefficient of absorption of  $\text{SO}_2$  in water at  $35^\circ$  = 22.43.

Salt		3-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
KI	1	45.43	41.87	38.04	34.64	30.25	26.30
	l-lo	23.00	19.44	15.61	12.21	7.82	3.87
KBr	1	36.14	34.12	31.93	29.04	27.49	24.83
	l-lo	13.71	11.69	9.50	7.21	5.01	2.40
KCl	1	30.02	28.93	27.94	26.54	25.15	23.74
	l-lo	7.59	6.50	5.31	4.11	2.72	1.31
KCNS	1	42.94	38.13	35.05	32.03	28.79	25.63
	l-lo	18.51	15.70	12.62	9.60	6.36	3.20
$\text{NH}_4\text{NO}_3$	1	27.43	26.66	25.57	24.78	24.23	23.35
	l-lo	5.00	4.23	3.14	2.35	1.80	0.92
$\text{KNO}_3$	1	27.33	26.54	25.72	24.79	24.03	23.27
	l-lo	4.90	4.11	3.29	2.36	1.60	0.84

Solubility in salts + Aq at 35°.—*Continued*

l = coefficient of absorption of SO<sub>2</sub> in the given salt solution at 35°  
 lo = coefficient of absorption of SO<sub>2</sub> in water at 35° = 22.43

Salt		3 normal	2.5-normal	2 normal	1.5-normal	1-normal	0.5-normal
$\frac{1}{2}(\text{NH}_4)_2\text{SO}_4$	l	24.60	24.23	23.93	23.49	23.14	22.91
	l-lo	2.17	1.80	1.50	1.06	0.71	0.48
$\frac{1}{2}\text{CdI}_2$	l	24.30	23.99	23.71	23.38	23.06	22.75
	l-lo	1.87	1.56	1.28	0.95	0.63	0.32
$\frac{1}{2}\text{Na}_2\text{SO}_4$	l	19.27	19.79	20.20	20.81	21.35	21.88
	l-lo	-3.16	-2.64	-2.23	-1.62	-1.08	-0.55
$\frac{1}{2}\text{CdBr}_2$	l	19.17	19.70	20.60	20.81	21.46	21.88
	l-lo	-3.26	-2.73	-1.83	-1.62	-0.97	-0.55
$\frac{1}{2}\text{CdCl}_2$	l	18.68	19.23	20.02	20.55	21.23	21.73
	l-lo	-3.75	-3.20	-2.41	-1.88	-1.20	-0.70
$\frac{1}{2}\text{CdSO}_4$	l	16.25	17.41	18.31	19.42	20.43	21.45
	l-lo	-6.81	-5.02	-4.12	-3.01	-2.00	-0.98

## Solubility in salts + Aq at 25°.

l = coefficient of absorption of SO<sub>2</sub> in the given solution at 25°.  
 lo = coefficient of absorption of SO<sub>2</sub> in water at 25° = 32.76.

Salt		3-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
KI	l	68.36	62.63	56.75	50.58	44.76	38.66
	l-lo	35.60	29.87	23.99	17.82	12.00	5.90
$\frac{1}{2}\text{CdI}_2$	l	35.77	34.98	34.74	34.16	33.76	33.27
	l-lo	3.01	2.22	1.98	1.40	1.00	0.51
NH <sub>4</sub> Br	l	52.25	49.17	46.06	42.78	39.46	36.28
	l-lo	19.49	16.41	13.30	10.02	6.70	3.52
KBr	l	52.26	48.87	44.96	42.41	39.11	35.94
	l-lo	19.00	15.71	12.70	9.15	6.35	3.18
NaBr	l	37.74	36.84	36.26	35.27	34.54	33.76
	l-lo	4.98	4.08	3.50	2.51	1.78	1.00
$\frac{1}{2}\text{CdBr}_2$	l	27.46	28.15	29.27	30.17	31.01	31.91
	l-lo	-5.30	-4.61	-3.49	-2.59	-1.75	-0.85
NH <sub>4</sub> Cl	l	42.78	41.37	39.76	38.06	36.37	34.58
	l-lo	10.02	8.61	7.00	5.30	3.61	1.80
KCl	l	42.27	40.96	39.32	37.76	36.05	34.42
	l-lo	9.51	8.20	6.56	5.00	3.29	1.66

## Solubility in salts + Aq at 25°—Continued.

l = coefficient of absorption of SO<sub>2</sub> in the given solution at 25°.l<sub>0</sub> = coefficient of absorption of SO<sub>2</sub> in water at 25° = 32.76.

Salt		2-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
NaCl	l	31.36	31.51	31.76	31.96	32.25	32.46
	l-l <sub>0</sub>	-1.40	-1.25	-1.00	-0.80	-0.51	-0.30
$\frac{1}{2}$ CdCl <sub>2</sub>	l	26.06	27.09	28.16	29.46	30.55	31.66
	l-l <sub>0</sub>	-6.70	-5.67	-4.60	-3.30	-2.21	-1.10
NH <sub>4</sub> CNS	l	61.46	57.01	52.26	47.26	42.74	37.78
	l-l <sub>0</sub>	28.70	24.25	19.50	14.50	9.98	5.02
KCNS	l	61.26	55.87	51.86	47.02	42.38	37.57
	l-l <sub>0</sub>	28.50	23.11	19.10	14.26	9.62	4.81
NaCNS	l	48.34	45.86	43.37	40.78	38.24	35.44
	l-l <sub>0</sub>	15.58	13.10	10.61	8.02	5.48	2.68
NH <sub>4</sub> NO <sub>3</sub>	l	39.14	38.01	37.27	36.28	35.07	33.96
	l-l <sub>0</sub>	6.38	5.25	4.51	3.52	2.31	1.20
KNO <sub>3</sub>	l	38.52	37.57	36.66	35.77	34.79	33.80
	l-l <sub>0</sub>	5.76	4.81	3.90	3.01	2.03	1.04
$\frac{1}{2}$ (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	l	35.96	35.47	34.95	34.34	33.82	33.35
	l-l <sub>0</sub>	3.20	2.71	2.19	1.58	1.06	0.59
$\frac{1}{2}$ K <sub>2</sub> SO <sub>4</sub>	l	..	..	..	..	33.61	33.20
	l-l <sub>0</sub>	..	..	..	..	0.85	0.48
$\frac{1}{2}$ Na <sub>2</sub> SO <sub>4</sub>	l	28.44	28.66	29.51	30.45	31.14	31.93
	l-l <sub>0</sub>	-4.32	-4.10	-3.25	-2.31	-1.62	-0.80
$\frac{1}{2}$ CdSO <sub>4</sub>	l	23.76	25.14	26.58	28.24	29.71	31.11
	l-l <sub>0</sub>	-9.00	-7.62	-6.18	-4.52	-3.05	-1.85

(Fox, Z. phys. Ch. 1902, 41. 462.)

Sol. in Cl<sub>2</sub> + Aq. Sol. in Br<sub>2</sub>. Solidification curves determined (Van der Goot, Z. phys. Ch. 1913, 84. 419.)

Solubility of  $\text{SO}_2$  in alcohol. 1 vol alcohol at  $t^\circ$  and 760 mm. dissolves V vols  $\text{SO}_2$  gas at  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	328.62	9	201.33	17	130.61
1	311.98	10	190.31	18	124.58
2	295.97	11	179.91	19	119.17
3	280.58	12	170.13	20	114.48
4	265.81	13	160.98	21	110.22
5	251.67	14	152.45	22	106.68
6	238.16	15	144.55	23	103.77
7	225.26	16	137.27	24	101.47
8	212.98				

(Bunsen's Gasometry.)

100 pts. absolute methyl alcohol dissolve 247 pts.  $\text{SO}_2$  at  $0^\circ$  and 760 mm.; 47 pts. at  $26^\circ$  and 760 mm.; 100 pts. absolute ethyl alcohol dissolve 115 pts.  $\text{SO}_2$  at  $0^\circ$  and 760 mm.; 32.3 pts. at  $26^\circ$  and 760 mm. (de Bruyn, Z. phys. Ch. 10, 783.)

Sol. in ether.

Absorbed by oil of turpentine.

Rapidly absorbed by anhydrous aldehyde in the cold, 11 pts. aldehyde absorbing 19 pts.  $\text{SO}_2$ .

Absorption coefficient of aldehyde for  $\text{SO}_2$  is 1.4 times greater than that of alcohol, and 7 times greater than that of  $\text{H}_2\text{O}$ . (Geuther and Cartmell, Proc. Roy. Soc. 10, 111.)

1 pt. camphor dissolves 0.880 pt. by weight (=308 vols.)  $\text{SO}_2$  at  $0^\circ$  and 725 mm.; 1 pt. glacial  $\text{HC}_2\text{H}_3\text{O}_2$  dissolves 0.961 pt. by weight (=318 vols.)  $\text{SO}_2$  at  $0^\circ$  and 725 mm.; 1 pt. formic acid dissolves 0.821 pt. by weight (=351 vols.)  $\text{SO}_2$  at  $0^\circ$  and 725 mm.; 1 pt. acetone dissolves 2.07 pts. by weight (=589 vols.)  $\text{SO}_2$  at  $0^\circ$  and 725 mm.; 1 pt. sulphuryl chloride dissolves 0.323 pt. by weight (=187 vols.)  $\text{SO}_2$  at  $0^\circ$  and 725 mm. (Schulze, J. pr. (2) 24, 168.)

Solubility of  $\text{SO}_2$  in  $\text{CHCl}_3$ .

C = g.  $\text{SO}_2$  in 1 cc. of the solution

P = Pressure in mm Hg.

$t^\circ$	C	P	$\frac{C}{P} \times 10^4$
0	0.000701	2.7	2.6
"	0.001790	5.6	3.14
"	0.006982	22.0	3.17
"	0.03097	90.2	3.43
"	0.08217	219.6	3.74
25	0.000869	5.7	1.17
"	0.001712	12.9	1.37
"	0.006723	48.0	1.40
"	0.02954	206.2	1.47
"	0.07839	488.8	1.60

(Lindner, M. 1912, 33, 645.)

Distribution of  $\text{SO}_2$  between  $\text{H}_2\text{O}$  and  $\text{CHCl}_3$  at  $20^\circ$ .

$c_1$  = g.  $\text{SO}_2$  per l. of  $\text{H}_2\text{O}$  solution.

$c_2$  = g.  $\text{SO}_2$  per l. of  $\text{CHCl}_3$  solution.

$C_1$	$C_2$	$C_1/C_2$
1.738	1.123	1.55
1.753	1.122	1.56
2.326	1.704	1.37
2.346	1.703	1.38
2.628	1.897	1.38
3.039	2.395	1.27
3.058	2.385	1.28
3.686	3.063	1.20
3.735	3.062	1.22
4.226	3.626	1.17
5.269	4.798	1.10
5.372	4.813	1.12
6.588	6.183	1.07
31.92	33.84	0.94
33.26	37.25	0.89

(McCrae, Z. anorg. 1903, 35, 12.)

Distribution of  $\text{SO}_2$  between  $\text{HCl}$  + Aq and  $\text{CHCl}_3$  at  $20^\circ$ .

$c_1$  = g.  $\text{SO}_2$  per l. of  $\text{HCl}$  + Aq solution

$c_2$  = g.  $\text{SO}_2$  per l. of  $\text{CHCl}_3$  solution.

$\text{HCl}$  = normality of  $\text{HCl}$  + Aq used

$\text{HCl}$	$C_1$	$C_2$	$C_1/C_2$
0.05-N	1.86	1.46	1.28
	3.076	2.830	1.08
	4.277	4.07	1.04
	5.340	5.42	0.96
0.1-N	1.25	1.41	0.88
	1.324	1.416	0.93
	2.78	3.08	0.90
	3.86	4.08	0.94
0.2-N	5.161	5.715	0.90
	1.268	1.509	0.84
	1.914	2.274	0.84
	2.464	3.040	0.81
0.4-N	3.967	4.898	0.81
	1.202	1.614	0.79
	1.894	2.263	0.83

(McCrae, Z. anorg. 1903, 35, 14.)

Sulphur dioxide ammonia,  $\text{SO}_2, \text{NH}_3$ .

Very hygroscopic. Easily sol. in  $\text{H}_2\text{O}$  with decomp. (Schumann, Z. anorg. 1900, 23, 49.)

$\text{SO}_2, 2\text{NH}_3$ . Somewhat hygroscopic. Sol. in  $\text{H}_2\text{O}$  with evolution of  $\text{NH}_3$ . (Schumann, Z. anorg. 1900, 23, 50.)

$\text{SO}_2, 4\text{NH}_3$ . Very deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Divers and Ogawa, Chem. Soc. 1901, 79, 1103.)

Sulphur trioxide,  $\text{SO}_3$ .

Fumes on air. Miscible with  $\text{H}_2\text{O}$ , with evolution of much heat. Sol. in  $\text{H}_2\text{SO}_4$ . De-comp. by alcohol and ether.

Exists in two modifications, one of which is liquid and miscible with  $\text{H}_2\text{SO}_4$ , while the solid form is only slowly sol therein.

Miscible with  $\text{CS}_2$  at  $30^\circ$ , but at  $15^\circ$   $\text{CS}_2$  dissolves only  $\frac{1}{2}$  pt.  $\text{SO}_2$ , and  $\text{SO}_2$   $\frac{1}{2}$  pt.  $\text{CS}_2$ . (Schultz-Sellack, Pogg. 139, 480.)

There is only one modification, the liquid, which absorbs  $\text{H}_2\text{O}$  and becomes solid. (Rebs, A. 246, 356.)

Miscible with liquid  $\text{SO}_2$ . (Schultz-Sellack.)

See also Sulphuric acid.

### Sulphur heptoxide, $\text{S}_2\text{O}_7$

Fumes on air. Slowly decomp. at  $0^\circ$ , instantaneously on warming. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Berthelot, J. pr. (2) 17, 48.)

Forms compound  $\text{S}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$ .

Formula is  $\text{SO}_3$  according to Traube (B. 24, 1784), and  $\text{S}_2\text{O}_7$  in  $\text{SO}_2 + \text{SO}_3$ .

See also Marshall (Chem. Soc. 69, 771).

Traube (B. 26, 148) denies the existence of  $\text{SO}_4$ .

### Sulphur oxybromide, $\text{SOBr}_2$ .

See Thionyl bromide.

### Sulphur oxychloride, $\text{SOCl}_2$ .

See Thionyl chloride.

$\text{SO}_2\text{Cl}_2$ . See Sulphuryl chloride.

$\text{S}_2\text{O}_2\text{Cl}_2$ . See Pyrosulphuryl chloride.

$\text{HSO}_2\text{Cl}$ . See Sulphuryl hydroxyl chloride.

$\text{S}_2\text{OCl}_2$ . Decomp. by  $\text{H}_2\text{O}$  and alcohol.

(Ogier, C. R. 94, 446.)

Mixture of about  $17\text{SOCl}_2 + 2\text{SOCl}_2$  and  $5\text{SO}_2\text{Cl}_2$ . (Knoll, B. 1898, 81, 2183.)

### Sulphur oxytetraachloride, $\text{S}_2\text{O}_4\text{Cl}_4$ .

Violently decomp. by  $\text{H}_2\text{O}$ , dil. acids, or alcohol. (Millon, A. ch. (3) 29, 327.)

Sol. in warm  $\text{S}_2\text{Cl}_2$ . (Carus, A. 106, 295.)

Decomp. violently with  $\text{CS}_2$ .

### Sulphur oxyfluoride, $\text{SO}_2\text{F}_2$ .

See Sulphuryl fluoride.

$\text{SOF}_2$ . See Thionyl fluoride.

### Sulphur diphosphide, $\text{P}_2\text{S}_2$ .

See Phosphorus monosulphide.

### Sulphur tetraphosphide, $\text{P}_4\text{S}_4$ .

See Phosphorus semisulphide.

### Sulphuretted hydrogen, $\text{H}_2\text{S}$ .

See Hydrogen sulphide.

### Sulphuric acid, $\text{H}_2\text{SO}_4$ .

Miscible with  $\text{H}_2\text{O}$  in all proportions.

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$ 

Baume degrees	Sp. gr.	% $\text{H}_2\text{SO}_4$	Baume degrees	Sp. gr.	% $\text{H}_2\text{SO}_4$
06	1.842	100	60	1.841	100
00	1.725	84.22	60	1.717	82.31
55	1.018	74.32	65	1.618	74.32
50	0.921	66.45	64	1.603	72.70
45	1.106	58.02	54	1.586	71.17
40	1.375	50.41	52	1.566	69.30
35	1.315	43.21	51	1.530	68.03
30	1.200	39.22	60	1.422	66.45
25	1.210	30.12	19	1.515	64.37
20	1.162	24.01	48	1.500	62.80
15	1.114	17.40	47	1.482	61.32
10	1.070	11.73	46	1.460	59.85
5	1.023	6.60	45	1.454	58.02

(Vauquelin, A. ch. 76, 290.)

(Darcet, A. ch. (2) 1, 198.)

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$ 

% $\text{H}_2\text{SO}_4$	Sp. gr. at $15^\circ$	Sp. gr. at $25^\circ$	% $\text{H}_2\text{SO}_4$	Sp. gr. at $15^\circ$	Sp. gr. at $25^\circ$
0	0.0080	0.0055	50	1.8368	1.3780
2.5	1.0115	1.0115	55	1.4347	
5	1.0284	1.0272	60	1.4890	1.4787
10	1.0650	1.0604	65	1.5402	
15	1.0908	1.0870	70	1.5914	1.5803
20	1.1378	1.1311	75	1.6534	
25	1.1797	1.1707	80	1.7082	1.6996
30	1.2154	1.2078	85	1.7602	
35	1.2502	1.2430	90	1.8150	1.7940
40	1.2870	1.2895	95	1.8318	
45	1.3400		100	1.8400	1.8285

(Delezenne, 1823.)

Sp. gr. at  $15.56^\circ$ , and h. pt. of  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Sp. gr.	% $\text{SO}_2$	B. pt.	Sp. gr.	% $\text{SO}_2$	B. pt.
1.850	81	328*	1.769	87	217*
1.849	80	318	1.757	60	210
1.848	79	310	1.744	65	205
1.847	78	301	1.730	64	200
1.845	77	293	1.715	63	195
1.842	76	285	1.699	62	190
1.838	75	277	1.694	61	185
1.833	74	268	1.679	60	182
1.827	73	260	1.650	58.6	177
1.819	72	253	1.620	56	143
1.810	71	245	1.498	40	127
1.801	70	238	1.300	30	115
1.791	69	230	1.200	20	107
1.780	68	224	1.100	10	103

(Dalton, X.  $\text{S}_2$  at 2, 210.)

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ .

Sp. gr.	% $\text{SO}_2$	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{SO}_2$	% $\text{H}_2\text{SO}_4$
1.8488	81.54	100	1.6975	57.08	70
1.8460	79.90	98	1.5700	65.45	68
1.8410	78.28	96	1.5504	53.82	60
1.8390	76.66	91	1.5290	52.18	64
1.8233	75.02	02	1.5096	50.55	62
1.8115	73.30	00	1.4800	48.92	60
1.7902	71.75	88	1.4600	47.29	68
1.7771	70.12	86	1.4400	45.66	66
1.7670	68.40	84	1.4205	44.03	64
1.7300	66.58	82	1.4073	42.40	62
1.7120	64.23	80	1.3884	40.77	60
1.6870	63.00	78	1.3697	39.14	48
1.0030	61.97	76	1.3430	37.51	40
1.6415	60.34	74	1.3315	35.88	44
1.6204	58.71	72	1.3105	34.25	42

Sp gr of  $H_2SO_4 + Aq$  at  $15^\circ$ —Continued

Sp gr	% $SO_3$	% $H_2SO_4$	Sp gr	% $SO_3$	% $H_2SO_4$
1 2960	32.61	40	1 1410	16.31	20
1 2321	30.98	38	1 1240	14.68	18
1 2534	29.35	36	1 1060	13.05	16
1 2190	27.72	34	1 0853	11.41	14
1 2334	27.09	32	1 0849	9.78	12
1 2184	25.46	30	1 0822	8.15	10
1 2032	23.83	28	1 0814	6.52	8
1 1876	22.20	26	1 0405	4.89	6
1 1708	20.57	24	1 0238	3.26	4
1 1549	18.94	22	1 0140	1.63	2

(Ure, Schw J 25, 144)

Sp gr of  $H_2SO_4 + Aq$ 

Degrees Baume	Sp gr	At $0^\circ$		At $15^\circ$	
		% $SO_3$	% $H_2SO_4$	% $SO_3$	% $H_2SO_4$
5	1 036	5.1	4.2	5.4	4.5
10	1 075	10.3	8.4	10.9	8.9
15	1 119	15.5	12.7	16.3	13.3
20	1 161	21.2	17.3	22.4	18.3
25	1 200	27.2	22.2	28.3	23.1
30	1 242	33.0	27.4	34.8	28.4
35	1 286	37.0	30.7	38.9	31.8
40	1 329	40.1	33.0	41.6	34.0
45	1 372	43.1	34.1	43.0	35.1
50	1 415	45.1	35.2	44.3	36.2
55	1 457	46.5	35.8	45.6	37.2
60	1 500	47.9	37.5	46.9	38.3
65	1 543	49.3	38.6	48.4	39.5
70	1 587	50.0	39.7	49.9	40.7
75	1 630	51.4	41.9	52.5	42.9
80	1 673	52.8	43.1	54.0	44.1
85	1 716	54.3	44.3	55.4	45.2
90	1 759	55.7	45.5	56.9	46.4
95	1 802	57.1	46.6	58.2	47.5
100	1 845	58.5	47.8	59.6	48.7
105	1 888	60.0	49.0	61.1	50.0
110	1 930	61.4	50.1	62.6	51.1
115	1 973	62.9	51.3	63.9	52.2
120	2 015	64.4	52.6	65.4	53.4
125	2 058	65.9	53.8	66.0	54.6
130	2 097	67.4	55.0	68.4	55.8
135	2 135	68.9	56.2	70.0	57.1
140	2 174	70.5	57.5	71.0	58.4
145	2 212	72.1	58.8	72.2	59.7
150	2 251	73.6	60.1	74.7	61.0
155	2 289	75.2	61.4	76.3	62.3
160	2 327	76.9	62.8	78.0	63.6
165	2 365	78.4	64.2	79.8	65.1
170	2 403	80.0	65.7	81.7	66.7
175	2 441	81.6	67.2	83.9	68.5
180	2 479	83.2	69.0	85.3	70.4
185	2 517	84.8	71.3	86.5	73.0
190	2 555	86.4	72.2	91.8	74.9
195	2 593	88.0	73.8	94.5	77
200	2 631	90.0	75.5	100.0	81.6

(Bureau A ch. (3) 25, 121)

The sp gr. found at  $t^\circ$  can be reduced to sp. gr. at  $0^\circ$  by multiplying by  $\frac{144.38}{144.38 - t}$ , or by using the following table. (Bureau)

Correction of sp gr. for temperature, to be added for a lowering of the temp. of  $10^\circ$ , or subtracted for a corresponding increase

Sp gr. of acid at $0^\circ$	Corr.	Sp gr. of acid at $0^\circ$	Corr.	Sp gr. of acid at $0^\circ$	Corr.
1.04	0.002	1.15	0.005	1.45	0.008
1.07	0.003	1.20	0.006	1.70	0.009
1.10	0.004	1.30	0.007	1.85	0.009

(Bureau)

Sp gr. of  $H_2SO_4 + Aq$  at  $15^\circ$ . a = %; b = sp. gr. if % is  $SO_3$ ; c = sp. gr. if % is  $H_2SO_4$ .

a	b	c	a	b	c
1	1.009	1.0064	51	1.530	1.408
2	1.017	1.013	52	1.545	1.418
3	1.025	1.019	53	1.556	1.428
4	1.034	1.0256	54	1.573	1.438
5	1.041	1.032	55	1.585	1.448
6	1.049	1.039	56	1.600	1.4586
7	1.058	1.0464	57	1.615	1.469
8	1.067	1.0536	58	1.627	1.480
9	1.076	1.061	59	1.642	1.490
10	1.085	1.068	60	1.653	1.510
11	1.095	1.0756	61	1.675	1.512
12	1.104	1.083	62	1.689	1.523
13	1.114	1.091	63	1.701	1.534
14	1.123	1.098	64	1.716	1.545
15	1.133	1.106	65	1.730	1.557
16	1.142	1.1136	66	1.742	1.578
17	1.150	1.121	67	1.755	1.580
18	1.160	1.129	68	1.770	1.592
19	1.170	1.136	69	1.781	1.604
20	1.180	1.144	70	1.792	1.615
21	1.190	1.1516	71	1.802	1.627
22	1.200	1.159	72	1.810	1.639
23	1.210	1.167	73	1.819	1.651
24	1.220	1.174	74	1.825	1.663
25	1.229	1.182	75	1.830	1.675
26	1.239	1.190	76	1.834	1.686
27	1.248	1.198	77	1.837	1.698
28	1.258	1.2066	78	1.839	1.710
29	1.268	1.215	79	1.841	1.722
30	1.278	1.223	80	1.842	1.734
31	1.288	1.231	81	..	1.745
32	1.300	1.239	82	..	1.756
33	1.310	1.2476	83	..	1.767
34	1.320	1.256	84	..	1.777
35	1.332	1.264	85	..	1.786
36	1.344	1.272	86	..	1.794
37	1.354	1.281	87	..	1.802
38	1.367	1.289	88	..	1.809
39	1.378	1.2976	89	..	1.816
40	1.390	1.306	90	..	1.822
41	1.401	1.315	91	..	1.827
42	1.415	1.324	92	..	1.831
43	1.427	1.333	93	..	1.834
44	1.440	1.342	94	..	1.836
45	1.451	1.351	95	..	1.8376
46	1.465	1.361	96	..	1.8384
47	1.478	1.370	97	..	1.840
48	1.490	1.379	98	..	1.8406
49	1.501	1.3886	99	..	1.842
50	1.517	1.398	100	..	1.8426

(Bureau, calculated by Gerlach, Z anal 8, 292)

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ ,  $\text{H}_2\text{O}$  at  $0^\circ = 1$ .

$\text{H}_2\text{SO}_4$	Sp. gr.	$\text{H}_2\text{SO}_4$	Sp. gr.	$\text{H}_2\text{SO}_4$	Sp. gr.
1	1.006	35	1.264	68	1.592
2	1.012	36	1.272	69	1.604
3	1.018	37	1.281	70	1.615
4	1.025	38	1.290	71	1.626
5	1.032	39	1.298	72	1.638
6	1.039	40	1.307	73	1.650
7	1.046	41	1.316	74	1.662
8	1.053	42	1.324	75	1.674
9	1.061	43	1.333	76	1.684
10	1.069	44	1.342	77	1.697
11	1.076	45	1.352	78	1.710
12	1.084	46	1.361	79	1.721
13	1.091	47	1.370	80	1.732
14	1.099	48	1.379	81	1.743
15	1.106	49	1.389	82	1.753
16	1.114	50	1.399	83	1.763
17	1.122	51	1.409	84	1.773
18	1.129	52	1.418	85	1.783
19	1.137	53	1.428	86	1.792
20	1.145	54	1.438	87	1.800
21	1.153	55	1.448	88	1.807
22	1.161	56	1.459	89	1.814
23	1.168	57	1.469	90	1.820
24	1.176	58	1.480	91	1.825
25	1.184	59	1.491	92	1.8294
26	1.191	60	1.501	93	1.8339
27	1.199	61	1.512	94	1.8372
28	1.207	62	1.523	95	1.8390
29	1.215	63	1.535	96	1.8406
30	1.223	64	1.546	97	1.8410
31	1.231	65	1.558	98	1.8412
32	1.239	66	1.569	99	1.8403
33	1.247	67	1.580	100	1.8384
34	1.256				

(From 1-91 % according to Kolb, calculated by Gerlach; from 92-100% according to Lunge and Naef, calculated by Gerlach, Z. anal. 27 316.)

Sp. gr. of  $\text{H}_2\text{SO}_4$  at  $15^\circ$  compared with  $\text{H}_2\text{O}$  at  $4^\circ$  and 0 mm. pressure

Sp. gr.	$\text{SO}_3$	$\text{H}_2\text{SO}_4$	Sp. gr.	$\text{SO}_3$	$\text{H}_2\text{SO}_4$
1.000	0.07	0.09	1.075	8.90	10.90
1.005	0.68	0.83	1.080	9.47	11.60
1.010	1.28	1.57	1.085	10.04	12.30
1.015	1.88	2.30	1.090	10.60	12.99
1.020	2.47	3.03	1.095	11.16	13.67
1.025	3.07	3.76	1.100	11.71	14.35
1.030	3.67	4.49	1.105	12.27	15.07
1.035	4.27	5.23	1.110	12.82	15.71
1.040	4.87	5.96	1.115	13.36	16.36
1.045	5.45	6.67	1.120	13.89	17.01
1.050	6.02	7.37	1.125	14.42	17.66
1.055	6.59	8.07	1.130	14.95	18.31
1.060	7.16	8.77	1.135	15.48	18.96
1.065	7.73	9.47	1.140	16.01	19.61
1.070	8.32	10.19	1.145	16.54	20.26

Sp. gr of  $\text{H}_2\text{SO}_4$ , etc.—Continued

Sp. gr.	$\text{SO}_3$	$\text{H}_2\text{SO}_4$	Sp. gr.	$\text{SO}_3$	$\text{H}_2\text{SO}_4$
1.150	17.07	20.91	1.455	46.31	55.50
1.155	17.59	21.55	1.460	45.69	55.97
1.160	18.11	22.19	1.465	46.07	56.43
1.165	18.64	22.83	1.470	46.45	56.90
1.170	19.06	23.47	1.475	46.83	57.37
1.175	19.69	24.12	1.480	47.21	57.83
1.180	20.21	24.76	1.485	47.57	58.28
1.185	20.73	25.40	1.490	47.95	58.74
1.190	21.26	26.04	1.495	48.34	59.22
1.195	21.78	26.68	1.500	48.73	59.70
1.200	22.30	27.32	1.505	49.12	60.18
1.205	22.82	27.95	1.510	49.51	60.65
1.210	23.33	28.58	1.515	49.89	61.12
1.215	23.84	29.21	1.520	50.28	61.59
1.220	24.36	29.84	1.525	50.66	62.06
1.225	24.88	30.48	1.530	51.04	62.53
1.230	25.39	31.11	1.535	51.43	63.00
1.235	25.88	31.70	1.540	51.78	63.43
1.240	26.35	32.28	1.545	52.12	63.85
1.245	26.83	32.86	1.550	52.46	64.26
1.250	27.29	33.40	1.555	52.79	64.67
1.255	27.76	34.00	1.560	53.12	65.08
1.260	28.22	34.57	1.565	53.46	65.49
1.265	28.69	35.14	1.570	53.80	65.90
1.270	29.15	35.71	1.575	54.13	66.30
1.275	29.62	36.29	1.580	54.46	66.71
1.280	30.10	36.87	1.585	54.80	67.13
1.285	30.57	37.45	1.590	55.18	67.59
1.290	31.04	38.03	1.595	55.55	68.05
1.295	31.52	38.61	1.600	55.93	68.51
1.300	31.99	39.19	1.605	56.30	68.97
1.305	32.46	39.77	1.610	56.68	69.43
1.310	32.94	40.35	1.615	57.05	69.89
1.315	33.41	40.93	1.620	57.40	70.32
1.320	33.88	41.50	1.625	57.75	70.74
1.325	34.35	42.08	1.630	58.09	71.16
1.330	34.80	42.66	1.635	58.43	71.57
1.335	35.27	43.20	1.640	58.74	71.99
1.340	35.71	43.74	1.645	59.10	72.40
1.345	36.14	44.28	1.650	59.45	72.88
1.350	36.58	44.82	1.655	59.78	73.23
1.355	37.02	45.35	1.660	60.11	73.64
1.360	37.45	45.88	1.665	60.46	74.07
1.365	37.89	46.41	1.670	60.82	74.51
1.370	38.32	46.94	1.675	61.20	74.97
1.375	38.75	47.47	1.680	61.57	75.42
1.380	39.18	48.00	1.685	61.93	75.86
1.385	39.62	48.53	1.690	62.29	76.30
1.390	40.05	49.06	1.695	62.64	76.73
1.395	40.48	49.59	1.700	63.00	77.17
1.400	40.91	50.11	1.705	63.35	77.60
1.405	41.33	50.63	1.710	63.70	78.04
1.410	41.76	51.15	1.715	64.07	78.48
1.415	42.17	51.66	1.720	64.43	78.92
1.420	42.57	52.15	1.725	64.78	79.36
1.425	42.96	52.63	1.730	65.14	79.80
1.430	43.36	53.11	1.735	65.50	80.24
1.435	43.75	53.59	1.740	65.86	80.68
1.440	44.14	54.07	1.745	66.22	81.12
1.445	44.53	54.55	1.750	66.58	81.56
1.450	44.92	55.03	1.755	66.94	82.00

Sp. gr. of $\text{H}_2\text{SO}_4$ , etc.—Continued.						Sp. gr. of conc. $\text{H}_2\text{SO}_4$ , etc.—Continued.			
Sp. gr.	% $\text{SO}_2$	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{SO}_2$	% $\text{H}_2\text{SO}_4$	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.
1.760	67.30	82.44	1.829	75.03	91.90	95.61	1.8414	93.32	1.8352
1.765	67.65	82.88	1.830	75.19	92.10	95.55	1.8413	93.29	1.8351
1.770	68.02	83.32	1.831	75.35	92.30	95.50	1.8412	93.26	1.8350
1.775	68.49	83.90	1.832	75.53	92.52	95.45	1.8411	93.23	1.8349
1.780	68.98	84.50	1.833	75.72	92.75	95.40	1.8410	93.20	1.8348
1.785	69.74	85.10	1.834	75.90	93.05	95.35	1.8409	93.17	1.8347
1.790	69.96	85.70	1.835	76.27	93.43	95.30	1.8408	93.14	1.8346
1.795	70.45	86.30	1.836	76.57	93.80	95.25	1.8407	93.12	1.8345
1.800	70.94	86.90	1.837	76.90	94.20	95.21	1.8406	93.09	1.8344
1.805	71.50	87.60	1.838	77.23	94.60	95.16	1.8405	93.06	1.8343
1.810	72.08	88.30	1.839	77.55	95.00	95.12	1.8404	93.00	1.8342
1.815	72.69	89.05	1.840	78.04	95.60	95.08	1.8403	92.98	1.8341
1.820	73.51	90.05	1.8405	78.33	95.95	95.04	1.8402	92.95	1.8340
1.821	73.63	90.20	1.8415	79.19	97.00	95.00	1.8401	92.93	1.8338
1.822	73.80	90.40	1.8410	79.76	97.70	94.96	1.8400	92.90	1.8337
1.823	73.96	90.60	1.8415	80.16	98.20	94.92	1.8399	92.87	1.8336
1.824	74.12	90.80	1.8400	80.57	98.70	94.88	1.8398	92.84	1.8335
1.825	74.20	91.00	1.8400	80.98	99.20	94.84	1.8397	92.82	1.8334
1.826	74.49	91.25	1.8395	81.18	99.45	94.81	1.8396	92.79	1.8333
1.827	74.69	91.50	1.8390	81.39	99.70	94.77	1.8395	92.77	1.8332
1.828	74.86	91.70	1.8385	81.59	99.95	94.73	1.8394	92.73	1.8331
(Lunge and Isler, Zest. angew. Ch. 9. 129.)						94.69	1.8393	92.71	1.8330
Sp. gr. of conc. $\text{H}_2\text{SO}_4 + \text{Aq}$ at 15°.						94.65	1.8392	92.69	1.8329
% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.			94.61	1.8391	92.66	1.8328
100	1.8384	99.02	1.8417			94.57	1.8390	92.63	1.8327
99.98	1.8385	98.98	1.8418			94.53	1.8389	92.61	1.8326
99.96	1.8386	98.94	1.8419			94.49	1.8388	92.59	1.8325
99.94	1.8387	98.84	1.8420			94.46	1.8387	92.56	1.8324
99.92	1.8388	98.84	1.8421			94.42	1.8386	92.54	1.8323
99.90	1.8389	98.78	1.8422			94.38	1.8385	92.52	1.8322
99.88	1.8390	98.71	1.8423			94.34	1.8384	92.49	1.8321
99.86	1.8391	98.63	1.8424			94.31	1.8383	92.46	1.8320
99.84	1.8392	98.56	1.8425			94.27	1.8382	92.44	1.8319
99.81	1.8393	98.48	1.8426			94.24	1.8381	92.41	1.8318
99.78	1.8394	98.40	1.8427			94.20	1.8380	92.39	1.8317
99.76	1.8395	98.32	1.8428			94.17	1.8379	92.37	1.8316
99.73	1.8396	98.22	1.8429			94.13	1.8378	92.34	1.8315
99.70	1.8397	98.08	1.8430			94.10	1.8377	92.32	1.8314
99.67	1.8398	97.85	1.8431			94.07	1.8376	92.29	1.8313
99.64	1.8399	97.50	1.8432			94.03	1.8375	92.27	1.8312
99.61	1.8400	97.10	1.8433			94.00	1.8374	92.24	1.8311
95.58	1.8401	96.93	1.8430			93.97	1.8373	92.22	1.8310
95.55	1.8402	96.76	1.8429			93.93	1.8372	92.19	1.8309
95.52	1.8403	96.65	1.8428			93.90	1.8371	92.17	1.8308
95.49	1.8404	96.55	1.8427			93.87	1.8370	92.15	1.8307
95.46	1.8405	96.46	1.8426			93.83	1.8369	92.12	1.8306
95.43	1.8406	96.39	1.8425			93.80	1.8368	92.10	1.8305
95.40	1.8407	96.31	1.8424			93.77	1.8367	92.07	1.8304
95.37	1.8408	96.24	1.8423			93.74	1.8366	92.05	1.8303
95.33	1.8409	96.16	1.8422			93.71	1.8365	92.02	1.8302
95.29	1.8410	96.09	1.8421			93.68	1.8364	92.00	1.8301
95.25	1.8411	96.02	1.8420			93.65	1.8363	91.98	1.8300
95.22	1.8412	95.95	1.8419			93.62	1.8362	91.95	1.8299
95.19	1.8413	95.88	1.8418			93.59	1.8361	91.93	1.8298
95.16	1.8414	95.81	1.8417			93.56	1.8360	91.91	1.8297
95.11	1.8415	95.74	1.8416			93.53	1.8359	91.88	1.8296
95.06	1.8416	95.67	1.8415			93.50	1.8358	91.86	1.8295
						93.47	1.8357	91.84	1.8294
						93.44	1.8356	91.81	1.8293
						93.41	1.8355	91.78	1.8292
						93.38	1.8354	91.76	1.8291
						93.35	1.8353	91.74	1.8290

Sp. gr. of conc. $\text{H}_2\text{SO}_4$ , etc.—Continued.			
% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.
91.72	1.8298	90.78	1.8244
91.70	1.8288	90.76	1.8243
91.68	1.8287	90.74	1.8242
91.65	1.8286	90.72	1.8241
91.63	1.8285	90.70	1.8240
91.61	1.8284	90.68	1.8239
91.59	1.8283	90.66	1.8238
91.56	1.8282	90.64	1.8237
91.54	1.8281	90.62	1.8236
91.52	1.8280	90.60	1.8235
91.50	1.8279	90.59	1.8234
91.47	1.8278	90.57	1.8233
91.45	1.8277	90.55	1.8232
91.43	1.8276	90.53	1.8231
91.41	1.8275	90.51	1.8230
91.39	1.8274	90.49	1.8229
91.37	1.8273	90.47	1.8228
91.35	1.8272	90.46	1.8227
91.32	1.8271	90.44	1.8226
91.30	1.8270	90.42	1.8225
91.28	1.8269	90.40	1.8224
91.26	1.8268	90.38	1.8223
91.24	1.8267	90.37	1.8222
91.22	1.8266	90.35	1.8221
91.20	1.8265	90.33	1.8220
91.18	1.8264	90.31	1.8219
91.16	1.8263	90.29	1.8218
91.14	1.8262	90.28	1.8217
91.12	1.8261	90.26	1.8216
91.10	1.8260	90.24	1.8215
91.08	1.8259	90.23	1.8214
91.06	1.8258	90.20	1.8213
91.04	1.8257	90.18	1.8212
91.02	1.8256	90.17	1.8211
91.00	1.8255	90.15	1.8210
90.98	1.8254	90.13	1.8209
90.96	1.8253	90.11	1.8208
90.94	1.8252	90.10	1.8207
90.92	1.8251	90.08	1.8206
90.90	1.8250	90.06	1.8205
90.88	1.8249	90.04	1.8204
90.86	1.8248	90.02	1.8203
90.84	1.8247	90.01	1.8202
90.82	1.8246	89.99	1.8201
90.80	1.8245	89.97	1.8200

(Richmond [calculated from Pickering, Chem Soc 57. 64], Jour Soc Ch Ind. 9. 479)

Sp. gr. of conc. $\text{H}_2\text{SO}_4 + \text{Aq}$ at 15°			
% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.
90	1.8185	96	1.8408
*90.20	1.8195	97	1.8410
91	1.8241	*97.70	1.8413
*91.48	1.8271	98	1.8412
92	1.8294	*98.39	1.8406
*92.83	1.8334	*98.00	1.8409
93	1.8339	99	1.8403
94	1.8372	*99.47	1.8395
*94.84	1.8387	100	1.8384
95	1.8390	*100.35	1.8411
*95.97	1.8406		

\*Determined by experiment  
(Lunge and Naef, Dingl. 248. 91.)

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at room temp. containing:

7.875	15.503	23.429% $\text{H}_2\text{SO}_4$
1.0651	1.1305	1.2003*

(Wagner, W. Ann. 1883, 18. 265).

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at 25°.

Concentration of $\text{H}_2\text{SO}_4 + \text{Aq}$		Sp. gr.
1—normal		1.0808
$\frac{1}{2}$ —	"	1.0154
$\frac{1}{3}$ —	"	1.0074
$\frac{1}{4}$ —	"	1.0035

(Wagner, Z. phys. Ch 1890, 5. 40.)

Sp. gr. of dil  $\text{H}_2\text{SO}_4 + \text{Aq}$

G-equivalents $\text{H}_2\text{SO}_4$ per liter	t°	Sp. gr. t°/t°
0.005049	17.343	1.0002082
0.01009	17.360	1.0004020
0.01512	17.382	1.0005879
0.02014	17.398	1.000769
0.03014	17.419	1.001125
0.002523	18.039	1.0001065
0.005050	18.040	1.0002084
0.01006	18.040	1.0004009
0.02005	18.040	1.0007666
0.03001	18.039	1.0011208
0.04980	18.040	1.0018096
0.06864	18.048	1.003460
0.146560	18.070	1.005045
0.19354	18.090	1.005580
0.28042	18.052	1.006086
0.47466	18.055	1.015616
0.4980	17.73	1.01634
4.980	17.95	1.15234
0.005176	12.997	1.0002106
0.01035	13.020	1.000411
0.01551	13.005	1.000603
0.12648	13.031	1.004438
0.25151	13.011	1.008565
0.37672	13.007	1.012639
0.50503	12.998	1.016758

(Kohlrausch, W. Ann. 1894. 53. 22.)

(Kohlrausch, W. Ann. 1894, 53. 22.)

Sp. gr. of $H_2SO_4 + Aq.$			
% $H_2SO_4$	79.68	60.98	35.77
Sp. gr. $20^\circ/20^\circ$	1.7383	1.5181	1.2719
% $H_2SO_4$	10.10	4.78	
Sp. gr. $20^\circ/20^\circ$	1.0685	1.0317	
(Le Blanc and Robland, Z. phys. Ch. 1896, 19, 258.)			

Sp. gr. of  $N-H_2SO_4 + Aq$  at  $18^\circ/4^\circ = 1.0306$ .  
(Loomis, W. Ann. 1896, 60, 550.)

Sp. gr. of  $H_2SO_4 + Aq$  at  $19^\circ/4^\circ$ , when p = percent strength of solution; d = observed density, w = volume conc. in grams per cc  $\left(\frac{pd}{100} = w\right)$

p	d	w
94.10	1.8380	1.7295
84.59	1.7998	1.5223
73.08	1.6743	1.2235
61.35	1.5341	0.9412
40.72	1.3220	0.5383
31.94	1.2430	0.3970
23.77	1.1747	0.2792
14.72	1.1023	0.1623
9.802	1.0670	0.1046
4.826	1.0320	0.0498

(Barnes, J Phys Chem 1898, 2, 546.)

Sp. gr. of  $H_2SO_4 + Aq$  at  $20^\circ$

Normality of $H_2SO_4 + Aq$	% $H_2SO_4$	Sp. gr.
11.53	70.07	1.6129
9.01	59.26	1.4901
6.95	49.10	1.3872
4.77	36.08	1.2756
3.008	25.00	1.1791
1.002	9.25	1.0612

(Forchheimer, Z. phys. Ch. 1900, 34, 27.)

Sp. gr. of conc. and fuming  $H_2SO_4$  at  $15^\circ$  and  $45^\circ$

% $H_2SO_4$	Total $SO_3$ %	Free $SO_3$ %	Sp. gr. at $15^\circ$	Sp. gr. at $45^\circ$
95.98	78.35		1.8418	.
96.68	78.92		1.8429	.
96.99	79.18		1.8431	.
97.66	79.72		1.8434 max.	.
98.65	80.53		1.8403	.
99.40	81.14		1.8388 min.	.
99.76	81.44		1.8418	.
100.00	81.63	0.0	1.8500	1.822
..	83.46	10.0	1.888	1.858
..	85.30	20.0	1.920	1.887
..	87.14	30.0	1.957	1.920
..	88.97	40.0	1.979	1.945
..	90.81	50.0	2.009	1.964 max.
..	92.65	60.0	2.020 max.	1.959
..	94.48	70.0	2.018	1.942
..	96.32	80.0	2.008	1.890
..	98.16	90.0	1.990	1.864
..	100.00	100.0	1.984	1.814

(Knietzsch, B. 1901, 34, 4102.)

Sp. gr. of fuming  $H_2SO_4$  at  $35^\circ$ .

Total $SO_3$ %	Free $SO_3$ %	Sp. gr.	Total $SO_3$ %	Free $SO_3$ %	Sp. gr.
81.63	0	1.8186	91.18	52	1.9749
81.99	2	1.8270	91.55	54	1.9760
82.36	4	1.8360	91.91	56	1.9772
82.73	6	1.8425	92.28	58	1.9784
83.09	8	1.8498	92.65	60	1.9798
83.46	10	1.8565	93.02	62	1.9799
83.82	12	1.8627	93.38	64	1.9872
84.20	14	1.8692	93.75	66	1.9936
84.56	16	1.8756	94.11	68	1.9900
84.92	18	1.8830	94.48	70	1.9864
85.30	20	1.8919	94.85	72	1.9802
85.66	22	1.9020	95.21	74	1.9442
86.03	24	1.9092	95.58	76	1.9379
86.40	26	1.9158	95.95	78	1.9315
86.76	28	1.9220	96.32	80	1.9251
87.14	30	1.9280	96.69	82	1.9183
87.50	32	1.9338	97.05	84	1.9115
87.87	34	1.9405	97.42	86	1.9046
88.24	36	1.9474	97.78	88	1.8980
88.60	38	1.9534	98.16	90	1.8888
88.97	40	1.9584	98.53	92	1.8800
89.33	42	1.9612	98.90	94	1.8712
89.70	44	1.9643	99.26	96	1.8605
90.07	46	1.9672	99.63	98	1.8488
90.44	48	1.9702	100.00	100	1.8370
90.81	50	1.9733			

(Knietzsch, B 1901, 34, 4101.)

Sp. gr. of  $H_2SO_4 + Aq$  at  $15^\circ/15^\circ$  in air.

Sp. gr.	% $H_2SO_4$	Sp. gr.	% $H_2SO_4$	Sp. gr.	% $H_2SO_4$
1.000	0.00	1.028	4.12	1.056	8.19
1.001	0.15	1.029	4.26	1.057	8.33
1.002	0.31	1.030	4.41	1.058	8.47
1.003	0.46	1.031	4.56	1.059	8.62
1.004	0.60	1.032	4.70	1.060	8.76
1.005	0.73	1.033	4.85	1.061	8.90
1.006	0.87	1.034	5.00	1.062	9.04
1.007	1.01	1.035	5.14	1.063	9.18
1.008	1.15	1.036	5.29	1.064	9.33
1.009	1.30	1.037	5.44	1.065	9.47
1.010	1.45	1.038	5.58	1.066	9.61
1.011	1.60	1.039	5.73	1.067	9.75
1.012	1.75	1.040	5.88	1.068	9.89
1.013	1.89	1.041	6.03	1.069	10.04
1.014	2.04	1.042	6.17	1.070	10.18
1.015	2.19	1.043	6.32	1.071	10.31
1.016	2.34	1.044	6.46	1.072	10.45
1.017	2.49	1.045	6.60	1.073	10.59
1.018	2.64	1.046	6.75	1.074	10.73
1.019	2.79	1.047	6.89	1.075	10.87
1.020	2.93	1.048	7.04	1.076	11.00
1.021	3.08	1.049	7.18	1.077	11.14
1.022	3.23	1.050	7.32	1.078	11.28
1.023	3.38	1.051	7.47	1.079	11.42
1.024	3.53	1.052	7.61	1.080	11.56
1.025	3.67	1.053	7.76	1.081	11.69
1.026	3.82	1.054	7.90	1.082	11.83
1.027	3.97	1.055	8.04	1.083	11.97

Sp. gr of  $\text{H}_2\text{SO}_4$ +Aq at  $15^\circ/15^\circ$  in air—  
*Continued.*

Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$
1.084	12 11	1.145	20 25	1.206	27 95
1.085	12 24	1.146	20 38	1.207	28 08
1.086	12 38	1.147	20 51	1.208	28 20
1.087	12 52	1.148	20 64	1.209	28 32
1.088	12 66	1.149	20 77	1.210	28 45
1.089	12 79	1.150	20 90	1.211	28 57
1.090	12 93	1.151	21 03	1.212	28 69
1.091	13 07	1.152	21 16	1.213	28 82
1.092	13 20	1.153	21 28	1.214	28 94
1.093	13 34	1.154	21 41	1.215	29 06
1.094	13 48	1.155	21 54	1.216	29 18
1.095	13 61	1.156	21 67	1.217	29 31
1.096	13 75	1.157	21 80	1.218	29 43
1.097	13 89	1.158	21 93	1.219	29 55
1.098	14 02	1.159	22 05	1.220	29 69
1.099	14 16	1.160	22 18	1.221	29 80
1.100	14 29	1.161	22 31	1.222	29 92
1.101	14 43	1.162	22 44	1.223	30 04
1.102	14 56	1.163	22 56	1.224	30 17
1.103	14 70	1.164	22 69	1.225	30 29
1.104	14 83	1.165	22 82	1.226	30 41
1.105	14 97	1.166	22 94	1.227	30 53
1.106	15 10	1.167	23 07	1.228	30 65
1.107	15 24	1.168	23 20	1.229	30 78
1.108	15 37	1.169	23 32	1.230	30 90
1.109	15 51	1.170	23 45	1.231	31 02
1.110	15 64	1.171	23 57	1.232	31 14
1.111	15 78	1.172	23 71	1.233	31 26
1.112	15 91	1.173	23 83	1.234	31 38
1.113	16 05	1.174	23 96	1.235	31 50
1.114	16 18	1.175	24 08	1.236	31 62
1.115	16 31	1.176	24 21	1.237	31 75
1.116	16 45	1.177	24 34	1.238	31 87
1.117	16 58	1.178	24 46	1.239	31 99
1.118	16 71	1.179	24 59	1.240	32 11
1.119	16 84	1.180	24 71	1.241	32 23
1.120	16 98	1.181	24 84	1.242	32 35
1.121	17 11	1.182	24 97	1.243	32 47
1.122	17 24	1.183	25 09	1.244	32 59
1.123	17 37	1.184	25 22	1.245	32 71
1.124	17 51	1.185	25 34	1.246	32 83
1.125	17 64	1.186	25 47	1.247	32 95
1.126	17 77	1.187	25 59	1.248	33 07
1.127	17 90	1.188	25 72	1.249	33 19
1.128	18 03	1.189	25 84	1.250	33 31
1.129	18 16	1.190	25 97	1.251	33 43
1.130	18 30	1.191	26 09	1.252	33 55
1.131	18 43	1.192	26 22	1.253	33 67
1.132	18 56	1.193	26 34	1.254	33 79
1.133	18 69	1.194	26 47	1.255	33 91
1.134	18 82	1.195	26 59	1.256	34 02
1.135	18 95	1.196	26 71	1.257	34 14
1.136	19 08	1.197	26 84	1.258	34 26
1.137	19 22	1.198	26 96	1.259	34 38
1.138	19 34	1.199	27 09	1.260	34 50
1.139	19 47	1.200	27 21	1.261	34 62
1.140	19 60	1.201	27 33	1.262	34 74
1.141	19 73	1.202	27 46	1.263	34 86
1.142	19 86	1.203	27 58	1.264	34 98
1.143	19 99	1.204	27 71	1.265	35 09
1.144	20 12	1.205	27 83	1.266	35 21

Sp. gr. of  $\text{H}_2\text{SO}_4$ +Aq at  $15^\circ/15^\circ$  in air—  
*Continued.*

Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$
1.267	35 33	1.328	42 35	1.389	48 92
1.268	35 45	1.329	42 46	1.390	49 02
1.269	35 57	1.330	42 57	1.391	49 13
1.270	35 68	1.331	42 68	1.392	49 23
1.271	35 80	1.332	42 79	1.393	49 34
1.272	35 92	1.333	42 90	1.394	49 44
1.273	36 04	1.334	43 01	1.395	49 54
1.274	36 15	1.335	43 12	1.396	49 65
1.275	36 27	1.336	43 23	1.397	49 75
1.276	36 39	1.337	43 35	1.398	49 86
1.277	36 51	1.338	43 46	1.399	49 96
1.278	36 62	1.339	43 57	1.400	50 06
1.279	36 70	1.340	43 68	1.401	50 16
1.280	36 86	1.341	43 79	1.402	50 26
1.281	36 97	1.342	43 90	1.403	50 37
1.282	37 09	1.343	44 01	1.404	50 47
1.283	37 21	1.344	44 12	1.405	50 57
1.284	37 32	1.345	44 23	1.406	50 67
1.285	37 44	1.346	44 34	1.407	50 77
1.286	37 56	1.347	44 45	1.408	50 88
1.287	37 68	1.348	44 56	1.409	50 98
1.288	37 79	1.349	44 67	1.410	51 08
1.289	37 91	1.350	44 77	1.411	51 18
1.290	38 03	1.351	44 88	1.412	51 28
1.291	38 14	1.352	44 99	1.413	51 38
1.292	38 26	1.353	45 10	1.414	51 48
1.293	38 37	1.354	45 21	1.415	51 58
1.294	38 49	1.355	45 32	1.416	51 68
1.295	38 60	1.356	45 43	1.417	51 78
1.296	38 72	1.357	45 53	1.418	51 89
1.297	38 83	1.358	45 64	1.419	51 99
1.298	38 95	1.359	45 75	1.420	52 09
1.299	39 06	1.360	45 86	1.421	52 19
1.300	39 18	1.361	45 97	1.422	52 29
1.301	39 29	1.362	46 07	1.423	52 39
1.302	39 41	1.363	46 18	1.424	52 49
1.303	39 52	1.364	46 29	1.425	52 59
1.304	39 64	1.365	46 39	1.426	52 69
1.305	39 75	1.366	46 50	1.427	52 79
1.306	39 86	1.367	46 61	1.428	52 89
1.307	39 98	1.368	46 71	1.429	52 98
1.308	40 09	1.369	46 82	1.430	53 08
1.309	40 20	1.370	46 92	1.431	53 18
1.310	40 32	1.371	47 03	1.432	53 28
1.311	40 43	1.372	47 14	1.433	53 38
1.312	40 54	1.373	47 24	1.434	53 48
1.313	40 66	1.374	47 35	1.435	53 58
1.314	40 77	1.375	47 45	1.436	53 68
1.315	40 88	1.376	47 56	1.437	53 78
1.316	40 99	1.377	47 67	1.438	53 88
1.317	41 11	1.378	47 77	1.439	53 97
1.318	41 22	1.379	47 88	1.440	54 07
1.319	41 33	1.380	47 98	1.441	54 17
1.320	41 45	1.381	48 09	1.442	54 27
1.321	41 56	1.382	48 10	1.443	54 36
1.322	41 67	1.383	48 30	1.444	54 46
1.323	41 79	1.384	48 40	1.445	54 56
1.324	41 90	1.385	48 50	1.446	54 65
1.325	42 01	1.386	48 61	1.447	54 75
1.326	42 12	1.387	48 71	1.448	54 85
1.327	42 23	1.388	48 82	1.449	54 94

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ/15^\circ$  in air —  
*Continued.*

Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$
1.460	55.04	1.511	60.78	1.572	66.23
1.451	55.14	1.512	60.87	1.573	66.31
1.452	55.24	1.513	60.96	1.574	66.40
1.453	55.33	1.514	61.05	1.575	66.49
1.454	55.43	1.515	61.14	1.576	66.57
1.455	55.53	1.516	61.24	1.577	66.66
1.456	55.62	1.517	61.33	1.578	66.75
1.457	55.72	1.518	61.42	1.579	66.83
1.458	55.82	1.519	61.51	1.580	66.92
1.459	55.91	1.520	61.60	1.581	67.01
1.460	56.01	1.521	61.69	1.582	67.10
1.461	56.11	1.522	61.78	1.583	67.18
1.462	56.20	1.523	61.87	1.584	67.27
1.463	56.30	1.524	61.96	1.585	67.36
1.464	56.39	1.525	62.05	1.586	67.44
1.465	56.49	1.526	62.14	1.587	67.53
1.466	56.59	1.527	62.23	1.588	67.62
1.467	56.68	1.528	62.32	1.589	67.70
1.468	56.78	1.529	62.41	1.590	67.79
1.469	56.87	1.530	62.50	1.591	67.88
1.470	56.97	1.531	62.59	1.592	67.97
1.471	57.06	1.532	62.68	1.593	68.06
1.472	57.16	1.533	62.77	1.594	68.14
1.473	57.25	1.534	62.86	1.595	68.23
1.474	57.35	1.535	62.95	1.596	68.31
1.475	57.44	1.536	63.04	1.597	68.40
1.476	57.54	1.537	63.13	1.598	68.49
1.477	57.63	1.538	63.22	1.599	68.57
1.478	57.73	1.539	63.31	1.600	68.66
1.479	57.82	1.540	63.40	1.601	68.74
1.480	57.92	1.541	63.49	1.602	68.83
1.481	58.01	1.542	63.58	1.603	68.92
1.482	58.10	1.543	63.67	1.604	69.00
1.483	58.20	1.544	63.76	1.605	69.09
1.484	58.29	1.545	63.85	1.606	69.17
1.485	58.38	1.546	63.94	1.607	69.26
1.486	58.48	1.547	64.03	1.608	69.35
1.487	58.57	1.548	64.12	1.609	69.43
1.488	58.66	1.549	64.20	1.610	69.52
1.489	58.75	1.550	64.29	1.611	69.60
1.490	58.85	1.551	64.38	1.612	69.69
1.491	58.94	1.552	64.47	1.613	69.78
1.492	59.03	1.553	64.55	1.614	69.86
1.493	59.12	1.554	64.64	1.615	69.95
1.494	59.22	1.555	64.73	1.616	70.03
1.495	59.31	1.556	64.82	1.617	70.12
1.496	59.41	1.557	64.91	1.618	70.20
1.497	59.50	1.558	65.00	1.619	70.29
1.498	59.59	1.559	65.08	1.620	70.38
1.499	59.68	1.560	65.17	1.621	70.46
1.500	59.78	1.561	65.26	1.622	70.55
1.501	59.87	1.562	65.35	1.623	70.63
1.502	59.96	1.563	65.44	1.624	70.72
1.503	60.05	1.564	65.52	1.625	70.80
1.504	60.14	1.565	65.61	1.626	70.89
1.505	60.23	1.566	65.70	1.627	70.97
1.506	60.33	1.567	65.79	1.628	71.06
1.507	60.42	1.568	65.88	1.629	71.14
1.508	60.51	1.569	65.96	1.630	71.23
1.509	60.60	1.570	66.05	1.631	71.31
1.510	60.69	1.571	66.14	1.632	71.40

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ/15^\circ$  in air —  
*Continued.*

Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$
1.633	71.48	1.694	76.65	1.755	82.01
1.634	71.57	1.695	76.74	1.756	82.11
1.635	71.65	1.696	76.82	1.757	82.21
1.636	71.74	1.697	76.91	1.758	82.31
1.637	71.82	1.698	76.99	1.759	82.41
1.638	71.91	1.699	77.08	1.760	82.51
1.639	71.99	1.700	77.17	1.761	82.61
1.640	72.07	1.701	77.25	1.762	82.71
1.641	72.16	1.702	77.34	1.763	82.80
1.642	72.25	1.703	77.42	1.764	82.90
1.643	72.33	1.704	77.51	1.765	83.00
1.644	72.42	1.705	77.60	1.766	83.10
1.645	72.50	1.706	77.68	1.767	83.20
1.646	72.59	1.707	77.77	1.768	83.29
1.647	72.67	1.708	77.85	1.769	83.39
1.648	72.76	1.709	77.94	1.770	83.49
1.649	72.84	1.710	78.03	1.771	83.59
1.650	72.93	1.711	78.11	1.772	83.69
1.651	73.01	1.712	78.20	1.773	83.78
1.652	73.10	1.713	78.28	1.774	83.88
1.653	73.18	1.714	78.37	1.775	83.98
1.654	73.27	1.715	78.46	1.776	84.08
1.655	73.35	1.716	78.54	1.777	84.18
1.656	73.43	1.717	78.63	1.778	84.29
1.657	73.52	1.718	78.72	1.779	84.39
1.658	73.62	1.719	78.80	1.780	84.50
1.659	73.69	1.720	78.89	1.781	84.60
1.660	73.77	1.721	78.97	1.782	84.71
1.661	73.86	1.722	79.06	1.783	84.81
1.662	73.94	1.723	79.15	1.784	84.92
1.663	74.02	1.724	79.23	1.785	85.03
1.664	74.11	1.725	79.32	1.786	85.14
1.665	74.19	1.726	79.41	1.787	85.25
1.666	74.27	1.727	79.49	1.788	85.36
1.667	74.36	1.728	79.58	1.789	85.47
1.668	74.44	1.729	79.67	1.790	85.60
1.669	74.53	1.730	79.75	1.791	85.72
1.670	74.61	1.731	79.84	1.792	85.84
1.671	74.69	1.732	79.93	1.793	85.96
1.672	74.78	1.733	80.02	1.794	86.08
1.673	74.86	1.734	80.11	1.795	86.20
1.674	74.95	1.735	80.20	1.796	86.32
1.675	75.03	1.736	80.29	1.797	86.45
1.676	75.12	1.737	80.38	1.798	86.58
1.677	75.20	1.738	80.47	1.799	86.71
1.678	75.29	1.739	80.56	1.800	86.84
1.679	75.37	1.740	80.65	1.801	86.97
1.680	75.46	1.741	80.74	1.802	87.10
1.681	75.54	1.742	80.84	1.803	87.23
1.682	75.63	1.743	80.92	1.804	87.36
1.683	75.71	1.744	81.01	1.805	87.50
1.684	75.80	1.745	81.10	1.806	87.64
1.685	75.88	1.746	81.19	1.807	87.78
1.686	75.97	1.747	81.28	1.808	87.92
1.687	76.05	1.748	81.37	1.809	88.06
1.688	76.14	1.749	81.46	1.810	88.20
1.689	76.22	1.750	81.55	1.811	88.34
1.690	76.31	1.751	81.64	1.812	88.49
1.691	76.39	1.752	81.73	1.813	88.64
1.692	76.48	1.753	81.82	1.814	88.79
1.693	76.56	1.754	81.92	1.815	88.95

*Continued on page 917*

Sp. gr. of  $H_2SO_4$  at  $t^\circ$ . Sp. gr. of  $H_2O$  at  $15^\circ=1$ .

$H_2SO_4$	$0^\circ$	$10^\circ$	$15^\circ$	$20^\circ$	$25^\circ$	$30^\circ$	$40^\circ$	$50^\circ$	$60^\circ$
0	1.00074	1.00060	1.00000	0.99910	0.99794	0.99654	0.99311	0.98895	0.98418
1	1.00833	1.00773	1.00698	1.00594	1.00465	1.00312	0.99950	0.99522	0.99034
2	1.01563	1.01466	1.01381	1.01266	1.01126	1.00963	1.00685	1.00343	0.99844
3	1.02281	1.02153	1.02055	1.01928	1.01777	1.01607	1.01216	1.00761	1.00252
4	1.03001	1.02841	1.02728	1.02590	1.02428	1.02251	1.01848	1.01383	1.00855
5	1.03728	1.03533	1.03400	1.03258	1.03096	1.02902	1.02487	1.02013	1.01484
6	1.04461	1.04232	1.04092	1.03934	1.03756	1.03555	1.03138	1.02653	1.02114
7	1.05199	1.04939	1.04786	1.04618	1.04434	1.04235	1.03796	1.03302	1.02752
8	1.05942	1.05652	1.05486	1.05308	1.05116	1.04910	1.04458	1.03952	1.03393
9	1.06689	1.06370	1.06192	1.06002	1.05799	1.05585	1.05119	1.04605	1.04041
10	1.07439	1.07093	1.06903	1.06702	1.06490	1.06267	1.05787	1.05264	1.04696
11	1.08194	1.07821	1.07619	1.07408	1.07186	1.06955	1.06465	1.05930	1.05357
12	1.08954	1.08555	1.08342	1.08120	1.07890	1.07650	1.07145	1.06604	1.06027
13	1.09718	1.09294	1.09071	1.08839	1.08600	1.08352	1.07834	1.07284	1.06703
14	1.10488	1.10040	1.09805	1.09564	1.09316	1.09061	1.08530	1.07971	1.07385
15	1.11261	1.10790	1.10546	1.10295	1.10039	1.09776	1.09233	1.08666	1.08075
16	1.12040	1.11547	1.11292	1.11033	1.10768	1.10498	1.09944	1.09368	1.08772
17	1.12823	1.12309	1.12045	1.11777	1.11505	1.11228	1.10661	1.10077	1.09476
18	1.13610	1.13076	1.12803	1.12526	1.12246	1.11963	1.11385	1.10792	1.10186
19	1.14402	1.13848	1.13566	1.13282	1.12995	1.12704	1.12115	1.11514	1.10902
20	1.15199	1.14625	1.14335	1.14043	1.13748	1.13451	1.12851	1.12242	1.11625
21	1.15998	1.15407	1.15109	1.14800	1.14508	1.14205	1.13594	1.12977	1.12353
22	1.16803	1.16194	1.15888	1.15581	1.15273	1.14964	1.14343	1.13718	1.13089
23	1.17611	1.16993	1.16673	1.16359	1.16045	1.15731	1.15100	1.14467	1.13832
24	1.18424	1.17784	1.17464	1.17143	1.16823	1.16503	1.15862	1.15221	1.14579
25	1.19240	1.18586	1.18266	1.17943	1.17620	1.17292	1.16651	1.15992	1.15335
26	1.20061	1.19393	1.19069	1.18748	1.18426	1.18106	1.17465	1.16807	1.16150
27	1.20885	1.20204	1.19865	1.19527	1.19190	1.18854	1.18218	1.17562	1.16892
28	1.21710	1.21019	1.20675	1.20332	1.19990	1.19650	1.18973	1.18307	1.17635
29	1.22539	1.21838	1.21489	1.21142	1.20796	1.20452	1.19767	1.19087	1.18414
30	1.23370	1.22661	1.22308	1.21957	1.21607	1.21259	1.20566	1.19879	1.19198
31	1.24204	1.23487	1.23131	1.22776	1.22423	1.22071	1.21371	1.20677	1.19989
32	1.25038	1.24316	1.23957	1.23600	1.23244	1.22887	1.22179	1.21476	1.20779
33	1.25878	1.25151	1.24789	1.24429	1.24069	1.23712	1.22999	1.22292	1.21589
34	1.26723	1.25990	1.25626	1.25263	1.24901	1.24540	1.23822	1.23109	1.22400
35	1.27571	1.26834	1.26468	1.26102	1.25738	1.25375	1.24652	1.23933	1.23219
36	1.28424	1.27683	1.27314	1.26947	1.26580	1.26214	1.25487	1.24763	1.24045
37	1.29283	1.28538	1.28167	1.27797	1.27429	1.27061	1.26329	1.25601	1.24878
38	1.30149	1.29400	1.29027	1.28655	1.28284	1.27915	1.27179	1.26448	1.25721
39	1.31022	1.30268	1.29894	1.29520	1.29148	1.28776	1.28038	1.27304	1.26575
40	1.31901	1.31144	1.30767	1.30392	1.30018	1.29646	1.28905	1.28169	1.27440
41	1.32788	1.32027	1.31648	1.31271	1.30896	1.30522	1.29779	1.29042	1.28311
42	1.33683	1.32917	1.32537	1.32158	1.31782	1.31407	1.30662	1.29924	1.29193
43	1.34587	1.33811	1.33432	1.33054	1.32676	1.32300	1.31555	1.30813	1.30081
44	1.35501	1.34727	1.34348	1.33969	1.33590	1.33212	1.32465	1.31710	1.30976
45	1.36425	1.35647	1.35268	1.34887	1.34506	1.34126	1.33378	1.32628	1.31881
46	1.37361	1.36579	1.36199	1.35818	1.35437	1.35056	1.34306	1.33553	1.32807
47	1.38308	1.37522	1.37142	1.36761	1.36380	1.35999	1.35248	1.34494	1.33747
48	1.39267	1.38476	1.38094	1.37713	1.37332	1.36951	1.36199	1.35444	1.34697
49	1.40238	1.39441	1.39059	1.38678	1.38296	1.37915	1.37162	1.36406	1.35659
50	1.41210	1.40418	1.40036	1.39654	1.39272	1.38891	1.38137	1.37381	1.36634
51	1.42214	1.41417	1.41035	1.40653	1.40271	1.39890	1.39135	1.38378	1.37631
52	1.43220	1.42418	1.42036	1.41654	1.41272	1.40891	1.40135	1.39378	1.38631

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq. at } t^\circ$ . Sp. gr. of  $\text{H}_2\text{O at } 15^\circ = 1$  Continued

$\text{H}_2\text{SO}_4$	$0^\circ$	$10^\circ$	$15^\circ$	$20^\circ$	$25^\circ$	$30^\circ$	$40^\circ$	$50^\circ$	$60^\circ$
53	1.44239	1.43420	1.43014	1.42611	1.42211	1.41814	1.41028	1.40254	1.39490
54	1.45269	1.44443	1.44034	1.43628	1.43225	1.42825	1.42034	1.41255	1.40488
55	1.46311	1.45477	1.45065	1.44656	1.44250	1.43847	1.43051	1.42268	1.41497
56	1.47364	1.46523	1.46107	1.45695	1.45285	1.44880	1.44078	1.43290	1.42515
57	1.48427	1.47578	1.47159	1.46743	1.46331	1.45922	1.45115	1.44322	1.43542
58	1.49499	1.48643	1.48221	1.47802	1.47387	1.46975	1.46162	1.45364	1.44579
59	1.50583	1.49719	1.49292	1.48870	1.48452	1.48037	1.47218	1.46415	1.45626
60	1.51676	1.50804	1.50374	1.49949	1.49527	1.49109	1.48285	1.47476	1.46683
61	1.52778	1.51899	1.51465	1.51036	1.50611	1.50190	1.49360	1.48546	1.47748
62	1.53889	1.53002	1.52564	1.52132	1.51703	1.51278	1.50442	1.49622	1.48819
63	1.55008	1.54113	1.53672	1.53236	1.52804	1.52376	1.51533	1.50708	1.49900
64	1.56135	1.55233	1.54788	1.54348	1.53913	1.53481	1.52632	1.51801	1.50988
65	1.57270	1.56360	1.55912	1.55469	1.55030	1.54595	1.53740	1.52903	1.52084
66	1.58414	1.57496	1.57044	1.56597	1.56154	1.55716	1.54854	1.54011	1.53187
67	1.59565	1.58640	1.58184	1.57733	1.57287	1.56846	1.55978	1.55128	1.54298
68	1.60724	1.59792	1.59332	1.58878	1.58427	1.57981	1.57104	1.56246	1.55408
69	1.61892	1.60951	1.60488	1.60030	1.59577	1.59129	1.58247	1.57384	1.56541
70	1.63068	1.62118	1.61651	1.61189	1.60732	1.60280	1.59391	1.58521	1.57672
71	1.64251	1.63293	1.62821	1.62355	1.61894	1.61437	1.60540	1.59663	1.58806
72	1.65439	1.64473	1.63997	1.63527	1.63062	1.62601	1.61696	1.60811	1.59946
73	1.66633	1.65658	1.65178	1.64704	1.64234	1.63769	1.62855	1.61961	1.61087
74	1.67831	1.66847	1.66362	1.65883	1.65408	1.64939	1.64015	1.63111	1.62227
75	1.69030	1.68037	1.67547	1.67063	1.66584	1.66109	1.65175	1.64280	1.63366
76	1.70228	1.69225	1.68731	1.68242	1.67757	1.67278	1.66332	1.65405	1.64498
77	1.71424	1.70411	1.69911	1.69416	1.68926	1.68439	1.67481	1.66540	1.65617
78	1.72615	1.71589	1.71083	1.70582	1.70085	1.69591	1.68616	1.67658	1.66717
79	1.73798	1.72758	1.72243	1.71735	1.71231	1.70731	1.69741	1.68767	1.67809
80	1.74970	1.73909	1.73386	1.72868	1.72356	1.71847	1.70842	1.69854	1.68881
81	1.76120	1.75088	1.74504	1.73979	1.73458	1.72942	1.71921	1.70916	1.69930
82	1.77244	1.76140	1.75595	1.75057	1.74524	1.73998	1.72962	1.71945	1.70950
83	1.78312	1.77193	1.76642	1.76097	1.75557	1.75022	1.73972	1.72943	1.71937
84	1.79316	1.78191	1.77636	1.77087	1.76543	1.76006	1.74943	1.73902	1.72883
85	1.80250	1.79123	1.78567	1.78016	1.77470	1.76929	1.75863	1.74816	1.73789
86	1.81108	1.79982	1.79428	1.78878	1.78331	1.77789	1.76721	1.75674	1.74642
87	1.81887	1.80767	1.80214	1.79666	1.79123	1.78584	1.77519	1.76473	1.75445
88	1.82589	1.81476	1.80926	1.80381	1.79839	1.79302	1.78242	1.77199	1.76176
89	1.83216	1.82111	1.81564	1.81022	1.80484	1.79950	1.78895	1.77856	1.76834
90	1.83771	1.82677	1.82135	1.81597	1.81063	1.80532	1.79483	1.78448	1.77429
91	1.84263	1.83179	1.82642	1.82109	1.81580	1.81054	1.80013	1.78985	1.77972
92	1.84691	1.83610	1.83068	1.82531	1.82007	1.81486	1.80447	1.79417	1.78400
93	1.85059	1.83997	1.83471	1.82950	1.82432	1.81918	1.80892	1.79870	1.78854
94	1.85363	1.84311	1.83790	1.83275	1.82763	1.82255	1.81253	1.80266	1.79296
95	1.85698	1.84655	1.84140	1.83626	1.83122	1.82620	1.81528	1.80553	1.79595
96	1.85976	1.84929	1.84417	1.83909	1.83407	1.82908	1.81824	1.80868	1.79929
97	1.86284	1.85216	1.84705	1.84198	1.83695	1.83196	1.82122	1.81182	1.80263
98	1.86536	1.85478	1.84975	1.84476	1.83981	1.83489	1.82426	1.81504	1.80603
99	1.86771	1.85712	1.85212	1.84715	1.84221	1.83730	1.82676	1.81764	1.80872
100	(1.85330)	(1.84255)	(1.83729)	(1.83213)	(1.82705)	(1.82206)	(1.81231)	(1.80288)	(1.79381)

Auszug aus Band 5 der wissenschaftlichen Abhandlungen der Normaleichungskommission  
 Berlin 1904, P. 257. Springer's publication.

(Domke, Z. anorg. 1905, 43. 176.)

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ/15^\circ$  in air.—  
Continued from page 915.

Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$
1 816	89.11	1 828	91 30	1 840	94 57
1 817	89 27	1 829	91 52	1 841	94 96
1 818	89 44	1 830	91 74	1 842	95 40
1 819	89 61	1 831	91 98	1 843	96.02
1 820	89 79	1 832	92 22	1 844	96.93
1 821	89 97	1 833	92 46	1 8442	97.50
1 822	90 15	1 834	92 71	1 844	99 08
1 823	90 33	1 835	92 98	1 843	99 84
1 824	90 51	1 836	93 26	1 842	99 29
1 825	90 70	1 837	93 56	1 841	98 61
1 826	90 90	1 838	93 87	1 840	98 88
1 827	91 10	1 839	94 20	18 394	100 00

(Lunge, calculated by Marshall, J Soc. Chem. Ind. 1902, 21. 1509)

Sp. gr. at  $20^\circ$  of  $\text{H}_2\text{SO}_4 + \text{Aq}$  containing  
M g. mols  $\text{H}_2\text{SO}_4$  per liter.

M.	0 01	0 025	0 05
Sp. gr.	1 000719	1 001907	1 003551
M.	0 075	0 10	0 25
Sp. gr.	1 005152	1 00677	1 01618
M.	0 50	0 75	1 0
Sp. gr.	1 03218	1 04760	1 06307
M.	1 5	2 0	
Sp. gr.	1 09345	1 12316	

(Jones and Pearson, Am. Ch. J. 1907, 33. 733.)

#### Boiling-point of $\text{H}_2\text{SO}_4 + \text{Aq}$

% $\text{H}_2\text{SO}_4$	B-pt.	% $\text{H}_2\text{SO}_4$	B-pt
5	101.0°	70	170 0°
10	102.0	72	174 5
15	105 5	74	180 5
20	105.0	76	189 0
25	105 5	78	199 0
30	108.0	80	207 0
35	110 0	82	218 5
40	114 0	84	227 0
45	118 5	86	238 5
50	124 0	88	251 5
53	128 5	90	262.5
56	133 0	91	268.0
60	141 5	92	274 5
62.5	147 0	93	281 5
65	153.5	94	288 5
67 5	161.0	95	295 0

(Lunge, B. 11. 370.)

Freezing- and melting-points of  $\text{H}_2\text{SO}_4 + \text{Aq}$

Sp gr at $15^\circ$	F-pt	M-pt
1 671	liq at $-20^\circ$	
1 691	"	
1 712	"	
1 727	$-7 5$	$-7 5$
1 732	$-8 5$	$-8 5$
1 749	$-0 2$	$+4 5$
1 767	$+1 6$	$+6 5$
1 790	$+4 5$	$+8 0$
1 807	$-9 0$	$-6 0$
1 822	liq. at $-20^\circ$	
1 842	"	

(Lunge, B. 15. 2644.)

Effect of impurities on sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

The figures show the increase in sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  caused by adding 0.1% of an impurity to acid of different strengths.

Salt	100 %	98 %	94 %	80 %	70 %
$\text{Na}_2\text{SO}_4$	0 0011	0 0010	0 0007	0 0003	0 0007
$\text{CaSO}_4$	0 0012	0 0011	0 0009	0 0007	0 0006
$\text{Al}_2(\text{SO}_4)_3$	insol	insol	insol	0 00127	0 0011
$\text{Fe}_2(\text{SO}_4)_3$	"	"	0 00087	0 0006	0 0007
$\text{PbSO}_4$	0 0017	0 0014	0 0015	insol	insol
$\text{MgSO}_4$	0 0011	0 0010	0 0012	0 0009	0 0009
$\text{As}_2\text{O}_3$	0 0013	0 0013	0 0013	0 0013	0 0013
$\text{HNO}_3$	0 00020	0 00027	0 00027	0 00023	0 00023

(Marshall, J Soc Chem. Ind. 1902, 21. 1508.)

Sp gr of mixtures of  $\text{H}_2\text{SO}_4$  (96 5%) and  
 $\text{HNO}_3$  (94%) at  $18^\circ/18^\circ$  in air

% $\text{HNO}_3$ in mixture	Sp gr	% $\text{HNO}_3$ in mixture	Sp. gr
0 00	1.8437	22 51	1 8215
0 57	1 8456	25 56	1.8112
1 05	1 8476	27 29	1.8053
4 67	1.8586	32 53	1 7863
7 17	1 8618	37 03	1 7700
7 37	1 8620	39 49	1 7601
7 75	1 8619	57 78	1 6879
9 10	1 8605	72 80	1 6227
11.33	1 8557	90 76	1 5408
12.71	1 8520	98 10	1 5080
16 52	1 8414	100.00	1 5009

(Marshall, J Soc Chem Ind. 1902, 21. 1508.)

Miscible with alcohol, with evolution of heat and formation of ethylsulphuric acid.

$+\text{H}_2\text{O} = \text{H}_2\text{SO}_4$ , also called tetrahydroxyl sulphuric acid. (Marignac, A. ch. (3) 39. 184.)

Mpt.  $8.35^\circ$  (Pickering.)

$+2\text{H}_2\text{O} = \text{H}_2\text{SO}_6$ , also called perhydroxyl sulphuric acid.

Mpt.  $-38.9^\circ$ . (Biron, J. Russ. Phys. Chem. Soc. 1899, 31. 517.)

$+3\text{H}_2\text{O}$ . (Pickering, Chem. Soc. 1890, 57. 331.)

+4H<sub>2</sub>O. Mpt. -75°. (Pickering, Chem Soc. 1890, 57. 331.)

Sp. gr. and fr. pt. of hydrates of H<sub>2</sub>SO<sub>4</sub>.

Hydrate	% H <sub>2</sub> SO <sub>4</sub>	Sp. gr. of the liquid	Fr. pt.
H <sub>2</sub> SO <sub>4</sub> (pure)	100	1.842	+10.5
H <sub>2</sub> SO <sub>4</sub> +H <sub>2</sub> O	84.48	1.777	+3.5
H <sub>2</sub> SO <sub>4</sub> +2H <sub>2</sub> O	73.08	1.650	-70.0
H <sub>2</sub> SO <sub>4</sub> +4H <sub>2</sub> O	57.65	1.478	-40.0
H <sub>2</sub> SO <sub>4</sub> +6H <sub>2</sub> O	47.57	1.376	-50.0
H <sub>2</sub> SO <sub>4</sub> +8H <sub>2</sub> O	40.50	1.311	-65.0
H <sub>2</sub> SO <sub>4</sub> +10H <sub>2</sub> O	35.25	1.268	-88.0
H <sub>2</sub> SO <sub>4</sub> +11H <sub>2</sub> O	33.11	1.249	-75.0
H <sub>2</sub> SO <sub>4</sub> +12H <sub>2</sub> O	31.21	1.233	-55.0
H <sub>2</sub> SO <sub>4</sub> +13H <sub>2</sub> O	29.52	1.219	-45.0
H <sub>2</sub> SO <sub>4</sub> +14H <sub>2</sub> O	28.00	1.207	-40.0
H <sub>2</sub> SO <sub>4</sub> +15H <sub>2</sub> O	26.63	1.196	-34.0
H <sub>2</sub> SO <sub>4</sub> +16H <sub>2</sub> O	25.39	1.187	-25.6
H <sub>2</sub> SO <sub>4</sub> +18H <sub>2</sub> O	23.22	1.170	-19.0
H <sub>2</sub> SO <sub>4</sub> +20H <sub>2</sub> O	21.40	1.157	-17.0
H <sub>2</sub> SO <sub>4</sub> +25H <sub>2</sub> O	17.88	1.129	-8.5
H <sub>2</sub> SO <sub>4</sub> +50H <sub>2</sub> O	9.82	1.067	-3.5
H <sub>2</sub> SO <sub>4</sub> +75H <sub>2</sub> O	6.77	1.045	0.0
H <sub>2</sub> SO <sub>4</sub> +100H <sub>2</sub> O	5.16	1.032	+2.5
H <sub>2</sub> SO <sub>4</sub> +300H <sub>2</sub> O	1.78	1.007	+4.5
H <sub>2</sub> SO <sub>4</sub> +1000H <sub>2</sub> O	0.54	1.001	+0.5

(Pictet, C. R. 1894, 119. 645)

Sulphuric acid, anhydrous, SO<sub>2</sub>

See Sulphur trioxide.

Disulphuric (Pyrosulphuric) acid, H<sub>2</sub>S<sub>2</sub>O<sub>7</sub>.

Very deliquescent. Miscible with H<sub>2</sub>O. Sol. in fuming H<sub>2</sub>SO<sub>4</sub>. Miscible in liquid SO<sub>2</sub>. (Schultz-Sellack)

H<sub>2</sub>S<sub>2</sub>O<sub>7</sub>, 2H<sub>2</sub>SO<sub>4</sub>. Fumes on air. (Jacquelin, A. ch. (3) 30. 343.)

Tetrasulphuric acid, H<sub>2</sub>S<sub>4</sub>O<sub>13</sub>

Fumes on air. (Weber, Pogg. 159. 313.)

Sulphates.

Most sulphates are easily sol. in H<sub>2</sub>O; but Ag<sub>2</sub>SO<sub>4</sub>, Hg<sub>2</sub>SO<sub>4</sub>, and CaSO<sub>4</sub> are only sl. sol., while BaSO<sub>4</sub>, SrSO<sub>4</sub>, and PbSO<sub>4</sub> are nearly insol. therein. All sulphates are sol. in conc. H<sub>2</sub>SO<sub>4</sub>. Basic sulphates are insol. in H<sub>2</sub>O. Most sulphates are insol. in alcohol.

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 823.)

Aluminum sulphate, basic, 2Al<sub>2</sub>O<sub>3</sub>.SO<sub>3</sub>+5H<sub>2</sub>O.

Slowly sol. in 10 mols. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>. (Schlumberger, Bull. Soc. 1895, (3) 13. 41.) +7H<sub>2</sub>O. Easily sol. in 8 mols. dil. HCl + Aq. or in 10 mols. 10% acetic acid in 24 hours. (Schlumberger.)

+10H<sub>2</sub>O. Insol. in H<sub>2</sub>O; easily sol. in cold dil. mineral acids, and HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq. (Crum, A. 89. 174.)

Min. *Felsbanyite*.

+15H<sub>2</sub>O. Min. *Paraluminite*.

8Al<sub>2</sub>O<sub>3</sub>, 5SO<sub>3</sub>+25H<sub>2</sub>O. Insol. in H<sub>2</sub>O; sol. in dil. acids (Lowe, J. pr. 79. 428)

5Al<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>+20H<sub>2</sub>O. Easily sol. in acids. (Debray, Bull. Soc. (2) 7. 9)

3Al<sub>2</sub>O<sub>3</sub>, 2SO<sub>3</sub>+9H<sub>2</sub>O. Nearly insol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Bayer, Dingl. 283. 211.)

+20H<sub>2</sub>O. Ppt.

4Al<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>+36H<sub>2</sub>O. Insol. in H<sub>2</sub>O. Easily sol. in dil. mineral acids, and hot HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq. (Debray, Bull. Soc. (2) 7. 1.)

Al<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>+6H<sub>2</sub>O = (AlO)<sub>2</sub>SO<sub>4</sub>+H<sub>2</sub>O. Insol. in H<sub>2</sub>O or HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq. Sl. sol. in hot HCl, easily sol. in warm KOH+Aq.

(Böttger, A. 244. 225)

+9H<sub>2</sub>O. (Athanasesco, C. R. 103. 27.)

Min. *Ahmanite*.

[Al<sub>2</sub>(OH)<sub>6</sub>]SO<sub>4</sub>+2H<sub>2</sub>O.

Sol. in HCl+Aq. in the cold with decomp. Very unstable. (Schlumberger, Bull. Soc. 1895, (3) 13. 60)

3Al<sub>2</sub>O<sub>3</sub>, 4SO<sub>3</sub>+9H<sub>2</sub>O. (Athanasesco, C. R. 103. 271)

+30H<sub>2</sub>O. Sol. in 144 pts. cold, and 30.8 pts. boiling H<sub>2</sub>O. Easily sol. in HCl, and HNO<sub>3</sub>+Aq. (Rammelsberg, Pogg. 43. 533.)

2Al<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>. Decomp. by H<sub>2</sub>O into 3Al<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub> and Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. (Maus.)

Al<sub>2</sub>O<sub>3</sub>, 2SO<sub>3</sub>=Al<sub>2</sub>O(SO<sub>4</sub>)<sub>2</sub>.

Min. *Ahmanite*.

+H<sub>2</sub>O. Sol. in small quantity of H<sub>2</sub>O, but decomp. by a large quantity into (AlO)<sub>2</sub>SO<sub>4</sub> and Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. (Maus, Pogg. 11. 80.)

+12H<sub>2</sub>O. Easily sol. in hot or cold H<sub>2</sub>O. Sat. solution contains 45% salt at 15°, which crystallises unchanged on evaporating. (Marguerite, C. R. 90. 354.)

Above basic compounds are mixtures. (Pickering, C. N. 45. 121, 133, 146.)

Aluminum sulphate, Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

100 pts. H<sub>2</sub>O dissolve (a) pts. Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, and (b) pts. Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+18H<sub>2</sub>O at:

	0°	10°	20°	30°	40°	50°
a	31.3	33.5	36.15	40.36	45.78	52.18
b	86.85	95.8	107.35	127.6	167.6	201.4

	60°	70°	80°	90°	100°
a	59.09	66.23	73.14	80.83	98.11
b	262.6	348.2	467.3	678.8	1132.

(Poggiale, A. ch. (3) 8. 467.)

See also +18H<sub>2</sub>O.

Sp. gr. of Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+Aq

g. Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	Sp. gr. at			
	15°	25°	35°	45°
5	1.0569	1.0503	1.045	1.0356
10	1.1071	1.1022	1.096	1.085
15	1.1574	1.1522	1.146	1.1346
20	1.2074	1.2004	1.192	1.1801
25	1.2572	1.2487	1.2407	1.2295

(Rouss, B. 17. 2888.)

Sp gr of  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  at  $15^\circ$  containing:  
 10 20 30%  $\text{Al}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$ ,  
 1 0535 1.1105 1.1710  
 40 50%  $\text{Al}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$ .  
 1 2355 1 3050

Sp. gr. of sat. solution = 1.34.  
 (Gerlach, Z. anal. 28. 493.)

Sp gr. of  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  at  $25^\circ$ .

Strength of $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$	Sp gr
1 normal	1 0550
$1/2$ "	1 0278
$1/4$ "	1 0138
$1/8$ "	1 0068

(Wagner, Z. phys. Ch 1890, 5. 35.)

100 pts. of a mixture of 1 vol.  $\text{H}_2\text{SO}_4 + 2$  vols.  $\text{H}_2\text{O}$  dissolve only 6.45 pts.  $\text{Al}_2(\text{SO}_4)_3$ . (Baud, C. R. 1903, 137. 494.)

$\text{Al}_2(\text{SO}_4)_3$  is completely pptd. from  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  by an excess of glacial  $\text{HCl} \cdot \text{H}_2\text{O}$ . (Peters, A. ch. (2) 63. 444.)

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + (\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4$ .  
 See under  $(\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4$ .

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + \text{K}_2\text{Al}_2(\text{SO}_4)_4$ . See under  $\text{K}_2\text{Al}_2(\text{SO}_4)_4$ .

Solubility in  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  at  $25^\circ$

100 g. of the solution contain	
$\text{g. Al}_2(\text{SO}_4)_3$	$\text{g. Fe}_2(\text{SO}_4)_3$
27 82	0
26 01	6 064
24 21	9 819
21 64	13 02
15 22	23 28
10 70	31 91
10 23	31 90

\*Solution sat. with respect to both salts  
 (Wirth and Bakke, Z. anorg. 1914, 87. 48.)  
 See also under  $\text{Fe}_2(\text{SO}_4)_3$ .

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + \text{Li}_2\text{SO}_4$  at  $30^\circ$ .

Composition of					
Solution		Residue		Solid phase	
% $\text{Li}_2\text{SO}_4$	% $\text{Al}_2(\text{SO}_4)_3$	% $\text{Li}_2\text{SO}_4$	% $\text{Al}_2(\text{SO}_4)_3$		
25.1	0	.	.	$\text{Li}_2\text{SO}_4, \text{H}_2\text{O}$	
21.93	5 34	.	.	"	
16.10	14.89	63.70	4 02	"	
13 63	20 76	14.72	31 17	$\text{Li}_2\text{SO}_4, \text{H}_2\text{O} +$	
				$\text{Al}_2(\text{SO}_4)_3, 18\text{H}_2\text{O}$	
13.24	21 71	61.24	7 22	$\text{Li}_2\text{SO}_4, 4\text{H}_2\text{O}$	
11 73	22.08	6.92	33.54	$\text{Al}_2(\text{SO}_4)_3, 18\text{H}_2\text{O}$	
6 75	24 34	3 77	37 06	"	
3 44	26.12	.	.	"	
0 00	28 0	.	.	"	

(Schrenemakers and de Waal, Ch. Weekbl. 1906, 3. 539.)

100 g. of sat. solution of  $\text{Al}_2(\text{SO}_4)_3$  in glycol contain 14.4 g.  $\text{Al}_2(\text{SO}_4)_3$ . (de Coninck, Bull. Ac. Roy. Belg. 1906. 359.)

Insol. in ethyl acetate (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

+  $6\text{H}_2\text{O}$ . Very slowly sol. in cold, completely sol. in hot  $\text{H}_2\text{O}$ .

+  $8\text{H}_2\text{O}$ . (Marguerite-Delarcharbonny, C. R. 112. 229.)

+  $10\text{H}_2\text{O}$ . Deliquescent. (v. Hauer, W. A. B. 13. 449.)

+  $16\text{H}_2\text{O}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Baud, C. R. 1903, 137. 494.)

+  $17\text{H}_2\text{O}$ . (Czawalski, C. C. 1885. 721.)

+  $18\text{H}_2\text{O}$ . Permanent. (Berzelius.)

100 g. of the aqueous solution contain 27.82 g.  $\text{Al}_2(\text{SO}_4)_3$  at  $25^\circ$ . (Wirth, Z. anorg. 1913, 79. 361.)

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

$\text{H}_2\text{SO}_4 + \text{Aq}$ % $\text{H}_2\text{SO}_4$	100 g. of the solution contain g $\text{Al}_2(\text{SO}_4)_3$
0	27 82
5.23	29 21
9 90	26.21
18 70	20 44
25 50	15 40
40 70	5 07
52.25	1 216
63.70	1 243
73 64	2.915

(Wirth, Z. anorg. 1913, 79. 361.)

Hydrous salt is scarcely sol. in alcohol. (Berzelius.)

Min. *Alunogen*.

+  $27\text{H}_2\text{O}$ . Efflorescent. (Marguerite-Delarcharbonny, C. R. 99. 800.)

Aluminum sulphate, acid,  $\text{Al}_2\text{O}_3, 4\text{SO}_3 + 4\text{H}_2\text{O}$ .

Extremely slowly sol. in cold, more rapidly in hot  $\text{H}_2\text{O}$ . (Baud, C. R. 1903, 137. 493.)

$\text{Al}_2\text{O}_3, 6\text{SO}_3 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; solution soon decomp. into  $\text{Al}_2(\text{SO}_4)_3 + \text{H}_2\text{SO}_4$ . (Silberberger, M. 1904, 25. 221.)

Aluminum ammonium sulphate (Ammonia alum),  $(\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 2.9 pts. anhydrous salt at  $0^\circ$ ; 207.7 pts. anhydrous salt at  $110.6^\circ$ . (Mulder.)

100 pts.  $\text{H}_2\text{O}$  dissolve 8.74 pts. anhydrous salt at  $17.5^\circ$ . (Pohl, W. A. B. 6. 597.)

100 pts.  $H_2O$  at  $t^\circ$  dissolve pts.  
( $(NH_4)_2Al_2(SO_4)_4$ ).

$t^\circ$	Pts ( $(NH_4)_2Al_2(SO_4)_4$ )	Pts ( $(NH_4)_2Al_2(SO_4)_4 + 24H_2O$ )
0	2 10	3 90
10	4 99	9 52
20	7 74	15 13
30	10 94	22 01
40	14 88	30 92
50	20 09	44 11
60	26 70	66 65
70	35 11	90 67
80	45 66	134 47
90	58 68	209 31
100	74 53	357 48

(Poggiale, A. ch. (3) 8. 467.)

According to Locke (Am. Ch. J. 1901, 26. 174), Poggiale's tables for  $NH_4$  and K alums are evidently transposed, and the above data are applied by Poggiale to K alum.

1 l.  $H_2O$  dissolves 91.9 g. anhydrous, or 191.9 g. hydrated salt, or 0.387 mols. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1901, 26. 175.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	G ( $(NH_4)_2Al_2(SO_4)_4$ ) per 100 g. $H_2O$	G ( $(NH_4)_2Al_2(SO_4)_4 + 24H_2O$ ) per 100 g. $H_2O$	G mol. ( $(NH_4)_2Al_2(SO_4)_4$ ) per 100 g. $H_2O$
0	2 10	3 90	0 0044
5	3 50	6 91	0 0074
10	4 99	9 52	0 0105
15	6 25	12 66	0 0132
20	7 74	15 13	0 0163
25	9 19	19 19	0 0194
30	10 94	22 01	0 0231
40	14 88	30 92	0 0314
50	20 10	44 10	0 0424
60	26 70	66 65	0 0569
95	109 7	00	0 2312

(Mulder, Poggiale, Locke, Marmo, Gazz. ch. it 1905, 35. II, 351; Berkeley, Trans. Roy. Soc 1904, 203. A, 214, calc by Seidell, Solubilities.)

B.-pt. of sat. solution is  $110.6^\circ$ .

M.-pt. of  $(NH_4)_2Al_2(SO_4)_4 + 24H_2O = 92^\circ$ . (Tilden, Chem. Soc. 45. 409.);  $= 95^\circ$ . (Locke, l. c.)

Sp. gr. of aqueous solution at  $15^\circ$  contain ing:

3% 6% 9%  
1 0423 1.0141 1.0282 hydrous salt.

(Gerlach, Z. anal. 28. 495.)

Solubility of  $NH_4$  alum in presence of  
( $(NH_4)_2SO_4$  and  $Al_2(SO_4)_3$ ).

Mixture used	100 g. sat. solution contains	
	g ( $(NH_4)_2SO_4$ )	g $Al_2(SO_4)_3$
Sat. $NH_4$ alum at $18.5^\circ$	1 42	3 69
20 cc. above solution + 6 g. cryst $Al_2(SO_4)_3$	0 45	16.09
20 cc. above solution + 4 g. $(NH_4)_2SO_4$	20 81	0 29

(Rüdorff, 1885, B. 18. 1160.)

Insol in alcohol. (Mulder.)

Solubility of  $Al(NH_4)(SO_4)_2 + 12H_2O$  in a mixture of 93.3 g.  $H_2O$  and 23.33 g. glycerine = 6 15 g. (Dunlop, Pharm. J. 1910, 85. 6.)

Solubility in 93.3 g.  $H_2O$  + 23.3 g. glycerine + 3.9 g. phenol = 5.59 g.  $Al(NH_4)(SO_4)_2 + 12H_2O$ . (Dunlop.)

Min. *Tschermakite*

Aluminum ammonium chromium sulphate,  
 $Al_2(SO_4)_3$ ,  $(NH_4)_2SO_4$ ,  $Cr_2(SO_4)_3 + 48H_2O$ .

Sol. in  $H_2O$ ; decomp. by boiling. (Vohl, A. 94. 71.)

Aluminum caesium sulphate,  $Al_2Cs_2(SO_4)_4 + 24H_2O$ .

100 pts.  $H_2O$  at  $17^\circ$  dissolve 0.619 pt. caesium alum. (Redtenbacher, J. pr. 94. 442.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$  (calculated for salt dried at  $130^\circ$ )

$t^\circ$	Pts alum	$t^\circ$	Pts alum	$t^\circ$	Pts alum
0	0.19	25	0.49	65	2 38
10	0.29	35	0.69	80	5 29
17	0.38	50	1 235		

(Setterberg, A. 211. 104.)

Solubility in  $H_2O$ .

$t^\circ$	Pts anhydrous salt per litre	G mols anhydrous salt per litre
25	4 7	0 013
30	5.89	0.0167
35	7.29	0 0207
40	9 00	0 0256

(Locke, Am Ch J 1901, 26. 180.)

Solubility of  $\text{Al}_2\text{Cr}_3(\text{SO}_4)_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .  
(G.  $\text{Al}_2\text{Cr}_3(\text{SO}_4)_4 + 24\text{H}_2\text{O}$  in 100 g. solution.)

$t^\circ$	% salt	$t^\circ$	% salt
0	0.21	75	4.12
15	0.35	80	5.21
30	0.60	90	9.50
45	1.04	100.4	18.60
60	1.96		

(Berkeley, Trans. Roy. Soc. 1904, 203. A, 214.)

Solubility in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G $\text{Al}_2(\text{SO}_4)_3$	$t^\circ$	G $\text{Al}_2(\text{SO}_4)_3$	$t^\circ$	G $\text{Al}_2(\text{SO}_4)_3$	$t^\circ$	G $\text{Al}_2(\text{SO}_4)_3$
0	0.19	26	0.50	52	1.45	78	5.15
1	0.20	27	0.51	53	1.51	79	5.40
2	0.21	28	0.52	54	1.58	80	5.78
3	0.22	29	0.55	55	1.65	81	6.05
4	0.23	30	0.57	56	1.71	82	6.4
5	0.24	31	0.59	57	1.77	83	6.7
6	0.25	32	0.60	58	1.86	84	7.0
7	0.26	33	0.62	59	1.92	85	7.4
8	0.27	34	0.65	60	2.06	86	7.7
9	0.28	35	0.69	61	2.14	87	8.0
10	0.29	36	0.72	62	2.25	88	8.3
11	0.30	37	0.75	63	2.37	89	8.6
12	0.31	38	0.77	64	2.50	90	8.8
13	0.32	39	0.80	65	2.65	91	9.0
14	0.34	40	0.85	66	2.78	92	9.2
15	0.35	41	0.87	67	2.96	93	9.5
16	0.36	42	0.91	68	3.13	94	9.9
17	0.38	43	0.96	69	3.34	95	10.1
18	0.39	44	1.01	70	3.50	96	10.4
19	0.40	45	1.06	71	3.67	97	10.8
20	0.41	46	1.10	72	3.85	98	11.1
21	0.42	47	1.17	73	4.07	99	11.5
22	0.43	48	1.21	74	4.30	100	12.0
23	0.45	49	1.27	75	4.50		
24	0.47	50	1.30	76	4.72		
25	0.49	51	1.39	77	4.95		

Values from 0-7° obtained by interpolation using Setterberg's values for 0° (A. 1882, 211. 100)

From 80-100° they were calculated by extrapolation.

(Hart and Huselson, J. Am. Chem. Soc. 1914, 36. 2084.)

Melts in crystal  $\text{H}_2\text{O}$  at 106° (Tilden, Chem. Soc. 45. 409); at 120.5° (Erdmann); at 122° (Locke.)

Aluminum calcium sulphate, basic,  $\text{Al}_2\text{O}_3$ ,  $6\text{CaO}$ ,  $8\text{SO}_4 + 32\text{H}_2\text{O}$ .

Min. *Etringite*. Mostly sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ .

Aluminum chromium sulphate,  $\text{Al}_2\text{Cr}_2(\text{SO}_4)_4$ .  
Insol. in  $\text{H}_2\text{O}$ .  
 $\text{Al}_2\text{Cr}_2(\text{SO}_4)_4 \cdot \text{H}_2\text{SO}_4$ . Insol. in  $\text{H}_2\text{O}$  (Étard C. R. 86. 1400.)

Aluminum chromium potassium sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{Cr}_2(\text{SO}_4)_3$ ,  $2\text{K}_2\text{SO}_4 + 48\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ , but decompose on boiling. (Vohl.)

Aluminum copper sulphate,  $2\text{Al}_2\text{O}_3$ ,  $9\text{CuO}$ ,  $3\text{SO}_4 + 21\text{H}_2\text{O}$ .  
Min. *Cyanotrichite*. (Percy, Phil. Mag. (3) 36. 103.)

Aluminum hydroxylamine sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $(\text{NH}_2\text{OH})_2\text{SO}_4 + 24\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Meyeringh, B. 10. 1946.)

Aluminum iron (ferrous) sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{FeSO}_4 + 24\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Klauser, A. 14. 261.)  
Min. *Halotrichite*.  
 $\text{Al}_2(\text{SO}_4)_3$ ,  $2\text{FeSO}_4 + 27\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Berthier)  
 $\text{Al}_2\text{O}_3$ ,  $2\text{SO}_3$ ,  $6\text{FeSO}_4$ . Easily sol. in  $\text{H}_2\text{O}$ . (Phillips.)  
 $\text{Al}_2(\text{SO}_4)_3$ ,  $2\text{FeSO}_4$ ,  $\text{H}_2\text{SO}_4$ . Insol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 87. 602.)

Aluminum iron (ferric) sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{Fe}_2(\text{SO}_4)_3$ .  
Insol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 86. 1399.)  
 $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{H}_2\text{SO}_4$ . As above (Étard)  
See  $\text{Al}_2(\text{SO}_4)_3 + \text{Fe}_2(\text{SO}_4)_3$ , under  $\text{Al}_2(\text{SO}_4)_3$  and  $\text{Fe}_2(\text{SO}_4)_3$

Aluminum ferrous potassium sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $12\text{FeSO}_4$ ,  $2\text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$ .  
Permanent. Sol. in  $\text{H}_2\text{O}$ . (Dufrenoy.)

Aluminum lead sulphate,  $\text{Al}_2\text{Pb}_2(\text{SO}_4)_4 + 20\text{H}_2\text{O}$ .  
Permanent; insol. in  $\text{H}_2\text{O}$ . (G. H. Bailey J. Chem. Soc. Ind. 6. 415.)

Aluminum lithium sulphate,  $\text{Li}_2\text{Al}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

Sol. in 24 pts. cold, and 0.87 pt. hot  $\text{H}_2\text{O}$ . (Kralovansky, Schw. J. 54. 340)  
Does not exist. (Rammelsberg, J. B. 1847-48. 394; Arfvedson; Cmelin.)

Aluminum lithium potassium sulphate (?).  
Sol. in  $\text{H}_2\text{O}$ , from which it crystallises on cooling. (Joss, J. pr. 1. 142.)

Aluminum magnesium sulphate,  $\text{MgSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3 + 22\text{H}_2\text{O}$ .

Min. *Pickeringite*.  
 $2\text{MgSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3 + 22\text{H}_2\text{O}$ . Min. *Pickeringite*.  
 $3\text{MgSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3 + 36\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Klauser, A. 14. 264.)

Aluminum magnesium manganous sulphate,  $Al_2(SO_4)_3, MgSO_4, MnSO_4 + 25H_2O$ .

As sol. in  $H_2O$  as K alum. (Kane.) Very sol. in  $H_2O$ . (Smith, *Sill. Am. J.* (2) 18. 379.) Min. *Bojemanite*.

Aluminum manganous sulphate,  $Al_2(SO_4)_3, MnSO_4 + 25H_2O$ .

Sol. in  $H_2O$ . (Berzelius.) +24 $H_2O$ . Min. *Apjohnite*

Aluminum manganic sulphate,  $2Al_2(SO_4)_3, Mn_2(SO_4)_3$ .

Insol. in  $H_2O$ . (Étard, C. R. 86. 1399)

Aluminum nickel sulphate,  $Al_2(SO_4)_3, 2NiSO_4, H_2SO_4$ .

Insol. in  $H_2O$ , but gradually decomp thereby. (Étard, C. R. 87. 602.)

Aluminum potassium sulphate, basic,  $3(Al_2O_3, SO_3), K_2SO_4 + 6H_2O = K_2SO_4, 3Al_2(SO_4)_3(OH)_4$ .

Min. *Alunite*. Insol. in  $H_2O$ . Insol. in conc.  $HCl + Aq$ .

Sol. in boiling  $H_2SO_4$  of 1.845 sp. gr, but more easily in a mixture of 12 g.  $H_2SO_4$  and 1.5 g.  $H_2O$ , and also in weaker acids, if heated to 210°. (Mitscherlich, J. pr. 81. 108.)

+9 $H_2O$ . Min. *Lévigite* Sl. sol. in boiling  $HCl + Aq$ . (Mitscherlich, J. pr. 83. 455.)

Nearly insol. in  $HCl$  or conc.  $HNO_3 + Aq$ , but sol. in a mixture of 1 pt.  $H_2SO_4$  and 1 pt.  $H_2O$ . (Debray, *Bull. Soc.* (2) 7. 9)

$Al_2O(SO_4)_3, K_2SO_4$ . Sol. in  $H_2O$ , but decomp. by heating.

With varying composition. Precipitates. Insol. in  $H_2O$ . Very sl. sol. in cold, gradually in hot acids. (Bley, J. pr. 39. 17.) Very difficultly sol. in warm conc.  $HCl + Aq$ , but easily sol. in  $KOH + Aq$ . (Naumann, B. 8. 1630.)

Aluminum potassium sulphate (Potash alum),  $KAl(SO_4)_2 + 12H_2O$  or  $K_2Al_2(SO_4)_4 = K_2SO_4, Al_2(SO_4)_3 + 24H_2O$ .

Sol. in  $H_2O$  with absorption of heat.

When 100 pts.  $H_2O$  at 10.8° are mixed with 14 pts. alum, the temp. is lowered 1.4° (Rüdorff, B. 2. 68.)

Burnt alum is very slowly sol. in  $H_2O$ .

100 pts.  $H_2O$  at t° dissolve P pts.  $K_2Al_2(SO_4)_4 + 24H_2O$

t°	P	t°	P
12 5	7 6	50 0	46 7
21 25	10 4	62 5	230 0
25 0	22 0	75 0	920 0
37 5	44 1	87 5	1506 6

(Brandes, 1822.)

Sol in 18 pts. cold, and 1 6 pts. boiling  $H_2O$  (Fourcroy), in 14.12 pts. cold, and 0.75 pt. boiling  $H_2O$  (Bergmann), in 16 pts. cold, and 0.75 pt. boiling  $H_2O$  (Poggiale, A. ch. (3) 8. 467.)

5.50°, and 1 pts. alum

$K_2Al_2(SO_4)_4 + Aq$  sat. in cold contains 5.2% alum (Fourcroy), 6.7% (Boerhave)

100 pts.  $H_2O$  dissolve (a) pts. anhydrous alum, and (b) pts. crystallised at t°.

	0°	10°	20°	30°	40°	50°
a	2 62	4 50	6 57	9 05	12 35	15 9
b	5 22	9 16	13 66	19 29	27 3	36 5

	60°	70°	80°	90°	100°
a	21 1	26 95	35 2	50 3	70 83
b	51 3	71 97	103 1	187 8	421 9

(Poggiale, A. ch. (3) 8. 467.)

According to Loëke (*Am. Ch. J.* 1901, 28. 174), Poggiale's tables for  $NH_4$  and K alums are evidently transposed, and the above date are applied by Poggiale to  $NH_4$  alum.

100 pts.  $H_2O$  dissolve  $K_2Al_2(SO_4)_4 + 24H_2O$  corresponding to pts anhydrous  $K_2Al_2(SO_4)_4$

Temp	Pts $K_2Al_2(SO_4)_4$	Temp.	Pts $K_2Al_2(SO_4)_4$
0	3 0	80	25
5	3 5	70	40
10	4 0	80	71
15	5 0	90	109
20	5 9	92 5	119 5
30	7 9	100	154
40	11 7	110	200
50	17 0	111 9	210 6

(Mulder, Scheek, *Verhandel* 1864. 90.)

100 pts.  $H_2O$  at 17° dissolve 13.5 pts.  $K_2Al_2(SO_4)_4 + 24H_2O$ , or 7 36 pts.  $K_2Al_2(SO_4)_4$ . (Redtenbacher, J. pr. 94. 442)

Forms supersaturated solutions very easily. Supersat. solutions are brought to crystallisation by addition of a crystal of alum or an isomorphous substance, as chrome or iron alum. Other substances as  $NaCl$ , etc. have no action (Thomson, *Chem. Soc.* 35. 199.)

1 l.  $H_2O$  dissolves 72.3 g. anhydrous, or 138.4 g. hydrated salt, or 0.28 g. mol. of anhydrous salt at 25° (Loëke, *Am. Ch. J.* 1901, 28. 175)

Solubility in  $H_2O$  at t°.  
(g. alum in 1000 g.  $H_2O$ .)

t°	g. alum	t°	g. alum
0	57 0	75	1280 9
5	76 3	76	1412 1
10	84 9	77	1517 9
15	103 6	78	1680 1
20	120 3	79	1775 2
25	131 3	80	1950 0
30	184 9	82	2273 5
36	204 3	84	2661 5
40	250 0	84 6	2816 0
45	290 2	85 1	3166 6
50	367 8	85 3	3337 2
55	457 7	85 6	3372 2
60	585 4	86	3997 8
65	708 4	87	4825 4
70	943 8	88	6630 6

(Marino, *Gazz. ch. it.* 1905, 35. (2) 351)

Solubility in H<sub>2</sub>O at t°.

t°	g K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> per 100 g. H <sub>2</sub> O	g K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O per 100 g. H <sub>2</sub> O	g mol K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> per 100 g. H <sub>2</sub> O
0	3 0	5 65	0 0058
5	3 5	6 62	0 0068
10	4 0	7 60	0 0077
15	5 0	9 59	0 0097
20	5 9	11 40	0 0114
25	7 23	14 14	0 0140
30	8 39	16 58	0 0162
40	11 70	23 83	0 0227
50	17 00	36 40	0 0329
60	24 75	57 35	0 0479
70	40 00	110 5	0 0774
80	71 0	321.3	0 01374
90	109 0	2,275 0	0 2110
92.5	119 0	∞	0 2318

(Mulder, Poggiale, Locke; Marino, Gazz ch. it. 1905, 35, (2) 351; and Berkeley, Proc Roy Soc. 1904, 203, A, 214, calc. by Seidell, Solubilities, 1st Ed.)

M.-pt. of K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O=84.5° (Tilden, Chem. Soc. 45, 409.); =92.5° (Erdmann); =91° (Locke).

Sp. gr. of sat. K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq at 8°=1.045 (Anthon); at 15°=1.0488 (Michel and Kraft); at 15°=1.0456 (Stolba)

Sp. gr. of K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq at 15° containing 5% K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>=1.0477. (Kohlrausch, W. Ann. 1879, 1.)

Sp. gr. of K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq at 15°. a=pts. K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O in 100 pts. solution; b=pts. K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> in 100 pts. solution; c=pts. K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> for 100 pts. H<sub>2</sub>O

a	b	c	Sp. gr.
4	2 1792	2 2277	1 0210
8	4 3584	4 5570	1 0420
12	6 5376	6 9950	1 0641
13	7 083	7 622	1 0690

(Gerlach, Z anal 27 280.)

Saturated solution boils at 111.9°, and contains 210.6 pts. K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O to 100 pts. H<sub>2</sub>O. (Mulder.)

100 pts. H<sub>2</sub>O contain 52 pts. K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>, and boils at 104.5°. (Griffiths.) Crust forms at 103.3°, when the solution contains 114.2 pts. K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> to 100 pts. H<sub>2</sub>O (Gerlach, Z. anal. 26, 426.)

B.-pt. of K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq containing pts. K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> to 100 pts. H<sub>2</sub>O

B.-pt.	Pts. K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub>	B.-pt.	Pts. K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub>
100 5°	17 0	104 0°	83 9
101 0	30 2	104 5	90 7
101 5	-11 8	105 0	97 6
102 0	51 6	105 5	103 9
102 5	60 4	106 0	110.5
103 0	68 7	106 5	116.9
103.5	76 7	106 7	120 55

(Gerlach, Z anal. 26, 435.)

K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.  
K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> is nearly insol. in sat. Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+Aq. (Crum, A. 89, 156.)

Solubility in Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+Aq. Solid Phase=K alum+Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

t°	g Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> +18H <sub>2</sub> O in 1000 g. H <sub>2</sub> O	g K <sub>2</sub> SO <sub>4</sub> in 1000 g. H <sub>2</sub> O
0	234 73	23 45
20	824 26	30.85
35	911 02	35 29
50	1,243 21	59 55
65	1,598 00	119 43
77	1,872 11	183 80

(Marino, Gazz ch. it. 1905, 35, (2) 351)

Solubility is decreased by presence of Na alum. (Venable, C. N. 1879, 40, 198.)

Nearly completed pptd. from sat. aq. solution by addition of Fe or Cr alum. (v. Hauer, J. B. 1866, 59)

K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+MgSO<sub>4</sub>.

K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq sat. at 10°, and then sat. with MgSO<sub>4</sub> at 9°, contains for 100 pts. H<sub>2</sub>O—

	At 10°		At 9°
Alum (anhydrous)	4 0	2 7	
MgSO <sub>4</sub>		31 2	31 1
		33 9	

(Mulder)

K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+K<sub>2</sub>SO<sub>4</sub>.

K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq at 10°, and then sat. with K<sub>2</sub>SO<sub>4</sub> at same temp., contains for 100 pts. H<sub>2</sub>O—

	At 10°		At 9°
Alum (anhydrous)	4 0	0 86	
K <sub>2</sub> SO <sub>4</sub>		9 16	9 7
		10.20	

(Mulder)

Solubility in  $K_2SO_4 + Aq$  Solid phase =  
K alum +  $K_2SO_4$ .

$t^\circ$	$\frac{g}{g}$ $\frac{Al_2(SO_4)_3 + 18H_2O}{in 1000 g H_2O}$	$\frac{g}{g}$ $\frac{K_2SO_4}{in 1000 g H_2O}$	$t^\circ$	$\frac{g}{g}$ $\frac{Al_2(SO_4)_3 + 18H_2O}{in 1000 g H_2O}$	$\frac{g}{g}$ $\frac{K_2SO_4}{in 1000 g H_2O}$
0	5.06	75.83	40	73.88	163.10
0 5	8.658	75.18	50	126.00	195.40
5	16.07	85.78	60	249.70	238.80
10	18.52	96.50	70	529.01	323.74
15	20.56	109.30	80	1,044.04	517.27
30	39.60	147.80			

(Marino, I. c.)



$K_2Al_2(SO_4)_4 + Aq$  sat at  $10^\circ$ , and then sat with  $Na_2SO_4$  at  $9^\circ$ , contains for 100 pts  $H_2O$ —

	At $10^\circ$		At $9^\circ$
Alum (anhydrous)	4.0	4.1	
$Na_2SO_4$		8.8	8.4
		12.9	

(Mulder)

Solubility of  $K_2Al_2(SO_4)_4 + Ti_2Al_2(SO_4)_4$  in  $H_2O$  at  $25^\circ$ .

$\frac{g}{g}$ $\frac{K_2Al_2(SO_4)_4}{per l.}$	$\frac{g}{g}$ $\frac{Ti_2Al_2(SO_4)_4}{per l.}$	Solid phase $\frac{Mol}{K_2Al_2(SO_4)_4}$	Sp gr
69.90	0.00	100	1.0591
74.58	0.48	99.61	1.0601
67.90	1.72	98.48	1.0598
65.30	4.52	95.45	1.0603
64.95	9.60	91.73	1.0605
53.23	18.44	82.54	1.0609
45.32	24.60	75.12	1.0609
38.02	32.48	65.73	1.0611
34.54	35.59	61.36	1.0611
28.35	42.99	51.93	1.0623
10.94	66.12	21.34	1.0654
0.00	75.46	0.00	1.0674

(Foch, Z. Kryst. Min. 1897, 28. 397.)

Insol. in alcohol of 0.905 sp. gr. or less. (Anthon, J. pr. 14. 125.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Solubility in  $H_2O$  is increased by glycerine. (Dunlop, Pharm. J. 1910, 31. 6.)

Min. *Kalsmit*.

+ $8H_2O$ . Stable in dry air. (Marino, I. c.)

+ $14H_2O$ . Converted into ord. alum in air. (Marino.)

Aluminum rubidium sulphate,  $Al_2Rb_2(SO_4)_4 + 24H_2O$ .

100 pts.  $H_2O$  dissolve 2.27 pts at  $17^\circ$ ; very sol in hot  $H_2O$ . (Redtonbacher, J. pr. 94. 442.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$  (calculated for salt dried at  $130^\circ$ ).

$t^\circ$	Pts alum	$t^\circ$	Pts alum	$t^\circ$	Pts alum
0	0.71	25	1.85	65	9.63
10	1.09	35	2.67	80	21.60
17	1.42	50	4.98		

(Setterberg, A. 211. 104)

Solubility in  $H_2O$ .

$t^\circ$	Pts per litre	G mols anhydrous salt per litre
25	18.1	0.059
30	21.9	0.072
35	26.6	0.087
40	32.2	0.106

(Locke, Am. Ch. J. 1901, 26. 180.)

Melts in crystal  $H_2O$  at  $99^\circ$  (Tilden, Chem. Soc. 45. 409); at  $105^\circ$  (Erdmann); at  $109^\circ$  (Locke.)

Aluminum silver sulphate,  $Al_2Ag_2(SO_4)_4 + 24H_2O$ .

Decomp. by  $H_2O$  (Church and Northcote, C. N. 9. 155.)

Aluminum sodium sulphate,  $Al_2Na_2(SO_4)_4 + 24H_2O$ .

Very sl. efflorescent.

Sol in 2.14 pts  $H_2O$  at  $13^\circ$ , or 100 pts  $H_2O$  dissolve 46.7 pts soda alum. Sol in 1 pt boiling  $H_2O$  (Zellner, Schw. J. 86. 183.)

100 pts  $H_2O$  dissolve 110 pts. at  $15.5^\circ$ , and form a liquid of 1.296 sp. gr. (Ure)

100 pts.  $H_2O$  dissolve 51 pts. soda alum at  $16^\circ$ . (Augé, C. R. 110. 1139.)

100 pts.  $H_2O$  dissolve 110 pts. soda alum at  $0^\circ$  (Tilden, Chem. Soc. 45. 409.)

100 g  $H_2O$  dissolve at:

$10^\circ$   $15^\circ$   $20^\circ$   $25^\circ$   $30^\circ$

36.7 38.7 40.9 43.1 45.8 g. anhydrous salt. (Smith, J. Am. Chem. Soc. 1909, 31. 247.)

M.-pt. of  $Na_2Al_2(SO_4)_4 + 24H_2O = 61^\circ$ . (Tilden, Chem. Soc. 45. 409.);  $= 63^\circ$ . (Locke, Am. Ch. J. 1901, 26. 183.)

Insol. in absolute alcohol. (Zellner.)

Min *Mendozite*.

**Aluminum thallous sulphate,  $\text{TlAl}(\text{SO}_4)_2$ .**

0.177 g. mols. of anhydrous salt are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ ; or 1 l.  $\text{H}_2\text{O}$  dissolves 75 g. of the anhydrous, or 117.8 g. of the hydrated salt at  $25^\circ$ . (Locke, Am. Ch. J. 1901, 26, 175.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{Al}_2\text{Tl}_2(\text{SO}_4)_4$ in 100 g. $\text{H}_2\text{O}$	G. $\text{Al}_2\text{Tl}_2(\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$ in 100 g. $\text{H}_2\text{O}$
0	3.15	4.84
5	3.80	5.86
10	4.60	7.12
20	6.40	10.00
25	7.60	11.95
30	9.38	14.89
40	14.40	23.67
50	22.50	38.41
60	35.36	65.19

(Saidell, Solubilities, 1st Ed., p. 15.)

$3\text{Al}_2(\text{SO}_4)_3, \text{Ti}_2\text{SO}_4 + 96\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Lamy.)

**Aluminum zinc sulphate,  $\text{Al}_2(\text{SO}_4)_3, \text{ZnSO}_4 + 24\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Kane.)

**Aluminum sulphate chromium chloride,  $\text{Al}(\text{OH})_3(\text{SO}_4)_2\text{CrCl}_3(\text{OH})_4 + 2\text{H}_2\text{O}$ .**  
(Werner, B 1906, 39, 337.)

**Aluminum sulphate sodium fluoride.**

Decomp. by  $\text{H}_2\text{O}$ . (Weber, Dmgl. 263, 112.)

**Ammonium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ .**

Sol. in  $\text{H}_2\text{O}$  with absorption of heat.  
75 pts.  $(\text{NH}_4)_2\text{SO}_4$  mixed with 100 pts.  $\text{H}_2\text{O}$  lower the temperature from  $13.2^\circ$  to  $6.8^\circ$ , that is,  $6.4^\circ$  (Rüdorff, B. 2, 68.)

Sol. in 1.31 pts.  $\text{H}_2\text{O}$  at  $19^\circ$  (Schiff, A 109, 326)  
Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl)  
Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $15.0^\circ$ , and in 1 pt. boiling  $\text{H}_2\text{O}$  (Fourcroy)  
100 pts.  $\text{H}_2\text{O}$  at  $62.6^\circ$  dissolve 78 pts.  $(\text{NH}_4)_2\text{SO}_4$  (Wenzel)  
100 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  dissolve 66.739 pts.  $(\text{NH}_4)_2\text{SO}_4$  (Michel and Kraft)

Sol. in 1.3 pts. cold  $\text{H}_2\text{O}$ . (Vogel, N. Rep. Pharm. 10, 9.)

Sol. in 1.37 pts. cold  $\text{H}_2\text{O}$  at  $10^\circ$ . (Mulder, J. B. 1866, 67.)

Sol. in 1.34 pts.  $\text{H}_2\text{O}$  at  $16-17^\circ$ . (v. Hauer, W. A. B. 53, 2, 221.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$
71.00	73.65	76.30	478.95 pts. $(\text{NH}_4)_2\text{SO}_4$
40°	50°	60°	70°
81.60	84.25	86.90	89.55 pts. $(\text{NH}_4)_2\text{SO}_4$
80°	90°	100°	
92.20	94.85	97.50	pts. $(\text{NH}_4)_2\text{SO}_4$

(Alluard, C. R. 59, 500.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $(\text{NH}_4)_2\text{SO}_4$	$t^\circ$	Pts. $(\text{NH}_4)_2\text{SO}_4$	$t^\circ$	Pts. $(\text{NH}_4)_2\text{SO}_4$
0	70.6	37	80.1	74	93.1
1	70.9	38	80.4	75	93.4
2	71.1	39	80.7	76	93.8
3	71.4	40	81.0	77	94.2
4	71.6	41	81.3	78	94.5
5	71.8	42	81.7	79	94.9
6	72.1	43	82.0	80	95.3
7	72.3	44	82.3	81	95.6
8	72.5	45	82.7	82	96.0
9	72.8	46	83.0	83	96.4
10	73.0	47	83.3	84	96.8
11	73.2	48	83.7	85	97.2
12	73.5	49	84.0	86	97.6
13	73.7	50	84.4	87	98.0
14	74.0	51	84.7	88	98.4
15	74.2	52	85.1	89	98.8
16	74.4	53	85.5	90	99.2
17	74.7	54	85.8	91	99.6
18	74.9	55	86.2	92	100.0
19	75.1	56	86.6	93	100.4
20	75.4	57	86.9	94	100.8
21	75.7	58	87.3	95	101.2
22	75.9	59	87.7	96	101.6
23	76.2	60	88.0	97	102.1
24	76.4	61	88.4	98	102.5
25	76.7	62	88.7	99	102.9
26	76.9	63	89.1	100	103.3
27	77.2	64	89.5	101	103.8
28	77.5	65	89.9	102	104.2
29	77.8	66	90.2	103	104.6
30	78.0	67	90.6	104	105.1
31	78.3	68	90.9	105	105.5
32	78.6	69	91.3	106	106.0
33	78.9	70	91.6	107	106.5
34	79.2	71	92.0	108	107.0
35	79.5	72	92.4	108.9	107.5
36	79.8	73	92.7	..	..

(Mulder, calculated from his own and other observations, Scheik Verhandl. 1866, 80.)

100 g.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  contain 41.4 g.  $(\text{NH}_4)_2\text{SO}_4$  at  $0^\circ$ . (de Waal, Dissert. 1910); 44.27 g. at  $30^\circ$ . (Schreinemakers, Z. phys. Ch. 11, 110); 47.81 g. at  $70^\circ$ . (de Waal, Ch. 11, 110); 47.81 g. at  $15^\circ$  has sp. gr. 1.248. (Michel and Kraft, A. ch. (3) 41, 471.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ .

% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.
1	1.0057	18	1.1035	35	1.2004
2	1.0115	19	1.1092	36	1.2060
3	1.0172	20	1.1149	37	1.2116
4	1.0230	21	1.1207	38	1.2172
5	1.0287	22	1.1265	39	1.2228
6	1.0345	23	1.1323	40	1.2284
7	1.0403	24	1.1381	41	1.2343
8	1.0460	25	1.1439	42	1.2402
9	1.0518	26	1.1496	43	1.2462
10	1.0575	27	1.1554	44	1.2522
11	1.0632	28	1.1612	45	1.2583
12	1.0690	29	1.1670	46	1.2644
13	1.0747	30	1.1724	47	1.2705
14	1.0805	31	1.1780	48	1.2766
15	1.0862	32	1.1836	49	1.2828
16	1.0920	33	1.1892	50	1.2890
17	1.0977	34	1.1948	..	..

(Schiff, calculated by Gerlach, Z. anal. 8. 280.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ .

% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.
5	1.0292	20	1.1160	31	1.1787
10	1.0581	30	1.1730		

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ .

% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.
3	1.0181	10	1.0600	30	1.1773
6	1.0359	20	1.1190	40	1.2352

(Gerlach, Z. anal. 28. 493.)

Sp. gr. of sat. solution = 1.248. (Gerlach.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ .

$\frac{1}{2}(\text{NH}_4)_2\text{SO}_4$ g. mol in 1000 g. of solution	Sp. gr. $10^\circ/10^\circ$
0	1.000000
0.5514	1.000347
1.1251	1.000704
2.3114	1.001436
4.5840	1.002823
10.0893	1.006093
20.0138	1.012023
40.5236	1.024117
56.8536	1.033690

(Dijken, Z. phys. Ch. 1897, 24. 107.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $20^\circ$ .

Normality of $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.
3.75	40.28	1.2289
2.964	32.99	1.1858
1.978	23.01	1.1319
0.876	10.88	1.0626
0.492	6.275	1.0352

(Forchheimer, Z. phys. Ch. 1900, 34. 22.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $20^\circ$ .

Solution	Sp. gr.	weight of 10 com. of the solution	% $(\text{NH}_4)_2\text{SO}_4$
sat	1.248	12.5062 g.	53.2
$\frac{3}{4}$ "	1.196	11.9034 "	39.9
$\frac{1}{2}$ "	1.139	11.3377 "	26.6
$\frac{1}{4}$ "	1.077	10.7232 "	13.3
$\frac{1}{8}$ "	1.039	.	6.65

(Wiener, Z. phys. Chem. 1911, 71. 120.)

B.-pt. of sat. solution: crust formed at  $106.2^\circ$ , solution containing 88.2 pts.  $(\text{NH}_4)_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp. observed,  $108.2^\circ$ . (Gerlach, Z. anal. 26. 426.)

B.-pt. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  containing pts.  $(\text{NH}_4)_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ .

B.-pt.	Pts. $(\text{NH}_4)_2\text{SO}_4$	B.-pt.	Pts. $(\text{NH}_4)_2\text{SO}_4$
100.5°	7.8	105.0°	71.8
101.0	15.4	105.5	78.7
101.5	22.8	106.0	85.5
102.0	30.1	106.5	92.3
102.5	37.2	107.0	99.1
103.0	44.2	107.5	105.9
103.5	51.1	108.0	112.6
104.0	58.0	108.2	115.3
104.5	64.9	.	...

(Gerlach, Z. anal. 26. 431.)

Sol. with decomp. in  $\text{HCl} + \text{Aq}$ .

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

100 g of the solution contain		Solid phase
Mol $\text{H}_2\text{SO}_4$	Mol $(\text{NH}_4)_2\text{SO}_4$	
0.00	2.28	$(\text{NH}_4)_2\text{SO}_4$
0.24	3.25	
0.47	3.19	
0.97	3.15	
1.19	3.15	
1.43	3.22	$(\text{NH}_4)_2\text{H}(\text{SO}_4)_2$
1.72	3.18	
2.20	3.02	
2.60	2.97	
2.71	3.00	
2.82	3.03	
2.96	3.10	
3.20	3.19	
3.32	3.25	
3.47	3.32	$(\text{NH}_4)\text{HSO}_4$
3.54	3.20	
3.76	2.84	
4.22	2.26	
5.09	1.44	

(D'Ans, Z. anorg. 1909, 65. 229.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ .

Composition of the solution			Solid phase
% by wt $\text{H}_2\text{SO}_4$	% by wt $(\text{NH}_4)_2\text{SO}_4$	% by wt $\text{H}_2\text{O}$	
10.63	43.59	45.79	$(\text{NH}_4)_2\text{SO}_4$
10.70	43.25	46.05	"
13.18	44.10	42.72	$(\text{NH}_4)_2\text{SO}_4 +$ $3(\text{NH}_4)_2\text{SO}_4 \cdot \text{H}_2\text{SO}_4$
16.67	42.06	41.27	"
25.82	41.15	33.03	"
27.33	41.16	31.51	"
32.32	44.63	22.26	"
33.12	45.50	21.83	"
33.84	45.52	20.64	$(\text{NH}_4)\text{HSO}_4$
33.96	45.31	20.73	"
38.51	35.87	26.12	"
42.12	30.10	27.78	"
45.80	24.88	29.32	"
45.77	24.30	29.93	"
56.55	16.98	26.37	"
62.43	20.41	17.16	"
62.46	24.40	13.14	"
63.12	24.20	12.68	"
62.67	27.67	9.76	"
62.83	29.75	8.42	"
62.56	30.26	7.28	"
62.67	31.86	5.47	"
62.69	33.70	3.71	"
61.63	36.75	1.72	"
62.23	36.95	0.82	"

(Van Dorp, Z. phys. Ch. 1910, 73. 285.)

Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

In 1000 g of the solution		Solid phase
Mol $\text{H}_2\text{SO}_4$	Mol $(\text{NH}_4)_2\text{SO}_4$	
4.29	2.17	$(\text{NH}_4)\text{HSO}_4$
4.57	1.83	
4.85	1.60	
5.25	1.36	
5.66	1.22	
6.16	1.26	$(\text{NH}_4)\text{HSO}_4$
6.47	1.55	
6.51	1.95	
6.50	2.37	
6.43	2.50	
7.28	1.64	$(\text{NH}_4)\text{H}_2(\text{SO}_4)_2$
7.99	1.38	
(7.60)	(1.74)	
(8.00)	(1.42)	
9.02	0.96	
9.21	0.832	$(\text{NH}_4)\text{HSO}_4$
9.60	0.977	
9.68	1.00	
9.67	1.26	
10.43	0.894	

(D'Ans, Z. anorg. 1913, 80. 241.)

Very easily sol. even in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Guard, Bull. Soc. (2) 43. 522.)Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

In 1000 g of the solution	
Mol $(\text{NH}_4)_2\text{SO}_4$	Mol $\text{NH}_3$
3.28	0
2.60	1.02
2.13	1.95
1.59	3.44
1.16	5.35
0.78	7.13
0	9.47

(D'Ans and Schreiner, Z. anorg. 1910, 67. 438.)

100 pts.  $\text{H}_2\text{O}$  dissolve 46.5 pts.  $(\text{NH}_4)_2\text{SO}_4$  and 26.8 pts.  $\text{NH}_4\text{Cl}$  at  $21.5^\circ$ .Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $30^\circ$ .

% $\text{NH}_4\text{Cl}$	% $(\text{NH}_4)_2\text{SO}_4$	Solid phase
0	44	$(\text{NH}_4)_2\text{SO}_4$
6.86	36.15	"
14.62	28.6	"
17.60	25.69	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{Cl}$
17.93	25.81	"
19.07	23.22	$\text{NH}_4\text{Cl}$
19.97	21.3	"
22.3	16.33	"
24.06	12.72	"
29.5	0	"

(Schreinemakers, Arch. Néer. Sc. 1910, (2) 15. 92.)

See also under  $\text{NH}_4\text{Cl}$

$(\text{NH}_4)_2\text{SO}_4 + \text{CuSO}_4$   
Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{CuSO}_4$  in  $\text{H}_2\text{O}$  at  
 $16^\circ$

Solution	$\% \text{CuSO}_4$	$\% (\text{NH}_4)_2\text{SO}_4$
Both salts in excess	8.55	7.12
15 cc. sat. sol + 3 g. $(\text{NH}_4)_2\text{SO}_4$	1.77	18.16
15 cc. sat. sol + 3 g. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	15.85	5.65

(Rüdorff, B. 6. 482)

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{CuSO}_4$  in  $\text{H}_2\text{O}$  at  
 $30^\circ$ .

$\% (\text{NH}_4)_2\text{SO}_4$	$\% \text{CuSO}_4$	Solid phase
0	20.32	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
2.45	20.10	"
5.79	20.53	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + \text{CuSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
6.98	16.77	$\text{CuSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
8.19	13.65	"
9.33	11.03	"
17.53	4.05	"
29.27	1.57	"
38.32	0.77	"
43.29	0.49	$\text{CuSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O} + (\text{NH}_4)_2\text{SO}_4$
44	0	$(\text{NH}_4)_2\text{SO}_4$

(Schreinemakers, Arch. Néer. Sc. 1910, 15, 12)

See also under  $\text{CuSO}_4$ .

$(\text{NH}_4)_2\text{SO}_4 + \text{FeSO}_4$

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{FeSO}_4$  in  $\text{H}_2\text{O}$  +  
Aq at  $30^\circ$

Composition of the solution		Solid phase
% by wt. $\text{FeSO}_4$	% by wt. $(\text{NH}_4)_2\text{SO}_4$	
24.90	0	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
25.24	5.24	"
25.22	5.93	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O} + \text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
25.26	5.89	"
23.59	6.44	$\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
17.64	8.90	"
13.13	11.45	"
7.95	16.29	"
5.70	19.64	"
1.72	34.24	"
0.79	43.86	$\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O} + (\text{NH}_4)_2\text{SO}_4$
0.79	43.90	"
0	44.27	$(\text{NH}_4)_2\text{SO}_4$

(Schreinemakers, Z. phys. Ch. 1910, 71. 111)

$(\text{NH}_4)_2\text{SO}_4 + \text{Li}_2\text{SO}_4$   
Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{Li}_2\text{SO}_4$

Temp = $30^\circ$		
$\% (\text{NH}_4)_2\text{SO}_4$	$\% \text{Li}_2\text{SO}_4$	Solid phase
44.1	0	$(\text{NH}_4)_2\text{SO}_4$
40.8	3	"
39.5	6.6	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{LiSO}_4$
30	10	$\text{NH}_4\text{LiSO}_4$
21.6	15	"
15	20	"
12.5	21.9	$\text{NH}_4\text{LiSO}_4 + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
8.9	23	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
0	25.1	"

Temp = $50^\circ$		
$\% (\text{NH}_4)_2\text{SO}_4$	$\% \text{Li}_2\text{SO}_4$	Solid phase
45.7	1	$(\text{NH}_4)_2\text{SO}_4$
43.05	5.86	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{LiSO}_4$
19.65	16.35	$\text{NH}_4\text{LiSO}_4$
13.90	21.20	"
13.97	21.23	$\text{NH}_4\text{LiSO}_4 + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
11.45	21.75	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
9.63	22.79	"
8.58	23.09	"
7.56	23.86	"
0	24.3	"

(Schreinemakers and Cocheret, Chem. Weekbl. 1905, 2. 771)

$(\text{NH}_4)_2\text{SO}_4 + \text{MnSO}_4$

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{MnSO}_4$  in  $\text{H}_2\text{O}$   
G per 100 g. sat. solution.

Temp = $30^\circ$		
$\text{MnSO}_4$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
39.3	0	$\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$
38.49	3.64	$\text{MnSO}_4 \cdot 5\text{H}_2\text{O} + \text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
33.44	4.91	"
22.06	9.65	"
9.02	20.36	"
2.91	37.42	"
1.75	42.58	$\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O} + (\text{NH}_4)_2\text{SO}_4$
1.77	43.24	$(\text{NH}_4)_2\text{SO}_4$
0	43.4	"

Temp = $50^\circ$		
$\text{MnSO}_4$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
36.26	0	$\text{MnSO}_4 \cdot \text{H}_2\text{O}$
35.35	2.95	$\text{MnSO}_4 \cdot \text{H}_2\text{O} + 2\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$
30.57	5.14	$2\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$
16.86	17.62	"
6.92	35.98	"
6.29	39.71	"
5.70	43.24	$2\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 + (\text{NH}_4)_2\text{SO}_4$
3.49	44.02	$(\text{NH}_4)_2\text{SO}_4$
0	45.7	"

(Schreinemakers, Chem. Weekbl. 1909, 6. 131.)

$(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4$   
100 pts.  $(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4 + \text{Aq}$  sat at 16 17° contain 38.41 pts. of the two salts, of which 5.45 pts are  $\text{K}_2\text{SO}_4$ , and 32.96 pts.  $(\text{NH}_4)_2\text{SO}_4$ . (v Hauer, J. pr 28. 137.)

100 pts.  $\text{H}_2\text{O}$  dissolve 50.6 pts.  $(\text{NH}_4)_2\text{SO}_4$  and 7.2 pts.  $\text{K}_2\text{SO}_4$  at 11°. (Mulder, J. B. 1866. 67.)

$(\text{NH}_4)_2\text{SO}_4$  and  $\text{K}_2\text{SO}_4$  replace each other in solution, so that by adding one of these salts to a seemingly saturated solution of the other, it is dissolved with pptn. of the other salt. (Rudorff, B. 6. 485.)

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4$  at 19 1°.

Solution	% $\text{K}_2\text{SO}_4$	% $(\text{NH}_4)_2\text{SO}_4$
Both salts in excess	39.3	37.97
15 cc sat sol + 4 g $\text{K}_2\text{SO}_4$	4.94	33.26
15 cc sat sol + 1 g $(\text{NH}_4)_2\text{SO}_4$	2.05	40.80

(Rudorff, B. 6. 482)

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at 25°.

g $\text{K}_2\text{SO}_4$ per l.	g $(\text{NH}_4)_2\text{SO}_4$ p.p.t.	g $\text{K}_2\text{SO}_4$ p.p.t.	g $(\text{NH}_4)_2\text{SO}_4$ per l.
127.9	0.0	59.28	355.0
135.7	115.7	40.27	482.7
84.2	281.1	0.0	542.3

Results are also given for 14°, 15°, 16°, 30°, 46° and 47°.

(Fock, Z. Kryst. Min. 1897, 28. 365)

$(\text{NH}_4)_2\text{SO}_4 + \text{Th}(\text{SO}_4)_3$ .

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{Th}(\text{SO}_4)_3$  at 16°  
Pts per 100 pts.  $\text{H}_2\text{O}$ .

$(\text{NH}_4)_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_3$	Solid phase
2.13	3.361	$\text{Th}(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$
4.80	5.269	"
10.02	8.947	"
16.56	13.330	$\text{Th}(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O} + \text{Th}(\text{SO}_4)_3$
28.00	10.359	$(\text{NH}_4)_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$
35.20	9.821	$\text{Th}(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$
45.14	6.502	" + $\text{Th}(\text{SO}_4)_3 \cdot 2(\text{NH}_4)_2\text{SO}_4$
49.05	5.750	$2\text{H}_2\text{O}$
52.88	4.583	$\text{Th}(\text{SO}_4)_3 \cdot 2(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$
69.74	1.653	$\text{Th}(\text{SO}_4)_3 \cdot 3(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$
		"

(Barre, A. ch. 1911, (8) 24. 239.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Insol. in absolute alcohol. Sol. in 500 pts alcohol of 0.872 sp. gr., and in 62.5 pts of 0.906 sp. gr. (Anthon, J. pr 14. 125.)

Sol. in 217.4 pts of 0.88% alcohol (sp. gr. = 0.88) at 24.3° (Pohl, J. pr 56. 219.)

Tolerably sol. in alcohol, the sp. gr. of which is greater than 0.860. Insol. in alcohol of sp. gr. less than 0.850.

#### Solubility in dil alcohol

When  $(\text{NH}_4)_2\text{SO}_4$  is dissolved in dil. alcohol, two layers are formed, the compositions of which are as follows:

Sp. gr	Lower layer 100 ccm. contain in g		
	alcohol	water	salt
1.2240		71.43	74.16
1.1775	8.85	68.26	59.54
1.1661	10.62	67.70	56.56
1.1655	11.29	67.34	56.30
1.1735	11.42	66.54	59.20

Sp. gr	Upper layer 100 ccm. containing.		
	alcohol	water	salt
0.9530	41.37	48.47	5.45
0.9512	44.20	45.95	4.97
0.9440	44.27	45.61	4.51
0.9098	52.64	36.78	1.56
0.8750	62.61	24.60	0.30
0.8549	67.04	18.36	0.09
0.8308	77.55	5.53	0.00

(Bodlander, Z. phys. Ch. 7. 3, 8)

#### Solubility in ethyl alcohol + Aq

Upper layer			
Temp.	g $\text{H}_2\text{O}$	g. alcohol	g. salt
16.6°	52.80	40.21	6.99
33.0°	47.99	46.75	5.29
41.8°	47.34	47.07	4.99
55.7°	45.90	49.47	4.63

Lower layer			
16.6°	60.33	10.19	29.48
33.0°	61.02	9.80	29.18
41.8°	61.16	9.74	29.10
55.7°	61.59	9.46	28.95

(Traube, Z. phys. Ch. 1887, 1. 509.)

Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in alcohol at 30°

Two liquid layers are formed between alcohol concentrations of 5.8 and 62%.

Composition of layers.

Upper layer			Lower layer		
$\% (\text{NH}_4)_2\text{SO}_4$	$\% \text{alcohol}$	$\% \text{H}_2\text{O}$	$\% (\text{NH}_4)_2\text{SO}_4$	$\% \text{alcohol}$	$\% \text{H}_2\text{O}$
2.2	56.6	41.2	37.1	5.8	57.1
2.6	54.5	42.9	35.7	6.3	58
3.4	52.3	44.3	33.8	7.4	58.8
13.2	31.8	55	21.7	18.4	59.9
17	25	58	17	25	58

At concentration of 62% alcohol, the liquid is homogeneous and contains 1.3%  $(\text{NH}_4)_2\text{SO}_4$ .

(Wibaut, Chem Weekbl. 1909, 6. 401.)

Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in alcohol at 60°

$\% (\text{NH}_4)_2\text{SO}_4$	$\% \text{alcohol}$	$\% \text{H}_2\text{O}$
43.02	2.32	54.66
41.1	4.1	54.8
1.2	64.5	34.3
0.2	75.5	24.3

Between 4.1° and 64.5°, two liquid layers are formed

Composition of layers.

Upper layer			Lower layer		
$\% (\text{NH}_4)_2\text{SO}_4$	$\% \text{alcohol}$	$\% \text{H}_2\text{O}$	$\% (\text{NH}_4)_2\text{SO}_4$	$\% \text{alcohol}$	$\% \text{H}_2\text{O}$
1.2	64.5	34.3	41.1	4.1	54.8
1.6	60	38.4	36.8	6	57.2
3.8	50	46.2	30.8	9	60.2
7.4	40	52.6	26.6	12	61.4
10	34.4	55.6	23.6	15	61.4

(Schreinemakers, Z. phys. Ch. 1907, 59. 641.)

Solubility in alcohol + Aq at 0°.

$\% (\text{NH}_4)_2\text{SO}_4$	$\% \text{alcohol}$	$\% \text{H}_2\text{O}$
41.4	0	58.6
30.0	9.41	60.59
..	..	..
0.14	73.03	26.83

Two layers are formed between alcohol concentrations of 9.41 and 73.03%.

(de Waal, Dissert. 1910.)

Solubility in propyl alcohol + Aq at 20°.

$\% \text{propyl alcohol}$	$\% (\text{NH}_4)_2\text{SO}_4$
20	6.7
30	4.8
40	3.2
50	2.0
60	1.0
70	0.4

(Lanebarger, Am. Ch. J. 1892, 14. 380.)

100 g. 95% formic acid dissolve 25.4 g.  $(\text{NH}_4)_2\text{SO}_4$  at 16.5°. (Aschan, Ch. Ztg. 1913, 37. 1117.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329).

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in  $\text{CS}_2$  (Arcetowski, Z. anorg. 1894, 6. 257.)

Ammonium hydrogen sulphate,  $\text{NH}_4\text{HSO}_4$ .

Sl. deliquescent. Sol. in 1 pt. cold  $\text{H}_2\text{O}$ . (Lmk.)

Very sl. sol. in alcohol (Gerhardt, A. ch. (3) 20. 255.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329, Eidmann, C. C. 1899, II. 1014.)

$(\text{NH}_4)_2\text{H}(\text{SO}_4)_2$ . Not deliquescent. Sol. in  $\text{H}_2\text{O}$  (Mitscherlich, Pogg. 39. 198.)

$(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{H}_2\text{SO}_4$ . D'Ans and Schreiner, Z. anorg. 1913, 80. 241.)

Ammonium pyrosulphate,  $(\text{NH}_4)_2\text{S}_2\text{O}_7$ .

Decomp. by  $\text{H}_2\text{O}$ . (Schulze.)

$\text{NH}_4\text{HS}_2\text{O}_7$ . (D'Ans and Schreiner, Z. anorg. 1913, 80. 241.)

Ammonium octosulphate,  $(\text{NH}_4)_8\text{S}_8\text{O}_{32}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weber, B. 17. 2497.)

Ammonium antimony sulphate,

$(\text{NH}_4)_2\text{SO}_4 \cdot \text{Sb}_2(\text{SO}_4)_3$ .

Behaves toward  $\text{H}_2\text{O}$  and abs. alcohol as a mixture of the components (Metz, Z. anorg. 1905, 48. 152.)

Decomp. very slowly by  $\text{H}_2\text{O}$  (Gutmann, Arch. Pharm. 1898, 236. 479.)

Ammonium bismuth sulphate,  $\text{NH}_4\text{Bi}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$ .

Easily sol. in  $\text{HCl}$ , and  $\text{HNO}_3$  + Aq; less sol. in conc.  $\text{H}_2\text{SO}_4$ , and hot dil. acids. Slowly decomp. by cold  $\text{HC}_2\text{H}_3\text{O}_2$ , and dil.  $\text{H}_2\text{SO}_4$  + Aq. (Lüddecke, A. 140. 277.)

Ammonium cadmium sulphate,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{CdSO}_4 \cdot 6\text{H}_2\text{O}$ .

Can be recrystallised from a little  $\text{H}_2\text{O}$ . (v. Hauer.)

1 l.  $\text{H}_2\text{O}$  dissolves 723 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

$3(\text{NH}_4)_2\text{SO}_4, \text{CdSO}_4 + 10\text{H}_2\text{O}$  (André, C. R. 104. 987)

**Ammonium calcium sulphate,**  
 $(\text{NH}_4)_2\text{Ca}(\text{SO}_4)_2 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  (Fassbender, B. 11. 1968)  
Sol in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (Rose, Pogg. 110. 292.)

This double salt is stable between  $0^\circ$  and  $100^\circ$  in solutions containing an excess of  $(\text{NH}_4)_2\text{SO}_4$ . It is not formed if the solution contains less than 35%  $(\text{NH}_4)_2\text{SO}_4$  (Barre, C. R. 1909, 143. 1605.)

$(\text{SO}_4)_2\text{Ca}_2(\text{NH}_4)_2$ . Decomp. by  $\text{H}_2\text{O}$  (D'Ans, B. 1907, 40. 192)

This double salt is formed in the presence of an excess of  $\text{CaSO}_4$  and at temp. above  $80^\circ$ . (Barre, C. R. 1909, 143. 1605)

$\text{Ca}_2(\text{NH}_4)_2(\text{SO}_4)_4 + \text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . (D'Ans, B. 1907, 40. 192.)

**Ammonium calcium cupric sulphate,**  
 $\text{Ca}_2\text{Cu}(\text{NH}_4)_2(\text{SO}_4)_4 + 2\text{H}_2\text{O}$ .

Very stable. (D'Ans, B. 1908, 41. 1778.)

**Ammonium calcium potassium sulphate,**  
 $\text{NH}_4\text{CaK}(\text{SO}_4)_3 + \text{H}_2\text{O}$ .

Decomp. by cold  $\text{H}_2\text{O}$ . (Fassbender, B. 11. 1968)

**Ammonium cerous sulphate,  $(\text{NH}_4)_2\text{Ce}_2(\text{SO}_4)_4 + 5\text{H}_2\text{O}$ .**

More sol. in cold than in hot  $\text{H}_2\text{O}$  (Czudnowicz).

100 g.  $\text{H}_2\text{O}$  dissolve at:

22  $3^\circ$  22 35  $35^\circ$  1  $45^\circ$  2  $^\circ$   
5 331 5 328 5 184 4 993 g. anhydrous salt,

45  $^\circ$  55  $3^\circ$  55  $2^\circ$

2 994 2 240 2 187 g. anhydrous salt,

75  $4^\circ$  85  $2^\circ$

1 482 1 184 g. anhydrous salt

(Wolff, Z. anorg. 1905, 45. 102.)

$5(\text{NH}_4)_2\text{SO}_4, \text{Ce}_2(\text{SO}_4)_3$ . (Barre, C. R. 1910, 151. 873.)

**Ammonium ceric sulphate,  $3(\text{NH}_4)_2\text{SO}_4, \text{Ce}(\text{SO}_4)_3 + 4\text{H}_2\text{O}$**

Slightly efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Mendelejeff, A. 188. 50)

$3(\text{NH}_4)_2\text{SO}_4, 2\text{Ce}(\text{SO}_4)_3 + 3\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Mendelejeff.)

**Ammonium chromous sulphate,  $\text{NH}_4\text{Cr}(\text{SO}_4)_2$ .**

0.407 g. mol. anhydrous salt is sol in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Locke, Am. Ch. J. 1901, 26. 175.)

$+6\text{H}_2\text{O}$ . 100 cem. of sat. aqueous solution contain 55 g. of the salt at  $20^\circ$ . Insol. in alcohol (Laurent, C. R. 1911, 131. 112.)

**Ammonium chromic sulphate,  $(\text{NH}_4)_2\text{SO}_4, \text{Cr}_2(\text{SO}_4)_3$**

Not attacked by boiling  $\text{H}_2\text{O}$  or conc.  $\text{HCl} + \text{Aq}$ . Very slowly attacked by boiling  $\text{KOH} + \text{Aq}$  (sp. gr. = 1.3). Insol. in  $\text{CrCl}_3 + \text{Aq}$  or  $\text{SnCl}_2 + \text{Aq}$  (Klobb, Bull. Soc. (3) 9. 664.)  $+5\text{H}_2\text{O}$ . Is ammonium chromosulphate, which see.

$+24\text{H}_2\text{O}$  **Chrome Alum.**

**Violet modification.** Efflorescent. Sol. in cold  $\text{H}_2\text{O}$ , but solution is decomp. on heating with formation of green modification. The dil. solution of green modification is gradually converted into violet modification by standing. Alcohol ppts it from aqueous solution (Schrotter, Pogg. 53. 526.)

100 cc  $\text{H}_2\text{O}$  dissolve 10.78 g. anhydrous, or 21.21 g. hydrate salt at  $25^\circ$ . Melts in crystal  $\text{H}_2\text{O}$  at  $45^\circ$  (Locke, Am. Ch. J. 1901 26. 174)

Solubility in  $\text{H}_2\text{O}$ .

Saturation is very slowly reached owing to transition between violet and green modifications. If time of saturation is taken at 2½ hours, 100 g. of the solution contain at:

$0^\circ$	$30^\circ$	$40^\circ$
3.77	10.6	15.5 g. $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4$ .

This is assumed to be the solubility of the violet modification.

In 300 hours, 15.96 g. salt are dissolved at  $30^\circ$ , and 24.64 g. in 250 hours at  $40^\circ$  (Koppel, B. 1906, 39. 3741)

Calc from electrical conductivity measurements, a solution containing 3.8 g. of the sulphate in 100 g. contains 48% of the green compound at  $40^\circ$  and 61% at  $55^\circ$ . With solutions of 6-7 times the above concentration equilibrium is reached at  $40^\circ$  with 30-40% green alum. (Koppel)

Sp. gr. of aqueous solution of violet modification at  $15^\circ$ , containing:

4	8	12%	$(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .
1.020	1.0405	1.0610	

Sat. solution at  $15^\circ$  has sp. gr. = 1.070. (Gerlach.)

**Green modification.** Sol. in  $\text{H}_2\text{O}$  and alcohol. When in aqueous solution, it gradually changes to violet modification

Sp. gr. of aqueous solution of green modification at  $15^\circ$ , containing:

10	20	30%	$(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .
1.044	1.091	1.142	

40	50	60%	$(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .
1.197	1.255	1.317	

70	80	90%	$(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .
1.384	1.456	1.532	

(Gerlach, Z. anal. 28. 498.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

$3(\text{NH}_4)_2\text{SO}_4, \text{Cr}_2(\text{SO}_4)_3$ . Only sl. attacked by boiling  $\text{H}_2\text{O}$ . Not attacked by boiling conc.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Klobb, Bull. Soc. (3) 9. 663.)

**Ammonium cobaltous sulphate,**  
 $(\text{NH}_4)_2\text{Co}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve at:

0° 10° 18° 23° 35°  
 8.9 11.6 15.2 17.1 19.6 pts. anhydrous salt,

40° 45° 50° 60° 75°  
 22.3 25 28.7 34.5 43.3 pts. anhydrous salt.  
 (Tobler, A. 95. 193.)

100 pts. saturated solution contain at:

20° 40° 60° 80°  
 14.9 20.8 25.6 33 pts. anhydrous salt  
 (v Hauer, J. pr. 74. 433.)

1 l.  $\text{H}_2\text{O}$  dissolves 147.2 g. anhydrous salt  
 at 25°. Tobler's results are inaccurate.  
 (Locke, Am. Ch. J. 1902, 27. 459.)

Pptd. from aqueous solution by alcohol.

**Ammonium cobaltic sulphate,**  
 $(\text{NH}_4)_2\text{Co}_2(\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  with decomp (Marshall,  
 Chem. Soc. 59 760)

**Ammonium cobaltous cupric sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{CuSO}_4 \cdot 12\text{H}_2\text{O}$ .

Quite easily sol in hot  $\text{H}_2\text{O}$ , but on long  
 boiling a basic salt is pptd. (Vohl, A. 94. 58)

**Ammonium cobaltous ferrous sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{FeSO}_4 \cdot 12\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  (Vohl, A. 94. 57)

**Ammonium cobaltous magnesium sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{MgSO}_4 \cdot 12\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$  (Vohl, A. 94. 57.)

**Ammonium cobaltous manganous sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{MnSO}_4 \cdot 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57)

**Ammonium cobaltous nickel sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{NiSO}_4 \cdot 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium cobaltous zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{ZnSO}_4 \cdot 12\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium cupric sulphate,  $(\text{NH}_4)_2\text{CuSO}_4$**

$\cdot 6\text{H}_2\text{O}$   
 Efflorescent in warm air.

Sol. in 1.5 pts. boiling  $\text{H}_2\text{O}$ , and separates almost  
 wholly on cooling (Vogel, J. pr. 2. 194)  
 Sol in 1.55 pts.  $\text{H}_2\text{O}$  at 18.75° (Abt)

100 pts.  $\text{H}_2\text{O}$  at 19° dissolve 26.6 pts., and  
 sat. solution has sp. gr. = 1.1337. (Schiff, A.  
 109. 426.)

100 g. sat. solution at 30° contain 30.36 g.  
 anhydrous salt (Schreinemakers, Arch. Néer.  
 Sci. 1910, (2) 15. 92.)

Solubility of  $(\text{NH}_4)_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  +  
 $(\text{NH}_4)_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 13–14°  
 Mols. per 100 mols.  $\text{H}_2\text{O}$ .

Cu salt	Ni salt	% Cu salt in solid phase
0	0.521	0
0.1476	0.295	10.29
0.2664	0.2089	30.59
0.4165	0.1449	52.23
0.4785	0.1202	78.80
1.0350	0	100

(Fock, Z. Kryst. Min. 1897, 28. 365.)

Solubility of  $(\text{NH}_4)_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  +  
 $\text{K}_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 13–14°  
 Mols. per 100 mols.  $\text{H}_2\text{O}$ .

K salt	$\text{NH}_4$ salt	% K salt in solid phase
0	1.035	0
0.897	0.8618	5.06
0.2269	0.6490	16.76
0.2570	0.5887	30.40
0.2946	0.5096	36.63
0.3339	0.3319	50.15
0.4560	0.1961	69.93
0.4374	0	100

(Fock.)

Solubility of  $(\text{NH}_4)_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  +  
 $(\text{NH}_4)_2\text{Zn}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 13–14°.  
 Mols. per 100 mols.  $\text{H}_2\text{O}$ .

Cu salt	Zn salt	% Cu salt in solid phase
0.0422	0.8069	2.39
0.0666	0.5638	4.52
0.1218	0.5115	9.03
0.2130	0.4924	14.67
0.3216	0.4022	22.62
1.035	0	100.

(Fock.)

$(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{CuSO}_4$  Very sol in  $\text{H}_2\text{O}$   
 (Klobb, C. R. 115. 220)

**Ammonium cupric ferrous sulphate.**

Sol in  $\text{H}_2\text{O}$  without decomposition. (Vohl,  
 A. 94. 61)

**Ammonium cupric magnesium sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CuSO}_4 \cdot \text{MgSO}_4 \cdot 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57)

**Ammonium cupric magnesium potassium sul-**  
**phate,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{CuSO}_4 \cdot \text{MgSO}_4 \cdot \text{K}_2\text{SO}_4$**   
 $\cdot 12\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  (Schiff.)  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CuSO}_4 \cdot 2\text{MgSO}_4 \cdot \text{K}_2\text{SO}_4 \cdot$   
 $18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Schiff)

**Ammonium cupric manganous sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{MnSO}_4 + 12\text{H}_2\text{O}$ .  
 Sol in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium cupric nickel sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{NiSO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl)

**Ammonium cupric potassium sulphate,**  
 $\text{NH}_4\text{KSO}_4, \text{CuSO}_4 + 6\text{H}_2\text{O}$ .  
 Sol in  $\text{H}_2\text{O}$ . (Schiff.)

**Ammonium cupric zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$ .  
 Sol in  $\text{H}_2\text{O}$ . (Vohl)

**Ammonium cupric sulphate ammonia,**  
 $(\text{NH}_4)_2\text{SO}_4, \text{CuO}, 2\text{NH}_3$ .

Sol in 15 pts cold  $\text{H}_2\text{O}$ , but decomp on exposure to air or dilution. Insol in alcohol. (Kuhn)

**Ammonium didymium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{D}_{12}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$ .  
 Sol. in 18 pts  $\text{H}_2\text{O}$ , and less easily in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (Manginac)  
 Moderately sol in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 43. 362)

**Ammonium erbium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$   
 Sol. in  $\text{H}_2\text{O}$  (Cleve)

**Ammonium gallium sulphate,**  
 $(\text{NH}_4)_2\text{Ga}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

Sol in cold water and dilute alcohol. Conc solution clouds up on boiling, but clears on cooling. Dil solution separates out a basic salt, insol. in hot or cold  $\text{H}_2\text{O}$ . (Boisbaudran.)

**Ammonium glucinum sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{GlSO}_4 + 2\text{H}_2\text{O}$   
 Sol. in  $\text{H}_2\text{O}$ . (Atterberg)

**Ammonium indium sulphate,**  
 $(\text{NH}_4)_2\text{In}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 200 pts salt at  $16^\circ$ , and 400 pts at  $30^\circ$ .

Insol in alcohol

Melts in crystal  $\text{H}_2\text{O}$  at  $36^\circ$  (Rössler, J. pr. (2) 7. 14.)  
 $+ 8\text{H}_2\text{O}$ . (Rössler.)

**Ammonium iridium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{Ir}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .

Easily sol in  $\text{H}_2\text{O}$ . (Marino, Z. anorg. 1904, 42, 221)

**Ammonium iron (ferrous) sulphate,**  
 $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ .

Much less sol. in  $\text{H}_2\text{O}$  than  $\text{FeSO}_4 + 7\text{H}_2\text{O}$ . (Vogel, J. pr. 2. 192.)

100 pts  $\text{H}_2\text{O}$  dissolve at:

$0^\circ \quad 12^\circ \quad 20^\circ \quad 30^\circ \quad 36^\circ$

12.2 17.5 21.6 28.1 31.8 pts. anhydrous salt,

$45^\circ \quad 55^\circ \quad 60^\circ \quad 65^\circ \quad 75^\circ$   
 36.2 40.3 44.6 49.8 56.7 pts. anhydrous salt.  
 (Tobler, A. 95. 193.)

100 pts.  $\text{H}_2\text{O}$  at  $16.5^\circ$  dissolve 35.9 pts. hydrous salt.

1 l.  $\text{H}_2\text{O}$  dissolves 351 pts or 1.044 g. mol. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

Sol. in  $\text{H}_2\text{O}$  without decomp. Aq solution at  $30^\circ$  contains 13.13%  $\text{FeSO}_4$  and 11.45%  $(\text{NH}_4)_2\text{SO}_4$  (Schrenemakers, C. C. 1910, I. 801.)

Sp. gr. of  $(\text{NH}_4)_2\text{FeSO}_4 + \text{Aq}$  at  $19^\circ$

% = %  $(\text{NH}_4)_2\text{FeSO}_4 + 6\text{H}_2\text{O}$

%	Sp gr	%	Sp gr	%	Sp gr
1	1.006	11	1.066	21	1.130
2	1.013	12	1.073	22	1.136
3	1.018	13	1.080	23	1.143
4	1.024	14	1.085	24	1.150
5	1.030	15	1.092	25	1.156
6	1.036	16	1.097	26	1.164
7	1.042	17	1.104	27	1.171
8	1.047	18	1.110	28	1.179
9	1.054	19	1.116	29	1.185
10	1.060	20	1.124	30	1.193

(Schiff calculated by Gerlach, Z. anal. 8. 250.)

Insol. in acetone

**Ammonium ferric sulphate, basic.**

Extremely difficultly sol. in  $\text{HCl} + \text{Aq}$ . Not decomp. by  $\text{KOH} + \text{Aq}$ . (Berzelius.)

$5(\text{NH}_4)_2\text{O}, 3\text{Fe}_2\text{O}_3, 12\text{SO}_3 + 18\text{H}_2\text{O}$  or  $2(\text{NH}_4)_2\text{O}, \text{Fe}_2\text{O}_3, 4\text{SO}_3 + 4\text{H}_2\text{O}$ . Sol. in 2.4 pts. cold  $\text{H}_2\text{O}$ . (Maus, Pogg. 11. 79.)

**Ammonium iron (ferric) sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{Fe}_2(\text{SO}_4)_3$ .

Attacked slowly by cold  $\text{H}_2\text{O}$ . (Lachaud and Lepierre)

Nearly insol in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1913, 84. 363)

$+ 24\text{H}_2\text{O}$ . Iron alum. Sol in 3 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Forchhammer, Ann. Plur. 6. 406.)

100 cc.  $\text{H}_2\text{O}$  dissolve 44.15 g. anhydrous, or 124.40 g. hydrated salt at  $25^\circ$ , or 1.659 g. mols. anhydrous salt are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Locke, Am. Ch. J. 1901, 26. 174.)

Sp. gr. of aqueous solution at  $15^\circ$  containing

5 10 15%  $(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ ,  
 1.023 1.047 1.071

20 25 30%  $(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ ,  
 1.066 1.122 1.148

35 40%  $(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .  
 1.175 1.203

40% solution is sat. at 15°. (Geilach, Z. anal. 28. 496.)

Melts in crystal  $\text{H}_2\text{O}$  at 40° (Locke.)

$3(\text{NH}_4)_2\text{SO}_4, \text{Fe}_2(\text{SO}_4)_3$ . Insol. in cold  $\text{H}_2\text{O}$ . (Lachaud and Lepierre.)

**Ammonium iron (ferroferrie) sulphate,**  
 $4(\text{NH}_4)_2\text{SO}_4, \text{FeSO}_4, \text{Fe}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$

Sl sol. in cold  $\text{H}_2\text{O}$ ; decomp. into basic salt by hot  $\text{H}_2\text{O}$ ; insol in alcohol. (Lachaud and Lepierre, C. R. 114. 916.)

**Ammonium ferrous magnesium sulphate,**  
 $4(\text{NH}_4)_2\text{SO}_4, 3\text{FeSO}_4, \text{MgSO}_4 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Schiff, A. 107. 64.)

$2(\text{NH}_4)_2\text{SO}_4, \text{FeSO}_4, \text{MgSO}_4 + 12\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium ferrous manganous sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{FeSO}_4, \text{MnSO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium ferrous nickel sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{FeSO}_4, \text{NiSO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium ferrous zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{FeSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Bette, A. 14. 286.)

**Ammonium lanthanum sulphate,  $(\text{NH}_4)_2\text{SO}_4, \text{La}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$**

Sl. sol. in  $\text{H}_2\text{O}$ . (Marignac.)

Quite sol. in  $\text{H}_2\text{O}$ . (Cleve.)

$+ 2\text{H}_2\text{O}$ . (Barre, C. R. 1910, 151. 872.)

$5(\text{NH}_4)_2\text{SO}_4, 2\text{La}_2(\text{SO}_4)_3$ . Sl. sol. in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  of concentrations above 60% (Barre, A. ch 1911, (8) 24. 246.)

$5(\text{NH}_4)_2\text{SO}_4, \text{La}_2(\text{SO}_4)_3$ . (Barre)

**Ammonium lead sulphate,  $(\text{NH}_4)_2\text{SO}_4, \text{PbSO}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  into its constituents.

(Wöhler and Litton, A. 43. 126.)

Decomp. by  $\text{H}_2\text{O}$ . Only stable in contact with solutions containing.

13.86 pts.  $(\text{NH}_4)_2\text{SO}_4$  per 100 pts.  $\text{H}_2\text{O}$  at 20°.

19.25 pts.  $(\text{NH}_4)_2\text{SO}_4$  per 100 pts.  $\text{H}_2\text{O}$  at 50°.

24.31 pts.  $(\text{NH}_4)_2\text{SO}_4$  per 100 pts.  $\text{H}_2\text{O}$  at 75°.

29.42 pts.  $(\text{NH}_4)_2\text{SO}_4$  per 100 pts.  $\text{H}_2\text{O}$  at 100°.

(Barre, C. R. 1909, 149. 294.)

**Ammonium lithium sulphate,  $\text{NH}_4\text{LiSO}_4$ .**

Solubility in  $\text{H}_2\text{O} = 35.25\%$  at  $-10^\circ$  and 36.18% at  $70^\circ$ . (Schreinemakers, C. C. 1906, I. 217.)

This is the only double salt which  $(\text{NH}_4)_2\text{SO}_4$  forms with  $\text{Li}_2\text{SO}_4$  below  $100^\circ$ .

(Spielrein, C. R. 1913, 157. 48.)

**Ammonium magnesium sulphate,**  
 $(\text{NH}_4)_2\text{Mg}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ .

100 pts  $\text{H}_2\text{O}$  dissolve 15.9 pts. anhydrous double salt at  $13^\circ$ . (Mulder)

100 pts  $\text{H}_2\text{O}$  dissolve at.

0° 10° 15° 20° 30°  
9.0 14.2 15.7 17.9 19.1 pts anhydrous salt,

45° 50° 55° 60° 75°

25.6 30.0 31.9 36.1 45.3 pts. anhydrous salt.

(Tobler, A. 96. 193.)

More sol. in  $\text{H}_2\text{O}$  than  $(\text{NH}_4)_2\text{SO}_4$  or  $\text{MgSO}_4$  (Graham.)

1 l.  $\text{H}_2\text{O}$  dissolves 199 pts anhydrous salt at  $25^\circ$ . Tobler's results are inaccurate.

(Locke, Am. Ch. J. 1902, 27. 459.)

100 g.  $\text{H}_2\text{O}$  dissolve at:

34° 41° F  
18.22 20.72 g.  $(\text{NH}_4)_2\text{SO}_4, \text{MgSO}_4, 6\text{H}_2\text{O}$ .

50° 59° F.  
22.48 24.08 g.  $(\text{NH}_4)_2\text{SO}_4, \text{MgSO}_4, 6\text{H}_2\text{O}$ ,

60° 70° F.  
24.81 28.26 g.  $(\text{NH}_4)_2\text{SO}_4, \text{MgSO}_4, 6\text{H}_2\text{O}$ ,

81° F  
33.33 g.  $(\text{NH}_4)_2\text{SO}_4, \text{MgSO}_4, 6\text{H}_2\text{O}$

(Lothian, Pharm. J. 1910, (4) 30. 546.)

Lothian's results for solubility in  $\text{H}_2\text{O}$  probably incorrect because of inaccuracy of experimental method. (Seidell, Pharm. J. 1911, (4) 33. 846)

Solubility of  $(\text{NH}_4)_2\text{Mg}(\text{SO}_4)_2$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g anhydrous salt per 100 g.	
	solution	$\text{H}_2\text{O}$
0	10.58	11.83
10	12.75	14.61
20	15.23	17.96
25	16.45	19.69
30	17.84	21.71
40	20.51	25.86
50	23.18	30.17
60	26.02	35.17
80	32.58	48.32
100	39.66	65.72

(Porlezza, Att. Acc. Linc. 1914, (5) 23. II, 509)

Min. *Cerbolets*.

**Ammonium magnesium nickel sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{MgSO}_4, \text{NiSO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium magnesium potassium zinc sulphate,  $2(\text{NH}_4)_2\text{SO}_4, 3\text{MgSO}_4, 3\text{K}_2\text{SO}_4, 2\text{ZnSO}_4 + 30\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Schiff, A. 107. 64.)

$(\text{NH}_4)_2\text{SO}_4, 2\text{MgSO}_4, 2\text{K}_2\text{SO}_4, \text{ZnSO}_4 + 18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Schiff.)

$(\text{NH}_4)_2\text{SO}_4, \text{MgSO}_4, \text{K}_2\text{SO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Schiff.)

Ammonium magnesium zinc sulphate,  
 $2(\text{NH}_4)_2\text{SO}_4, \text{MgSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Ammonium manganous sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,  
 $\text{MnSO}_4 + 6\text{H}_2\text{O}$

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Jahn.)  
 1 l.  $\text{H}_2\text{O}$  dissolves 372 g. anhydrous salt  
 at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)  
 $(\text{NH}_4)_2\text{SO}_4, 2\text{MnSO}_4$ . Readily decomp. by  
 $\text{H}_2\text{O}$ . (Lepierre, C. R. 1895, 120. 924.)

Ammonium manganic sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,  
 $\text{Mn}_2(\text{SO}_4)_3$

Decomp. by  $\text{H}_2\text{O}$ . Insol. in ether,  $\text{C}_6\text{H}_6$ , and  
 conc.  $\text{H}_2\text{SO}_4$ . Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Le-  
 pierre, Bull. Soc. 1895, (3) 13. 596.)  
 $+ 24\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mitscher-  
 lich.)

Ammonium manganous nickel sulphate,  
 $2(\text{NH}_4)_2\text{SO}_4, \text{MnSO}_4, \text{NiSO}_4 + 12\text{H}_2\text{O}$   
 Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Ammonium manganous zinc sulphate,  
 $2(\text{NH}_4)_2\text{SO}_4, \text{MnSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$   
 Sol. in  $\text{H}_2\text{O}$ . (Vohl)

Ammonium mercuric sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,  
 $8\text{HgSO}_4 + 2\text{H}_2\text{O}$ .

(Hirzel, J. B. 1850. 333.)  
 $(\text{NH}_4)_2\text{SO}_4, \text{HgSO}_4$ . Difficultly sol. in  
 $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$

Ammonium mercurous sulphate ammonia,  
 $3\text{Hg}_2\text{O}, 2(\text{NH}_4)\text{HgSO}_4, 2\text{NH}_3$ .

Insol. in hot or cold, dil. or conc.  $\text{H}_2\text{SO}_4$ ,  
 and  $\text{HNO}_3$ . Sol. in  $\text{HCl}$ . (Tarugi, Gazz.  
 ch. it. 1903, 33. (1) 131.)

Ammonium nickel sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,  
 $\text{NiSO}_4 + 6\text{H}_2\text{O}$ .

Sol. in 4 pts. cold  $\text{H}_2\text{O}$  (Lank, 1796.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$3.5^\circ$   $10^\circ$   $18^\circ$   $20^\circ$   $30^\circ$   
 1.8 3.2 5.8 5.9 8.3 pts. anhydrous salt,  
 $40^\circ$   $50^\circ$   $59^\circ$   $68^\circ$   $85^\circ$   
 11.5 14.4 16.7 18.8 28.6 pts. anhydrous salt.  
 (Tobler, A. 95. 193.)

100 pts. sat. solution contain at  $20^\circ$ , 9.4;  
 at  $40^\circ$ , 13.2; at  $60^\circ$ , 18.6; at  $80^\circ$ , 23.1 pts.  
 anhydrous salt. (v. Hauer, J. pr. 74. 433.)

1 l.  $\text{H}_2\text{O}$  dissolves 75.7 g. anhydrous salt  
 at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)  
 Nearly insol. in a weak acid solution of  
 $(\text{NH}_4)_2\text{SO}_4$ . (Thompson, C. C. 1863. 957.)

Ammonium nickel zinc sulphate,  $2(\text{NH}_4)_2\text{SO}_4$ ,  
 $\text{NiSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Ammonium nickel sulphate ammonia,  
 $(\text{NH}_4)_2\text{SO}_4, \text{NiSO}_4, 6\text{NH}_3 + 3\text{H}_2\text{O}$ .  
 (André, C. R. 106. 936.)

Ammonium platonic sulphate,  $2(\text{NH}_4)_2\text{SO}_4$ ,  
 $\text{Pt}_2(\text{SO}_4)_3 + 25\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Prost, Bull. Soc. (2) 46. 156.)

Ammonium potassium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,  
 $\text{K}_2\text{SO}_4 + 4\text{H}_2\text{O}$ .

Soluble in  $\text{H}_2\text{O}$  100 pts.  $\text{H}_2\text{O}$  at  $16^\circ$  dis-  
 solve 13.68 pts. salt. (Thomson, 1831.)

Min. *Taylorite*.

Ammonium praseodymium sulphate,  
 $(\text{NH}_4)_2\text{SO}_4, \text{Pr}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (von Scheele, Z. anorg.  
 1898, 18. 359.)

Ammonium rhodium sulphate,  
 $(\text{NH}_4)_2\text{SO}_4, \text{Rh}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$

Very sol.  $\text{H}_2\text{O}$ ; melts in crystal  $\text{H}_2\text{O}$  at  
 $102-103^\circ$ . (Piccini, Z. anorg. 1901, 27. 67.)

Ammonium samarium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,  
 $\text{Sm}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 43.  
 166.)

Ammonium scandium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,  
 $\text{Sc}_2(\text{SO}_4)_3$

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

Sol. in  $\text{H}_2\text{O}$  and in dil.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$   
 (R. J. Meyer, Z. anorg. 1914, 86. 279.)

Ammonium sodium sulphate,  $\text{NH}_4\text{NaSO}_4 +$   
 $2\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 46.6 pts. of cryst. salt  
 at  $15^\circ$ , and the solution has a sp. gr. of 1.1749.

Sp. gr. of aqueous solution containing:

31.8 24.44 15.9%  $\text{NH}_4\text{NaSO}_4 + 2\text{H}_2\text{O}$ ,  
 1.1749 1.1380 1.0849  
 12.72 6.36 %  $\text{NH}_4\text{NaSO}_4 + 2\text{H}_2\text{O}$ .  
 1.0679 1.0337  
 (Schiff, A. 114. 68.)

Ammonium strontium sulphate.

Insol. in excess of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$  (Rose,  
 Pogg. 110. 296.)

$(\text{NH}_4)_2\text{SO}_4, \text{SrSO}_4$ . This double salt is  
 only stable in contact with nearly sat. solutions  
 of  $(\text{NH}_4)_2\text{SO}_4$ . (Barre, C. R. 1909, 149.  
 293.)

Ammonium tellurium sulphate,  
 $(\text{NH}_4)\text{HSO}_4, 2\text{TeO}_3, \text{SO}_3 + 2\text{H}_2\text{O}$ .

As K salt. (Metzner, A. ch. 1898, (7)  
 15. 203.)

Ammonium thallic sulphate,  $\text{NH}_4\text{TI}(\text{SO}_4)_2$ .

(Marshall, C. C. 1902, II. 1089.)

$+ 4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Easily sol.  
 in dil. acids. (Fortini, Gazz. ch. it. 1905, 35.  
 (2) 450.)

**Ammonium thorium sulphate,  $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2$** 

Easily sol. in  $\text{H}_2\text{O}$  and sat.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$  (Cleve)  
 $+ 2\text{H}_2\text{O}$ . (Barre.)  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$ . (Barre, A. ch. 1911, (8) 24, 240.)  
 $3(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ . (B)

**Ammonium titanium sulphate,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{TiO}_2 \cdot \text{SO}_4 + \text{H}_2\text{O}$** 

Very sol. in  $\text{H}_2\text{O}$  with decomp.  
 Insol. in conc.  $\text{H}_2\text{SO}_4$ . (Rosenheim, Z. anorg. 1901, 26, 252.)  
 $(\text{NH}_4)_2\text{O} \cdot 2\text{TiO}_2 \cdot 2\text{SO}_3 + 3\text{H}_2\text{O}$ . Slowly decomp. by  $\text{H}_2\text{O}$ . (Blondel, Bull. Soc. 1899, (3) 21, 262.)

**Ammonium titanium sesquisulphate,  $(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{Ti}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$** 

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$ .  
 Insol. in  $\text{H}_2\text{SO}_4$ . Decomp. by boiling with conc.  $\text{H}_2\text{SO}_4$ . (Stahler, B. 1905, 38, 2623.)

**Ammonium uranous sulphate,  $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{U}(\text{SO}_4)_2$** 

Easily sol. in  $\text{H}_2\text{O}$  (Rammelsberg.)  
 Sol. in  $\text{H}_2\text{O}$  but solution rapidly decomp. (Kohlschutter, B. 1901, 34, 3630.)

**Ammonium uranyl sulphate,  $(\text{NH}_4)_2\text{SO}_4 \cdot (\text{UO}_2)_2\text{SO}_4 + 2\text{H}_2\text{O}$** 

Quite difficultly sol. in  $\text{H}_2\text{O}$  (Arfvedson)

**Ammonium vanadous sulphate,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{VSO}_4 + 6\text{H}_2\text{O}$** 

Decomp. in the air.  
 Sol. in  $\text{H}_2\text{O}$ . (Piccini, Z. anorg. 1899, 19, 205.)

Less sol. in  $\text{H}_2\text{O}$  than  $\text{VSO}_4 + 7\text{H}_2\text{O}$ . (Piccini and Marino, Z. anorg. 1902, 32, 60.)

**Ammonium vanadic sulphate,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{V}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$** 

Insol. in  $\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{SO}_4$ . Decomp. by boiling with conc.  $\text{H}_2\text{SO}_4$ .  
 Sol. in  $\text{HCl}$ . (Stahler, B. 1905, 38, 3980.)  
 $+ 24\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ ; decomp. in the air. (Piccini, Z. anorg. 1896, 11, 108.)  
 100 pts  $\text{H}_2\text{O}$  dissolve 39.76 pts. salt at  $10^\circ$   
 Sp. gr. of sat. solution at  $4^\circ/20^\circ = 1.687$  (Piccini, Z. anorg. 1897, 13, 446.)  
 1 l.  $\text{H}_2\text{O}$  dissolves 31.69 g. anhydrous or 78.51 g. hydrated salt at  $25^\circ$ , or 1.210 g. mols. anhydrous salt are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ .  
 Mpt of crystals =  $45^\circ$ . (Locke, Am. Ch. J. 1901, 26, 175.)

**Ammonium vanadyl sulphate,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{VOSO}_4 + 3\frac{1}{2}\text{H}_2\text{O}$** 

Easily sol. in  $\text{H}_2\text{O}$  and in a mixture of alcohol and conc.  $\text{H}_2\text{SO}_4$ , but cannot be recryst. therefrom. (Koppel and Behrendt, Z. anorg. 1903, 35, 176.)

$(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{VOSO}_4 + \text{H}_2\text{O}$  Deliquescent. Slowly but abundantly sol. in  $\text{H}_2\text{O}$ , but cannot be recryst. from it except by addition of  $\text{H}_2\text{SO}_4$ . (Koppel and Behrendt, Z. anorg. 1903, 35, 172.)

**Ammonium yttrium sulphate,  $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{Y}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$** 

Sol. in  $\text{H}_2\text{O}$ . (Cleve)

**Ammonium zinc sulphate,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{ZnSO}_4 + 6\text{H}_2\text{O}$** 

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{ZnSO}_4$  at:

$0^\circ$	$10^\circ$	$13^\circ$	$15^\circ$	$20^\circ$
7 3	8 8	10 0	12 5	12 6
pts. salt,				
$30^\circ$	$45^\circ$	$60^\circ$	$75^\circ$	$85^\circ$
16 5	21 7	29 7	37 8	46 2
pts. salt.				
(Tobler, A. 96, 193.)				

1 l.  $\text{H}_2\text{O}$  dissolves 140.8 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27, 469.)  
 $+ 7\text{H}_2\text{O}$  (André, C. R. 104, 987)

**Ammonium zirconium sulphate.**

Sol. in cold or hot  $\text{H}_2\text{O}$  or in acids. (Berzelius.)

**Ammonium sulphate antimony fluoride,  $(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{SbF}_6$** 

Very sol. in  $\text{H}_2\text{O}$ . (Mayer, B. 1894, 27, R. 922.)

**Ammonium sulphate chromic chloride,  $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CrCl}_3 + 6\text{H}_2\text{O}$** 

Sol. in  $\text{H}_2\text{O}$ . (Wernland, B. 1907, 40, 3768.)

**Ammonium sulphate hydrogen peroxide,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{H}_2\text{O}_2$** 

Efflorescent in air.  
 Easily sol. in  $\text{H}_2\text{O}$ . (Willstätter, B. 1903, 36, 1829.)

**Antimony sulphate basic,  $7\text{Sb}_2\text{O}_3 \cdot 2\text{SO}_3 + 3\text{H}_2\text{O}$** 

Insol. in, and not decomp. by hot or cold  $\text{H}_2\text{O}$  (Adie, Chem. Soc. 57, 540.)  
 $5\text{Sb}_2\text{O}_3 \cdot 2\text{SO}_3 + 7\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Hensgen, R. t. o. 4, 401.)  
 $2\text{Sb}_2\text{O}_3 \cdot \text{SO}_3 + x\text{H}_2\text{O}$ . Not decomp. by cold  $\text{H}_2\text{O}$ . (Adie.)  
 $\text{Sb}_2\text{O}_3 \cdot \text{SO}_3 = (\text{SbO})_2\text{SO}_4$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Peligot, J. B. 1847, 426.)  
 $+ \text{H}_2\text{O}$ . As above. (Adie.)  
 $\text{Sb}_2\text{O}_3 \cdot 2\text{SO}_3$ , and  $+ \text{H}_2\text{O}$ , and  $+ 2\text{H}_2\text{O}$ . Scarcely decomp. by cold, slowly by boiling  $\text{H}_2\text{O}$ . Slowly sol. in dil.  $\text{HCl} + \text{Aq.}$  (Adie.)

**Antimony sulphate,  $\text{Sb}_2(\text{SO}_4)_3$** 

Very deliquescent. Combines with  $\text{H}_2\text{O}$  to a hard mass with evolution of heat; with more  $\text{H}_2\text{O}$  it becomes liquid, and by repeated treat-

ment with much boiling  $\text{H}_2\text{O}$  it is wholly decomp. into  $\text{H}_2\text{SO}_4$  and  $\text{Sb}_2\text{O}_3$  (Henagen, R. t. c. 4. 401)

Antimony sulphate, acid,  $\text{Sb}_2\text{O}_3$ ,  $4\text{SO}_3$ ,

Decomp by  $\text{H}_2\text{O}$  (Adie)  
 $\text{Sb}_2\text{O}_3 + 8$ , or  $9\text{SO}_3$  Decomp by  $\text{H}_2\text{O}$ . (Adie)

Antimony barium sulphate,  
 $\text{Sb}_2(\text{SO}_4)_3$ ,  $\text{BaSO}_4 + 6\text{H}_2\text{O}$ .

As Ca comp (Kühl, Z. anorg. 1907, 54. 257.)

Antimony caesium sulphate,  $\text{SbCs}(\text{SO}_4)_2$ .

Slowly decomp by cold  $\text{H}_2\text{O}$ . (Gutman, Arch. Pharm. 1908, 246. 188)

Antimony calcium sulphate,  
 $\text{Sb}_2(\text{SO}_4)_3$ ,  $\text{CaSO}_4 + 6\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Kühl, Z. anorg. 1907, 54. 257.)

Antimony lithium sulphate,  $\text{SbLi}(\text{SO}_4)_2$ .

Decomp by  $\text{H}_2\text{O}$  (Gutman, Arch. Pharm. 1908, 246. 187.)

Antimony potassium sulphate,  $\text{KSb}(\text{SO}_4)_2$ .

Decomp. by  $\text{H}_2\text{O}$  (Gutmann, Arch. Pharm. 1898, 236. 478)

Antimony rubidium sulphate,  $\text{SbRb}(\text{SO}_4)_2$ .

Slowly decomp by cold  $\text{H}_2\text{O}$ . (Gutman.)

Antimony silver sulphate,  $\text{SbAg}(\text{SO}_4)_2$ .

Slowly decomp. by  $\text{H}_2\text{O}$ . (Kühl, Z. anorg. 1907, 54. 258.)

Slowly decomp. by cold  $\text{H}_2\text{O}$  (Gutman Arch. Pharm. 1908, 246. 189.)

Antimony sodium sulphate,  $\text{NaSb}(\text{SO}_4)_2$ .

Easily decomp. by  $\text{H}_2\text{O}$  (Gutmann, Arch. Pharm. 1898, 236. 478.)

Antimony strontium sulphate,  $\text{Sb}_2(\text{SO}_4)_3$ ,  
 $\text{SrSO}_4 + 6\text{H}_2\text{O}$ .

As Ca comp. (Kühl, Z. anorg. 1907, 54. 257.)

Antimony thallium sulphate,  $\text{SbTl}(\text{SO}_4)_2$ .

Slowly decomp. by cold  $\text{H}_2\text{O}$ . Decomp. by conc.  $\text{H}_2\text{SO}_4$ . (Gutman, Arch. Pharm. 1908, 246. 189.)

Arsenic sulphate.

See Arsenic sulphur trioxide.

Barium sulphate,  $\text{BaSO}_4$ .

Sol. in 43,000 pts  $\text{H}_2\text{O}$  (Kurvan); in 200,000 pts.  $\text{H}_2\text{O}$  (Margueritte, C. R. 38. 308)  
 100 pts  $\text{H}_2\text{O}$  dissolve 0.002 pt.  $\text{BaSO}_4$ . (Ure's Dict)

$\text{BaCl}_2 + \text{Aq}$  containing 1 pt.  $\text{BaO}$  to 71,000 pts  $\text{H}_2\text{O}$ , when treated with  $\text{H}_2\text{SO}_4$ , becomes turbid in  $\frac{1}{2}$  hour (Hartung, J. pr. 22. 32)

$\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  containing 1 pt.  $\text{BaO}$  to 25,000 pts  $\text{H}_2\text{O}$  gives a distinct cloud with  $\text{H}_2\text{SO}_4$  or  $\text{Na}_2\text{SO}_4 + \text{Aq}$ , with 50,000–100,000 pts  $\text{H}_2\text{O}$  a slight turbidity is produced, with 200,000–400,000 pts  $\text{H}_2\text{O}$  the mixture becomes turbid in a few minutes, while with 800,000 pts  $\text{H}_2\text{O}$  no action is visible (Lassaigne, J. Chim. Méd. 8. 526)

Sol. in 800,000 pts.  $\text{H}_2\text{O}$  (Calvert); in 400,000 pts. cold or hot  $\text{H}_2\text{O}$  (Fresenius).

Calculated from the electrical conductivity of the solution,  $\text{BaSO}_4$  is sol in 429,700 pts.  $\text{H}_2\text{O}$  at  $18.4^\circ$ , and 320,000 pts. at  $37.7^\circ$ . (Holleman, Z. phys. Ch. 12. 131)

1 l  $\text{H}_2\text{O}$  dissolves 1.72 mg at  $2^\circ$ ; 1.97 mg. at  $10^\circ$ ; 2.29 mg. at  $19.0^\circ$ ; 2.60 mg. at  $26^\circ$ ; 2.91 mg. at  $34^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241)

Calculated from the electrical conductivity of the solution,  $\text{BaSO}_4$  is sol in 425,000 pts  $\text{H}_2\text{O}$  at  $18.3^\circ$ . Results of Fresenius and Hintz (Z. anal. 1896, 35. 170) are incorrect. (Küster, Z. anorg. 1896, 12. 207.)

Sat. aq. solution contains 2.29 mg.  $\text{BaSO}_4$  per liter at  $25^\circ$  when particles of salt are not less than  $1.8\mu$  in diameter.

Sat. aq. solution contains 4.15 mg.  $\text{BaSO}_4$  per liter at  $25^\circ$  when particles of salt are  $0.1\mu$  in diameter ( $\mu = 0.0001 \text{ cm}$ ) (Hulett, Z. phys. Ch. 1901, 37. 398–9.)

In general the influence of the size of the grain on the solubility of the substance is negligible when the solubility exceeds 2%. The increase of normal solubility by using finely divided solids, amounts to 80% in the case of  $\text{BaSO}_4$ . (Hulett, Z. phys. Ch. 1904, 47. 366)

1 l.  $\text{H}_2\text{O}$  dissolves 2.3 mg.  $\text{BaSO}_4$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

Calculated from electrical conductivity of  $\text{BaSO}_4 + \text{Aq}$ .

0.0190 milh-equivalents are sol. in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$  0.0212 at  $25^\circ$ , 0.0288 at  $50^\circ$ ; 0.0334 at  $100^\circ$ .

(Melcher, J. Am. Chem. Soc. 1910, 32. 55.)

Not attacked by cold  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$  after several hours, and only in traces after several days. On boiling, traces of  $\text{BaSO}_4$  dissolve, and the liquid after cooling can be precipitated by  $\text{BaCl}_2$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but not by  $\text{H}_2\text{O}$  alone (Rose, Pogg. 95. 108)

By washing  $\text{BaSO}_4$  long enough with  $\text{H}_2\text{O}$  containing  $\text{HCl}$  or  $\text{HNO}_3$ ,  $[\text{HCl} \cdot \text{H}_2\text{O}_2]$  (Siegle), the filtrate can be precipitated by  $\text{H}_2\text{SO}_4$  or  $\text{BaCl}_2$ . (Piria, J. B. 1856. 334.)

1000 pts. 3%  $\text{HCl} + \text{Aq}$  dissolve 0.06 pt.  $\text{BaSO}_4$  in the cold, and still more on boiling.

230 ccm  $\text{HCl} + \text{Aq}$  of 1.02 sp. gr. dissolve 0.048 g.  $\text{BaSO}_4$  from 0.679 g.  $\text{BaSO}_4$  when boiled  $\frac{1}{4}$  hour

168 ccm  $\text{HCl} + \text{Aq}$  of 1.03 sp. gr. dissolve 0.0075 g.  $\text{BaSO}_4$  from 0.577 g.  $\text{BaSO}_4$  when boiled 5 minutes. (Siegle, J. pr. 69. 142)

Solubility of  $\text{BaSO}_4$  in  $\text{HCl} + \text{Aq}$ 

No cc $\text{HCl} + \text{Aq}$ containing 1 mg equiv $\text{HCl}$	Mg $\text{BaSO}_4$ per 1 mg equiv of $\text{HCl}$	g per 100 cc solution	
		$\text{HCl}$	$\text{BaSO}_4$
2.0	0.133	1.82	0.0067
1.0	0.089	3.65	0.0089
0.5	0.056	7.29	0.0101
0.2	0.017	18.23	0.0086

(Banthusch, J pr 1884, 29. 54)

100,000 pts  $\text{H}_2\text{O}$  dissolve 0.124 pt.  $\text{BaSO}_4$ ; 1000 pts.  $\text{HNO}_3 + \text{Aq}$  of 1.167 sp. gr. dissolve 2 pts.  $\text{BaSO}_4$ ; 1000 pts.  $\text{HNO}_3 + \text{Aq}$  of 1.032 sp. gr. dissolve 0.062 pt  $\text{BaSO}_4$ . (Calvert, Chem. Gaz. 1856. 55)

When 0.4 g.  $\text{BaSO}_4$  is heated  $\frac{1}{4}$  hour with 150 ccm.  $\text{HNO}_3 + \text{Aq}$  of 1.02 sp. gr., 0.165 g. is dissolved. (Siegle, J. pr. 69. 142.)

Solubility of  $\text{BaSO}_4$  in  $\text{HNO}_3 + \text{Aq}$ 

No cc $\text{HNO}_3 + \text{Aq}$ containing 1 mg equiv $\text{HNO}_3$	Mg $\text{BaSO}_4$ per 1 mg. equiv of $\text{BaSO}_4$	G per 100 cc. solution	
		$\text{HNO}_3$	$\text{BaSO}_4$
2.0	0.140	3.15	0.0070
1.0	0.107	6.31	0.0107
0.5	0.085	12.61	0.0170
0.2	0.048	31.52	0.0241

(Banthusch, J pr 1884, 29. 54.)

Acetic acid has less solvent power than other acids. 80 ccm.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  of 1.02 sp. gr. boiled with 0.4 g.  $\text{BaSO}_4$   $\frac{1}{4}$  hour dissolve 0.002 g. (Siegle, J. pr. 69. 142.)

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ . (See  $\text{BaH}_2(\text{SO}_4)_2$ .)

Sol. in fuming  $\text{H}_2\text{SO}_4$ . (See  $\text{BaS}_2\text{O}_7$ .)

Sol. in 2500 pts. boiling 40%  $\text{HBr} + \text{Aq}$ ; in 6000 pts. boiling 40%  $\text{HI} + \text{Aq}$ . (Haslam, C. N. 53. 87.)

Sol. in considerable amount in metaphosphoric acid +  $\text{Aq}$ . (Scheerer and Drechsel, J. pr. (2) 7. 68.)

Not attacked by boiling conc.  $\text{KOH} + \text{Aq}$  if  $\text{CO}_2$  is not present. (Rose, Pogg. 95. 104.)

Very sl. decomp. by standing a long time with cold conc. alkali carbonates +  $\text{Aq}$ .

Decomp. by boiling  $\text{Na}_2\text{CO}_3$  or  $\text{K}_2\text{CO}_3 + \text{Aq}$ , not by  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (See Storer's Dict. for analytical data.)

Very sl. sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ , 1 pt. dissolving in 230,000 pts sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ .

500 ccm. sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  with 50 ccm. sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  dissolve 2 g.  $\text{BaSO}_4$ . 100 ccm. sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  with 100 ccm. sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  dissolve only 0.08 g.  $\text{BaSO}_4$ , therefore above solubility is due to free chlorine. (Mittentzwey, J. pr. 75. 214.)

$\text{BaSO}_4$  cannot be precipitated from solutions containing free  $\text{Cl}_2$ . (Erdmann, J. pr. 75. 215.)

Pptn is retarded sl. by tartaric and racemic acids. (Spiller.)

$\text{Na}$  metaphosphate prevents pptn of  $\text{BaSO}_4$ , but not ortho- or pyrophosphate. (Scheerer, J. pr. 75. 114.)

Not precipitated in presence of alkali citrates. (Spiller.)

Much less sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  than in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . Insol. in warm conc.  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Diehl, J. pr. 79. 431.)

Not appreciably sol. in  $\text{H}_2\text{O}$  containing ammonium or sodium chloride. (Brett, Wittstein, Wackenroder.)

Not appreciably sol. in  $\text{H}_2\text{O}$  at  $250^\circ$ , or in  $\text{H}_2\text{O}$  containing  $\text{Na}_2\text{S}$ . (Senarmont.)

Solubility is increased by alkali nitrates, but not appreciably by  $\text{NaCl}$ ,  $\text{KClO}_3$ , or  $\text{Ba}(\text{NO}_3)_2$ . (Fresenius, Z. anal. 9. 52.) Scarcely sol. in boiling conc.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Fresenius.)

Solubility in  $\text{H}_2\text{O}$  increased by presence of  $\text{MgCl}_2$  (Fresenius); cerium salts (Marignac).

Sol. in  $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ . (Lunge, Z. anal. 19. 141.)

Solubility in various salts +  $\text{Aq}$  at  $20-25^\circ$ 

g salt per l.	Mg $\text{BaSO}_4$ dissolved per l. in		
	$\text{FeCl}_3$	$\text{AlCl}_3$	$\text{MgCl}_2$
1	58	33	30
2.5	72	43	30
5	115	60	33
10	123	94	33
25	150	116	50
50	160	170	50
100	170	175	50

(Fraps, Am. Ch. J. 1902, 27. 290.)

Solubility in sat. solution of various salts +  $\text{Aq}$ .

Salt	G. $\text{BaSO}_4$ sol. in 1 l. of the solvent
$\text{NaNO}_3$	0.2940
$\text{NaCl}$	0.00783
$\text{NH}_4\text{Cl}$	0.00827

(Ehlert, Z. Elektrochem. 1912, 18. 728.)

Conc.  $\text{CrCl}_3 + \text{Aq}$  dissolves 40-120 times as much  $\text{BaSO}_4$  as  $\text{H}_2\text{O}$ , when boiled therewith for 5 days; conc.  $\text{CrCl}_3 + \text{Aq}$  acidified with  $\text{HCl}$ , 450 times as much in 10 days. (Kuster, Z. anorg. 1905, 43. 348.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ . (Gawalowski, C. C. 1906, II. 7.)

100 cc. 95% formic acid dissolve 0.01 g.  $\text{BaSO}_4$  at  $18.5^\circ$ . (Aschan, Ch. Ztg. 1913, 37. 1117.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Min. Barite.

**Barium hydrogen sulphate,  $\text{BaH}_2(\text{SO}_4)_2$ .**

100 pts.  $\text{H}_2\text{SO}_4$  dissolve 222 pts.  $\text{BaSO}_4$  (Lies-Bodart and Jacquemin, C. R. 46. 1206); 569 pts.  $\text{BaSO}_4$  (Struve, Z. anal. 9. 34).

Boiling  $\text{H}_2\text{SO}_4$  dissolves 10-12% freshly precipitated  $\text{BaSO}_4$  without separating crystals on cooling.  $\text{H}_2\text{SO}_4$  at  $100^\circ$  dissolves more than boiling  $\text{H}_2\text{SO}_4$  and becomes cloudy if heated to boiling. (Schultz, Pogg. 133. 146.)

1 g.  $\text{BaSO}_4$  pptd. from  $\text{BaCl}_2$  is sol. in 3153 g. 91%  $\text{H}_2\text{SO}_4$ , from  $\text{Ba}(\text{NO}_3)_2$  is sol. in 1519 g. 91%  $\text{H}_2\text{SO}_4$ . (Varenne and Pauleau, C. R. 93. 1016.)

100 pts hot conc.  $\text{H}_2\text{SO}_4$  dissolve approx. 6 pts  $\text{BaSO}_4$  (Rohland, Z. anorg. 1910, 66. 206.)

10 ccm of sat.  $\text{BaSO}_4$ +absolute  $\text{H}_2\text{SO}_4$  contain approx. 2.851 g.  $\text{BaSO}_4$ . (Bergius, Z. phys. Ch. 1910, 72. 355.)

**Equilibrium in the system  $\text{BaSO}_4$ + $\text{H}_2\text{SO}_4$ + $\text{H}_2\text{O}$  at  $25^\circ$ .**

Composition of the solution

% $\text{H}_2\text{SO}_4$	g $\text{BaSO}_4$ per l	Solid phase
73.83	0.030	$\text{BaSO}_4$
78.04	0.135	"
80.54	0.285	"
83.10	0.800	"
85.78	3.215	$\text{BaSO}_4$ , $2\text{H}_2\text{SO}_4$ , $\text{H}_2\text{O}$
88.08	12.200	"
93.17	49.665	$\text{BaSO}_4$ , $\text{H}_2\text{SO}_4$

(Volkhonski, C. C. 1910, I. 1954, C. A. 1911. 617.)

Decomp. by  $\text{H}_2\text{O}$ , alcohol, or ether.

+ $2\text{H}_2\text{O}$ . (Schultz.)

$\text{BaSO}_4$ ,  $2\text{H}_2\text{SO}_4$ + $\text{H}_2\text{O}$ . (Volkhonski.)

**Barium pyrosulphate,  $\text{Ba}_2\text{O}_7$ .**

100 pts. fuming  $\text{H}_2\text{SO}_4$  dissolve 15.89 pts.  $\text{Ba}_2\text{O}_7$  (Struve, Z. anal. 9. 34.)

Very deliquescent.

Decomp. with  $\text{H}_2\text{O}$  with hissing (Schultz-Sellack, B. 4. 111.)

**Barium calcium sulphate,  $3\text{BaSO}_4$ ,  $\text{CaSO}_4$ .**

Min. *Dreelite*

**Barium platnic sulphate (?).**

Insol. in  $\text{H}_2\text{O}$  or boiling  $\text{HCl}$  or  $\text{HNO}_3$ +Aq. Sol. in hot conc.  $\text{H}_2\text{SO}_4$  or aqua regia (E. Davy)

**Barium tin (stannic) sulphate,  $\text{BaSO}_4$ ,  $\text{Sn}(\text{SO}_4)_2$ + $3\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  Insol. in  $\text{HCl}$  (Weinland and Kühl, Z. anorg. 1907, 54. 249.)

**Barium titanium sulphate,  $2\text{BaSO}_4$ ,  $3\text{Ti}(\text{SO}_4)_2$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ , giving titanamic acid. (Weinland, Z. anorg. 1907, 54. 255.)

**Barium sulphate potassium chloride,  $3\text{BaSO}_4$ ,  $\text{KCl}$** 

Ppt (Silberberger, M. 1904, 25. 233.)

**Bismuth sulphate, basic,  $(\text{BiO})_2\text{SO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ +Aq.

+ $2\text{H}_2\text{O}$  (Heintz, Pogg. 63. 55.)

$4\text{Bi}_2\text{O}_3$ ,  $3\text{SO}_3$ + $15\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Leist.)

$(\text{BiO})\text{HSO}_4$ + $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4$ +Aq.

+ $2\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$  with separation of  $(\text{BiO})_2\text{SO}_4$ + $2\text{H}_2\text{O}$ . (Heintz.)

$3\text{Bi}_2\text{O}_3$ ,  $2\text{SO}_3$ + $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Athanasesco, C. R. 103. 271.)

$5\text{Bi}_2\text{O}_3$ ,  $11\text{SO}_3$ + $17\text{H}_2\text{O}$ . This sulphate crystallizes out from sulphuric acid of any strength between  $\text{H}_2\text{SO}_4$ ,  $6\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ ,  $12\text{H}_2\text{O}$  (Adie, Proc. Chem. Soc. 1899, 16. 226.)

$\text{Bi}_2\text{O}_3$ ,  $2\text{SO}_3$ ,  $2\frac{1}{2}\text{H}_2\text{O}$  is in equilibrium at  $50^\circ$  with 5.4-51.4%  $\text{H}_2\text{SO}_4$ +Aq.

$\text{Bi}_2\text{O}_3$ ,  $\text{SO}_3$  is in equilibrium at  $50^\circ$  with acid solutions weaker than 5.4%  $\text{H}_2\text{SO}_4$ . (Allan, Am. Ch. J. 1902, 27. 287.)

**Bismuth sulphate,  $\text{Bi}_2(\text{SO}_4)_3$ .**

Very hygroscopic. Takes up  $\text{H}_2\text{O}$  with strong evolution of heat to form  $2\text{Bi}_2(\text{SO}_4)_3$ + $7\text{H}_2\text{O}$ , which becomes  $\text{Bi}_2(\text{SO}_4)_3$ + $3\text{H}_2\text{O}$  at  $100^\circ$ . Decomp. by boiling  $\text{H}_2\text{O}$  into  $\text{Bi}_2\text{O}_3$ ,  $\text{SO}_3$ + $\text{H}_2\text{O}$ . (Hengstenberg, J. B. 1885. 552.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790.)

**Bismuth sulphate, acid,  $\text{Bi}_2\text{O}_7$ ,  $4\text{SO}_3$ .**

$\text{Bi}_2\text{O}_7$ ,  $4\text{SO}_3$  is in equilibrium at  $50^\circ$  with 51.4-90%  $\text{H}_2\text{SO}_4$ +Aq. (Allan, Am. Ch. J. 1902, 27. 287.)

+ $\text{H}_2\text{O}$  Crystallizes out from sulphuric acid at temp. above  $170^\circ$ . (Adie, Proc. Chem. Soc. 1899, 16. 226.)

+ $3\text{H}_2\text{O}$ . Crystallizes from sulphuric acid of any strength between  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ ,  $2\text{H}_2\text{O}$ . (Adie.)

+7, or  $9\text{H}_2\text{O}$ = $\text{BiH}(\text{SO}_4)_2$ + $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids, especially  $\text{HCl}$ , and  $\text{HNO}_3$ +Aq. (Leist, A. 160. 29.)

+ $7\text{H}_2\text{O}$ . Crystallizes out from sulphuric acid of any strength between  $\text{H}_2\text{SO}_4$ ,  $3\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ ,  $5\text{H}_2\text{O}$ .

+ $10\text{H}_2\text{O}$ . Crystallizes out from sulphuric acid at temp. below  $170^\circ$ . (Adie.)

**Bismuth potassium sulphate,  $\text{Bi}_2(\text{SO}_4)_3$ ,  $3\text{K}_2\text{SO}_4$  (?).**

Decomp. by  $\text{H}_2\text{O}$ ; insol. in sat.  $\text{K}_2\text{SO}_4$ +Aq. (Heintz.)

$\text{Bi}_2(\text{SO}_4)_3$ ,  $2\text{K}_2\text{SO}_4$ .

$\text{BiK}(\text{SO}_4)_2$ = $\text{Bi}_2(\text{SO}_4)_3$ ,  $\text{K}_2\text{SO}_4$ . Insol. in cold  $\text{H}_2\text{O}$ , decomp. by boiling. (Brigham, Am. Ch. J. 14. 170.)

Bismuth sodium sulphate,  $\text{Bi}_4\text{Na}_2(\text{SO}_4)_6$ .

(Lüdecke, A. 140. 277)

Boron sulphate.

See Borosulphuric acid.

Bromomolybdenum sulphate.

See under Bromomolybdenum compounds.

Cadmium sulphate, basic,  $2\text{CdO}$ ,  $\text{SO}_3$ , and  $+\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . (Stromeyer.) Sl. sol. in hot  $\text{H}_2\text{O}$ . (Habermann, M. 6. 432.)  
 $4\text{CdO}$ ,  $\text{SO}_3$ . (Pickering, Chem. Soc. 1907, 91. 1987.)

Cadmium sulphate,  $\text{CdSO}_4$ .Sat.  $\text{CdSO}_4 + \text{Aq}$  contains at.

0°	10°	24°	30°	65°	
35.9	37.5	41.5	42.0	49.7%	CdSO <sub>4</sub>
80°	94°	130°	165°	188°	200°
43.5	51.6	27.7	14.7	7.1	2.3% CdSO <sub>4</sub>

$\text{CdSO}_4$  easily forms supersat. solutions.  
 (Étard, A. ch. 1894, (7) 2. 552.)

Solubility in  $\text{H}_2\text{O}$ 

$t^\circ$	Per cent $\text{CdSO}_4$ in sat. solution	Solid phase
-18	43.35	$\text{CdSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
-10	43.27	
0	43.01	
+10	43.18	
15	43.20	
20	43.37	
30	43.75	
40	43.99	
60	44.99	
62	45.06	
72	46.2	$\text{CdSO}_4 \cdot \text{H}_2\text{O}$
78.5	46.6	
74.5	46.7	
75	46.5	
77	42.2	
78.5	41.5	
85	39.6	
90	38.7	
95	38.1	
100	37.8	

(Mylius and Funk, B. 1897, 30. 825)

See also under  $\text{CdSO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ , and  $7\text{H}_2\text{O}$ 

Sp. gr. at  $0^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 14.0 g.  $\text{CdSO}_4$  in 1000 g.  $\text{H}_2\text{O} = 1.0122$ .

Sp. gr. at  $12^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 14.0 g.  $\text{CdSO}_4$  in 100 g.  $\text{H}_2\text{O} = 1.0121$

Sp. gr. at  $12^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 57.2 g.  $\text{CdSO}_4$  in 1000 g.  $\text{H}_2\text{O} = 1.0514$ .

Sp. gr. at  $0^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 183.1 g.  $\text{CdSO}_4$  in 1000 g.  $\text{H}_2\text{O} = 1.1552$ .

Sp. gr. at  $18^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 183.1 g.  $\text{CdSO}_4$  in 1000 g.  $\text{H}_2\text{O} = 1.1529$ .

(Fouqué, Ann. Observ. 1868, 9. 172.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$  at  $18^\circ$ .

% $\text{CdSO}_4$	1	5	10	15
Sp. gr.	1.0084	1.0486	1.1026	1.1607

% $\text{CdSO}_4$	20	25	30	35
Sp. gr.	1.2245	1.295	1.3725	1.4575

% $\text{CdSO}_4$	36
Sp. gr.	1.4743

(Grotnan, W. Ann. 1883, 18. 193.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$  at room temp. containing

7.14	14.66	22.011 % $\text{CdSO}_4$
1.0681	1.1591	1.2681

(Wagner, W. Ann. 1883, 18. 268.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$  at  $25^\circ$ 

Concentration of $\text{CdSO}_4 + \text{Aq}$	Sp. gr.
1-normal	1.0973
$\frac{1}{15}$ " "	1.0487
$\frac{1}{10}$ " "	1.0244
$\frac{1}{8}$ " "	1.0120

(Wagner, Z. phys. Ch. 1890, 5. 36.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$ .

% $\text{CdSO}_4$	$t^\circ$	Sp. gr. at $t^\circ$	Sp. gr. at $18^\circ$
0.0289	17.29	0.99908	0.99893
	23.65	0.99776	
0.0498	18.00		0.99915
0.0999	18.00		0.99961
0.495	18.00		1.0034
0.981	18.00		1.0084

(Wershofen, Z. phys. Ch. 1890, 5. 494.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 29.4654%  $\text{CdSO}_4 = 1.36289$ ; containing 21.3671%  $\text{CdSO}_4 = 1.24211$ . (Schönrock, Z. phys. Ch. 1893, 11. 781.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$  at  $18^\circ/4^\circ$ .

% $\text{CdSO}_4$	25.121	18.172
Sp. gr.	1.297	1.200

% $\text{CdSO}_4$	9.952	5.639
Sp. gr.	1.101	1.055

(do Muynck, W. Ann. 1894, 53. 561)

$\text{CdSO}_4 + \text{Aq}$  containing 13.40%  $\text{CdSO}_4$  has sp. gr.  $20^\circ/20^\circ = 1.1429$ .

$\text{CdSO}_4 + \text{Aq}$  containing 16.79%  $\text{CdSO}_4$  has sp. gr.  $20^\circ/20^\circ = 1.1847$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 282.)

Sp gr of  $\text{CdSO}_4$  at 18°, when p = per cent strength of solution; d = observed density, w = volume conc in grams per cc ( $\frac{pd}{100} = w$ )

p	d	w
39.86	1.5639	0.6231
31.53	1.4080	0.4439
20.85	1.3310	0.3574
24.17	1.2901	0.3118
18.35	1.2084	0.2217
13.27	1.1437	0.1518
9.97	1.1045	0.1102
7.46	1.0764	0.0803
6.12	0.0619	0.0650
2.52	0.0242	0.0259
1.45	0.0132	0.0147
0.464	0.0033	0.0046

(Barnes, J. phys. Ch. 1898, 2. 543.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$  sat. at 25° and 1 atm. = 1.617 (Sunnige, Z. phys. Ch. 1909, 67. 518.)

See also under  $\text{CdSO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ , and  $+4\text{H}_2\text{O}$  Insol in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329); methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

$+ \text{H}_2\text{O}$ . See Mylius and Funk, under  $\text{CdSO}_4$ .

$+1\frac{1}{3}\text{H}_2\text{O}$ . (Worobieff, Bull. Soc. 1896, (3) 16. 1754.)

$+2\frac{1}{2}\text{H}_2\text{O}$  1 pt.  $\text{H}_2\text{O}$  dissolves 0.59 pt. anhydrous salt at 23°, and not much more on heating. Sat. solution boils at 102°. Precipitated by alcohol (v. Hauer)

100 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{CdSO}_4$  at t°.

t°	G $\text{CdSO}_4$
0	75.52
5	75.65
7	65.73
9	75.85
11.5	75.94
13	76.04
15	76.11
16	76.16
17	76.13
18	76.14
19	76.18
25	76.79

(Kohnstamm and Cohen, W. Ann. 1898, 65. 352.)

100 pts.  $\text{H}_2\text{O}$  dissolves at:

13.7° 14.98° 15.0° 16.0°  
76.06 76.09 76.14 76.18 pts. anhydrous salt,  
16.96° 18.0° 19.0° 25.0°  
76.26 76.32 76.39 76.81 pts. anhydrous salt.  
(Steinwehr, W. Ann. 1902, (4) 9. 1050.)

100 g.  $\text{H}_2\text{O}$  dissolve 76.02 g.  $\text{CdSO}_4$  at 25°. (Stortenbecker, Z. phys. Ch. 1900, 34. 109.)

Solubility of  $\text{CdSO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$  at 25° and varying pressures

Pressure in atmospheres	G $\text{CdSO}_4$ in 100 g. $\text{H}_2\text{O}$
1	76.80
500	77.85
500	78.08
1000	78.77
1000	78.68

Det. by another method

Pressure in atmospheres	G $\text{CdSO}_4$ in 100 g. $\text{H}_2\text{O}$
250	77.53
500	78.02
750	78.60
1000	78.96

(Cohen and Sunnige, Trans. Farad. Soc. 1910, 5. 269.)

Sp. gr. at 21.6°/0° of  $\text{CdSO}_4 + \text{Aq}$  containing 11.47%  $\text{CdSO}_4 + \frac{1}{2}\text{H}_2\text{O} = 1.0944$ . (Kannmickoff, J. pr. 1885, (2) 31. 346.)

100 g.  $\text{H}_2\text{O}$  dissolve 57.61 g.  $\text{CdSO}_4 + 10.63$  g.  $\text{FeSO}_4$  at 25°. (Stortenbecker, Z. phys. Ch. 1900, 34. 109.)

$+4\text{H}_2\text{O}$  (Lescœur, A. ch. 1895, (7) 4. 222.)

Sp. gr. at 15° of  $\text{CdSO}_4 + \text{Aq}$  containing 10 g.  $\text{CdSO}_4 + 4\text{H}_2\text{O}$  in 100 cc of solution = 1.0790; containing 20 g.  $\text{CdSO}_4 + 4\text{H}_2\text{O}$  in 100 cc of solution = 1.1522 (Tiaube, J. pr. 1885, (2) 31. 207.)

Could not be obtained (Mylius and Funk)  $+7\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$

t°	% $\text{CdSO}_4$
-17	44.45
-16	44.5
-12	45.3
-10	46.1
-7	47.5
-5	48.5
-4.5	48.7

(Mylius and Funk, B. 1897, 30. 828.)

Cadmium caesium sulphate,  $\text{CdSO}_4 \cdot \text{Cs}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Tutton, Chem. Soc. 63. 337.)

1 l.  $\text{H}_2\text{O}$  dissolves 1399 g. anhydrous salt at 25° (Locke, Am. Ch. J. 1902, 27. 459.)

**Cadmium calcium potassium sulphate,**  
 $\text{Ca}_2\text{CdK}_2(\text{SO}_4)_4 + 2\text{H}_2\text{O}$ .  
 (D'Ans, B. 1908, 41. 1778.)

**Cadmium cerium sulphate,**  $\text{CdSO}_4 \cdot \text{Ce}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Wyrouboff.)

**Cadmium hydrazine sulphate,**  
 $\text{CdH}_2(\text{SO}_4)_2 \cdot 2\text{N}_2\text{H}_4$ .

1 pt. is sol. in 202.5 pts.  $\text{H}_2\text{O}$  at  $12^\circ$ .  
 Not attacked by dil acids Easily sol. in  
 $\text{NH}_4\text{OH} + \text{Aq}$ . (Curtius, J. pr 1894, (2) 50.  
 331.)

**Cadmium magnesium sulphate,**  $\text{CdSO}_4 \cdot \text{MgSO}_4 + 14\text{H}_2\text{O}$ .  
 Very efflorescent Sol. in  $\text{H}_2\text{O}$ . (Schiff, A.  
 104. 325)

**Cadmium potassium sulphate,**  $\text{K}_2\text{SO}_4 \cdot \text{CdSO}_4 + 13\frac{1}{2}\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$  (v. Hauer, Pogg 133. 176.)  
 100 pts  $\text{H}_2\text{O}$  dissolve 42.50 pts. anhydrous  
 salt at  $26^\circ$ ;

100 pts  $\text{H}_2\text{O}$  dissolves 42.80 pts anhydrous  
 salt at  $31^\circ$ ;

100 pts.  $\text{H}_2\text{O}$  dissolve 43.45 pts anhydrous  
 salt at  $40^\circ$ ;

100 pts  $\text{H}_2\text{O}$  dissolve 44.90 pts anhydrous  
 salt at  $64^\circ$  (Wyrouboff, Bull Soc. Min  
 1901, 24. 68.)

+  $2\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 42.89 pts  
 anhydrous salt at  $16^\circ$ ; 46.82 pts. at  $31^\circ$ ;  
 47.40 pts. at  $40^\circ$ . (Wyrouboff.)

+  $4\text{H}_2\text{O}$ . Efflorescent (Wyrouboff, Bull  
 Soc. Min 1891, 14. 235)

+  $6\text{H}_2\text{O}$ . Very efflorescent, and easily  
 decomp. (Schiff)

Does not exist (Wyrouboff.)

**Cadmium rubidium sulphate,**  $\text{CdSO}_4 \cdot \text{Rb}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Efflorescent Sol. in  $\text{H}_2\text{O}$ . (Tutton.)  
 1 l  $\text{H}_2\text{O}$  dissolves 767 g. anhydrous salt  
 at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

**Cadmium sodium sulphate,**  $\text{CdSO}_4 \cdot \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (v. Hauer.)

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2 + 2\text{H}_2\text{O}$  in 100 g  
 $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
21	35.49	24.04
25	35.88	24.46
30	36.28	24.605
35	36.69	24.99
40	37.24	25.455

(Koppel, Z. phys. Ch. 1905, 52. 413)  
 Decomp. by  $\text{H}_2\text{O}$  below  $20.5^\circ$ .

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O} + \text{CdSO}_4$   
 $\frac{1}{2}\text{H}_2\text{O}$  in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$	$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
0	73.51	9.85	15	73.70	9.475
5	73.38	9.67	20	73.81	9.453
10	72.76	9.53	25	73.71	10.18
			30	73.915	11.19
			35	75.01	12.32
			40	76.385	13.75

(Koppel)

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$   
 $10\text{H}_2\text{O}$  in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
-14.8	72.68	8.32
0	66.325	11.825
5	61.78	12.97
10	55.34	14.785
12	51.615	15.95
15	46.60	17.99
19.8	36.13	22.16
20	36.25	23.52
24	27.82	29.17
25	25.59	31.06
30	14.62	44.145

(Koppel)

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$   
 (anhydrous) in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
35	13.26	47.06
40	16.25	46.27

(Koppel.)

**Cadmium sulphate ammonia,**  $\text{CdSO}_4 \cdot 6\text{NH}_3$ .  
 Sol. in  $\text{H}_2\text{O}$  with separation of  $\text{CdO}$  (Rose,  
 Pogg. 20. 152)

$\text{CdSO}_4 \cdot 4\text{NH}_3 + 4\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ .  
 (Malaguti and Sarzeau, A. ch. (3) 9. 431.)

+  $2\text{H}_2\text{O}$  Ppt. (André, C. R. 104. 987.)

+  $2\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with separation of  
 basic sulphate. (Müller, A. 149. 70)

$\text{CdSO}_4 \cdot 3\text{NH}_3$ . (Isambert, C. R. 1870, 70.

457.)

**Cadmium sulphate cupric oxide,**  $\text{CdSO}_4 \cdot 3\text{CuO} + x\text{H}_2\text{O}$ .

(Recoura, C. R. 1901, 132. 1415.)

$2\text{CdSO}_4 \cdot 3\text{CuO} + 8\text{H}_2\text{O}$ . (Mailhe, A. ch.  
 1902, (7) 27. 333.)

+  $12\text{H}_2\text{O}$ . (Mailhe)

$6\text{CdSO}_4 \cdot 20\text{CuO} + x\text{H}_2\text{O}$ . (Recoura, C. R.  
 1901, 132. 1415.)

**Cadmium sulphate hydrazine,**  $\text{CdSO}_4 \cdot 2\text{N}_2\text{H}_4$

Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  but cannot be  
 cryst. therefrom. (Franzen, Z. anorg. 1908,  
 60. 282.)

Cadmium sulphate hydrogen chloride,  
 $3\text{CdSO}_4, 4\text{HCl} + 4\text{H}_2\text{O}$ .

Very deliquescent. (Baskerville and Harris,  
 J. Am. Chem. Soc. 1901, 23, 896.)

$3\text{CdSO}_4, 8\text{HCl}$  Very deliquescent. (Baskerville and Harris)

Caesium sulphate,  $\text{Cs}_2\text{SO}_4$ .

Not deliquescent.

100 pts.  $\text{H}_2\text{O}$  dissolve 158.7 pts.  $\text{Cs}_2\text{SO}_4$  at  $-2^\circ$ .

100 cc.  $\text{H}_2\text{O}$  at  $17-18^\circ$  dissolve 163.5 g.  $\text{Cs}_2\text{SO}_4$ . (Tutton, Chem. Soc. 1894, 65, 632)

#### Solubility in $\text{H}_2\text{O}$

$t^\circ$	G. $\text{Cs}_2\text{SO}_4$ per 100 g.			$t^\circ$	G. $\text{Cs}_2\text{SO}_4$ per 100 g.		
	Solution	$\text{H}_2\text{O}$	G. $\text{Cs}_2\text{SO}_4$ per l.		Solution	$\text{H}_2\text{O}$	G. $\text{Cs}_2\text{SO}_4$ per l.
0	62	6	167	1	3	42	60
10	63	4	173	1	3	49	70
20	64	1	178	7	3	56	80
30	64	8	184	1	3	62	90
40	65	5	189	9	3	68	100
50	66	1	194	9	3	73	108.6
							69
							224
							5
							4
							00

(Bekeley, Trans Roy Soc. 1901, 203, A 210)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$

Sat. solution contains 54.7%  $\text{Cs}_2\text{SO}_4 + 11.45\% \text{Na}_2\text{SO}_4$  at  $25^\circ$ . (Foote, J. Am. Chem. Soc. 1911, 33, 467.)

Insol. in alcohol. (Bunsen.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790)

Insol. in acetone. (Naumann, B. 1904, 37, 4329); (Edmann, C. C. 1899, II, 1014.)

Solubility in glycol at ord. temp.  $-3.0-3.2\%$ . (de Coninck, Belg. Acad. Bul. 1905, 359.)

Caesium hydrogen sulphate,  $\text{CsHSO}_4$ .

Sol. in  $\text{H}_2\text{O}$ .

Caesium pyrosulphate,  $\text{Cs}_2\text{S}_2\text{O}_7$ .

Decomp. by  $\text{H}_2\text{O}$ .

Caesium octosulphate,  $\text{Cs}_8\text{S}_8\text{O}_{34}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weber, B. 17, 2497)

Caesium calcium sulphate,  $\text{Ca}_2\text{Cs}_2(\text{SO}_4)_3$ .

Very stable. (D'Ans, B. 1908, 41, 1776.)

Caesium chromium sulphate,  $\text{Cs}_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

Melts in crystal  $\text{H}_2\text{O}$  at  $116^\circ$ . (Locke.)

#### Solubility in $\text{H}_2\text{O}$

Temp	G per litre	G mols anhydrous salt per l
$25^\circ$	5.7	0.015
$30^\circ$	9.6	0.025
$35^\circ$	12.06	0.032
$40^\circ$	15.3	0.0405

(Locke, Am. Ch. J. 1901, 26, 180.)

Caesium cobaltous sulphate,  $\text{Cs}_2\text{SO}_4, \text{CoSO}_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Tutton, Chem. Soc. 63, 337.)

1 l.  $\text{H}_2\text{O}$  dissolves 418.8 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27, 459.)

Caesium cobaltic sulphate,  $\text{Cs}_2\text{Co}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

Melts in crystal  $\text{H}_2\text{O}$  at  $116^\circ$ . (Locke, Am. Ch. J. 1901, 26, 183.)

Caesium copper sulphate,  $\text{Cs}_2\text{SO}_4, \text{CuSO}_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Tutton.)

1 l.  $\text{H}_2\text{O}$  dissolves 460 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27, 459.)

Caesium gallium sulphate,  $\text{Cs}_2\text{Ga}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

(Soret, Arch. sc. phys. nat. 1888, (3) 20, 531.)

Caesium indium sulphate,  $\text{Cs}_2\text{In}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

75.7 g. anhydrous (117.39 hydrated) salt or 0.172 g. mols of anhydrous salt are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Locke, Am. Ch. J. 1901, 26, 175)

100 pts.  $\text{H}_2\text{O}$  dissolve 3.04 pts. at  $16.5^\circ$ . (Chabrie and Rengade, C. R. 1900, 131, 1301.)

Caesium iridium sulphate,  $\text{Cs}_2\text{SO}_4, \text{Ir}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .

Mpt.  $109-110^\circ$

Very sl. sol. in cold. More easily sol. in hot  $\text{H}_2\text{O}$ . (Marino, Z. anorg. 1904, 42, 218.)

Caesium iron (ferrous) sulphate,  $\text{Cs}_2\text{SO}_4, \text{FeSO}_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Tutton.)

1 l.  $\text{H}_2\text{O}$  dissolves 1011 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27, 459.)

Caesium iron (ferric) sulphate,  $\text{Cs}_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

Melts in crystal  $\text{H}_2\text{O}$  at  $71^\circ$ . (Locke.)

Solubility in H<sub>2</sub>O

t°	G per litre	G mols anhydrous salt per litre
25	17.1	0.045
30	25.2	0.066
35	37.5	0.099
40	60.4	0.156

\* (Locke, Am. Ch. J. 1901, 26. 180.)

**Cæsium lanthanum sulphate, Cs<sub>2</sub>SO<sub>4</sub>, La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+2H<sub>2</sub>O.**(Baskerville, J. Am. Chem. Soc. 1904, 26. 67.)  
2Cs<sub>2</sub>SO<sub>4</sub>, 3La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. (Baskerville.)**Cæsium magnesium sulphate, Cs<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>+6H<sub>2</sub>O**Sol. in H<sub>2</sub>O. (Tutton.)  
1 l. H<sub>2</sub>O dissolves 533 g. anhydrous salt at 25° (Locke, Am. Ch. J. 1902, 27. 459.)**Cæsium manganous sulphate, Cs<sub>2</sub>SO<sub>4</sub>, MnSO<sub>4</sub>+8H<sub>2</sub>O.**Sol. in H<sub>2</sub>O (Tutton.)  
Sol. in H<sub>2</sub>O and acids with decomp. (Piccini, Z. anorg. 1899, 20. 14.)  
1 l. H<sub>2</sub>O dissolves 804 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 45)**Cæsium manganic sulphate, Cs<sub>2</sub>SO<sub>4</sub>, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+24H<sub>2</sub>O**Decomp. by H<sub>2</sub>O and dil. acids with separation of MnO<sub>2</sub>. Sol. in 1.3 H<sub>2</sub>SO<sub>4</sub>+Aq. and in conc. HNO<sub>3</sub>. Insol. in acetic acid. Sol. in oxalic acid+Aq. (Christensen, Z. anorg. 1901, 27. 332.)**Cæsium neodymium sulphate, Cs<sub>2</sub>SO<sub>4</sub>, Nd<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+3H<sub>2</sub>O.**

(Baskerville, J. Am. Chem. Soc. 1904, 26. 74.)

**Cæsium nickel sulphate, Cs<sub>2</sub>SO<sub>4</sub>, NiSO<sub>4</sub>+6H<sub>2</sub>O.**Sol. in H<sub>2</sub>O. (Tutton.)  
1 l. H<sub>2</sub>O dissolves 255.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)**Cæsium praseodymium sulphate, Cs<sub>2</sub>SO<sub>4</sub>, Pr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+2H<sub>2</sub>O**(Baskerville, J. Am. Chem. Soc. 1904, 26. 73.)  
+4H<sub>2</sub>O. (Baskerville.)**Cæsium rhodium sulphate, Cs<sub>2</sub>SO<sub>4</sub>, Rh<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+24H<sub>2</sub>O**Sl. sol. in cold, sol. in warm H<sub>2</sub>O; mpt. 110–111° (Piccini, Z. anorg. 1901, 27. 64.)**Cæsium thallic sulphate, CsTi(SO<sub>4</sub>)<sub>4</sub>+1½H<sub>2</sub>O**Hygroscopic. (Locke, Am. Ch. J. 1902, 27. 283.)  
+3H<sub>2</sub>O. Very sl. sol. in cold; easily sol. in hot H<sub>2</sub>O. Can be recryst. from H<sub>2</sub>SO<sub>4</sub>+Aq. The recryst. salt is at once decomp. by H<sub>2</sub>O or 95% alcohol (Locke.)**Cæsium thorium sulphate, Cs<sub>2</sub>SO<sub>4</sub>, Th(SO<sub>4</sub>)<sub>2</sub>+2H<sub>2</sub>O.**Sl. sol. in H<sub>2</sub>O (Manuelli, Gazz. ch. it. 1903, 32. (2) 524.)**Cæsium titanium sulphate, Cs<sub>2</sub>SO<sub>4</sub>, Ti<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+24H<sub>2</sub>O.**Deliquesces in the air and is decomp.  
Sl. sol. in cold H<sub>2</sub>O, decomp. by hot H<sub>2</sub>O. (Piccini, Gazz. ch. it. 1895, 25. 542.)  
Sl. sol. in cold H<sub>2</sub>O, more sol. in hot H<sub>2</sub>O acidified with H<sub>2</sub>SO<sub>4</sub>.  
Decomp. in neutral aq. solution. (Piccini, Z. anorg. 1898, 17. 356.)**Cæsium uranyl sulphate, Cs<sub>2</sub>(UO<sub>2</sub>)(SO<sub>4</sub>)<sub>2</sub>+2H<sub>2</sub>O.**

As Na salt. (de Coninck, C. C. 1905, I 1306.)

**Cæsium vanadium sulphate, Cs<sub>2</sub>V<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O.**771 g. anhydrous (13.1 g. hydrated) salt, or 0.0204 gr. mols. of the anhydrous salt are sol. in 1 l. H<sub>2</sub>O at 25° (Locke, Am. Ch. J. 1901, 26. 175.)  
Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O (Piccini, Z. anorg. 1896, 11. 114.)  
100 pts. H<sub>2</sub>O dissolve 0.484 pts. of the salt at 10° and sp. gr. of the solution at 4°/20° = 2.033. More sol. in hot H<sub>2</sub>O than in cold. (Piccini, Z. anorg. 1897, 13. 448.)**Cæsium zinc sulphate, Cs<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+6H<sub>2</sub>O**Sol. in H<sub>2</sub>O. (Bunsen and Kopp, Pogg. 113. 337.)  
1 l. H<sub>2</sub>O dissolves 386.3 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)**Cæsium zirconium sulphate, Zr<sub>2</sub>O<sub>3</sub>(CsSO<sub>4</sub>)<sub>2</sub>+11H<sub>2</sub>O.**

Ppt. (Rosenheim, B. 1905, 38. 815.)

**Calcium sulphate, CaSO<sub>4</sub>, and +2H<sub>2</sub>O.**The older determinations of the solubility of CaSO<sub>4</sub> in H<sub>2</sub>O have little, but historical, value, as the solutions were usually either non-saturated or supersaturated. They may be tabulated as follows

A = pts.  $H_2O$  required for dissolving 1 pt.  $CaSO_4$ , and B for 1 pt.  $CaSO_4 + 2H_2O$  at  $t^\circ$ .

$t^\circ$	A	B	Authority
Hot or cold	500		Fourcroy
Cold	500		Bergmann
Boiling	450		"
All temp.	322		Lassaigne
(?)	438		Anthou
(?)	250-300		Dumas
Hot or cold	578.5	461.5	Bucholz
Cold	480	380	Giese
Hot	491	388	"
16-20°	492	388	Tipp
12 5°	503	397	Lecoq

100 pts  $H_2O$  at  $t^\circ$  dissolve pts  $CaSO_4$

$t^\circ$	Pts $CaSO_4$	$t^\circ$	Pts $CaSO_4$	$t^\circ$	Pts $CaSO_4$
0	0 205	35	0 254	70	0 244
5	0 219	40	0 262	80	0 239
12	0 233	50	0 251	90	0 231
20	0 241	60	0 248	100	0 217
30	0 249				

(Poggiale, A. ch. (3) 8. 469)

Poggiale worked with supersat. solutions. (Droez, B. 10. 330.)

$H_2O$  dissolves  $CaSO_4$  most abundantly at 35° (Poggiale), at 32-41° (Maignac).

1 pt.  $CaSO_4 + 2H_2O$  dissolves at:

0° 18° 24° 32° 38°  
in 415 388 378 371 368 pts.  $H_2O$ ,

41° 53° 72° 86° 99°  
in 370 375 391 417 451 pts  $H_2O$ ,

or (by calculation) 1 pt anhydrous  $CaSO_4$  dissolves at.

0° 18° 24° 32° 38°  
in 525 458 479 470 466 pts.  $H_2O$ ,

41° 53° 72° 86° 99°  
in 468 474 495 528 571 pts.  $H_2O$ .

The above nonsat. solutions are obtained by using a large excess of  $CaSO_4 + 2H_2O$ . The undissolved part retains its water of crystallisation  $CaSO_4$ , dehydrated at 130-140°, forms a supersaturated solution with  $H_2O$  in 10 minutes, containing 1 pt.  $CaSO_4$  to 110 pts  $H_2O$ , which soon deposits crystals. The undissolved part takes up its water of crystallisation. Ignited  $CaSO_4$  dissolves very slowly in  $H_2O$ , so that in 24 hours the solution contains  $1/110$  to  $1/105$  anhydrous  $CaSO_4$ . By longer contact solution continues with formation of supersaturated solutions, which contain after 10-30 days  $1/172$  to  $1/222$   $CaSO_4$ , but these become normal as the anhydrous  $CaSO_4$  gradually takes up its water of crystallisation. The mineral anhydrite behaves similarly, water taking up  $1/132$   $CaSO_4$  in 1 day,  $1/131$  in 40 days, and  $1/137$  in 8 months.

Supersaturated solutions are also obtained

by evaporation of a saturated solution. By evaporation with heat, solutions are obtained containing  $1/200$   $CaSO_4$ , and in the cold with  $1/122$   $CaSO_4$ , in the solution over the separated  $CaSO_4 + 2H_2O$ . Neutralising dil.  $H_2SO_4 + Aq$  with  $CaCO_3$  gives a solution containing  $1/111$   $CaSO_4$ , which crystallises out partly in 24 hours, leaving  $1/111$   $CaSO_4$  dissolved.

Supersaturated solutions containing  $1/110$  to  $1/114$   $CaSO_4$  deposit crystals rapidly; those under  $1/200$  do not crystallise spontaneously. A solution containing  $1/133$  shows crystals in 14 days, and contains  $1/112$  in 1 month,  $1/111$  in 2 months,  $1/110$  in 3 months, in spite of repeated shaking.

Boiling diminishes the supersaturation without however removing it entirely. (Maignac, A. ch. (5) 1. 274.)

1 pt.  $CaSO_4 + 2H_2O$  is sol in 443 pts.  $H_2O$  at 13.7°, in 447 pts  $H_2O$  at 14.2°, in 421 pts.  $H_2O$  at 20.2°, in 419 pts.  $H_2O$  at 21.2°, and in 445 pts.  $H_2CO_3 + Aq$  sat. at 18.7°. (Church, J. B. 1867. 192.)

Church's solutions were not sat. (Droez, B. 10. 330.)

1000 pts.  $H_2O$  dissolve 2.19 pts.  $CaSO_4 + 2H_2O$  at 16.5°; 2.352 pts.  $CaSO_4 + 2H_2O$  at 22° (Cossa, Gazz. ch. it. 1873. 135.)

Cossa's solutions were not saturated. (Droez)

$CaSO_4 + 2H_2O$  is sol in 415 pts.  $H_2O$  at 0°; in 412 pts  $H_2O$  at 5°; in 407 pts.  $H_2O$  at 10°; in 398 pts  $H_2O$  at 15°; in 371 pts  $H_2O$  at 20°; in 365 pts  $H_2O$  at 25°; in 361 pts  $H_2O$  at 30°; in 359 pts.  $H_2O$  at 35°. (Droez, B. 10. 330.)

Sol. in 500 pts  $H_2O$  at 12.5°. (From Maignac's and his own results, de Bousbaudran, A. ch. (5) 3. 477.)

$CaSO_4$  is sol in 564.5 pts  $H_2O$  at 0.8°; 506.27 pts. at 14°; 472-3 pts. at 32.5-38.8°, 498.73 pts. at 64°; 533.92 pts. at 79.6°. (Raupenstrauch, M. 6. 563.)

According to Goldammer (C. C. 1888. 708)  $H_2O$  is fully saturated with  $CaSO_4$  by shaking the finely-powdered substance 5 minutes therewith.

The following results were obtained. Figures denote pts.  $H_2O$  in which 1 pt.  $CaSO_4$  was dissolved at  $t^\circ$  (a) from pptd.  $CaSO_4$ , "ipse fact.", (b) from pptd.  $CaSO_4$ , "gehe.", (c) from "glacies mariae pulv.", (d) from "glacies Mariae pulv.", containing less than  $2H_2O$

$t^\circ$	a	b	c	$t^\circ$	d
0	561.5	558	557.5	0	470.5
7.5	526	528	520	20	436
15	497.5	497.5	493		
22.5	481	481.5	479		
30	475	475	470	40	460
37.5	463	469	465.5		
45	473.5	474.5	470.5	60	476
60	484	486.5	482	80	502.5
75	507.5	508	503		
90	533.5	530	534	100	547
100	556	557	534.5		

Burnt gypsum easily forms supersat. solutions containing nearly 1%  $\text{CaSO}_4$ . It forms supersat. solutions more readily at  $0^\circ$ , and that tendency decreases with increase of temp., hence figures in (d) which contained burnt gypsum (Goldammer, C C 1888, 708.)

Calculated from electrical conductivity of  $\text{CaSO}_4 + \text{Aq}$ , 1 l.  $\text{H}_2\text{O}$  dissolves 2.07 g  $\text{CaSO}_4$  at  $18^\circ$ . (Kohlrausch and Rose, Z phys Ch 12, 241.)

The anhydrous salt varies in solubility. Solubility depends (1) upon temp. and time of drying, (2) upon the relative amount of salt, (3) upon time of shaking. Possibly a and b modifications. (Potilizin, C C 1894, II, 515.)

2.04 gr. are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46, 603.)

At  $15^\circ$  and after 5 minutes shaking, the highest degree of supersaturation which can be obtained with pure sol. calcium sulphate = 9.47 g. of the anhydrous salt or 11.978 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  in 1 l. of  $\text{H}_2\text{O}$ . (Cavazzi, C. C. 1905, I, 1694.)

Solubility of  $\text{CaSO}_4$  in 100 pts  $\text{H}_2\text{O}$  at high temp

$t^\circ$	Pts $\text{CaSO}_4$	$t^\circ$	Pts $\text{CaSO}_4$	$t^\circ$	Pts $\text{CaSO}_4$
140	0.078	175-185	0.027	250	0.016
165	0.056	240	0.018		

(Tilden and Shenstone, Phil. Trans. 1884, 31.)

Ppts. of  $\text{CaSO}_4$  which has been started by heating solution to  $140-150^\circ$  continues even after solution has cooled. (Storer.)

$\text{CaSO}_4$  is completely insol. in sea water or pure  $\text{H}_2\text{O}$  at temperatures between  $140^\circ$  and  $150^\circ$ . (Cousté.)

Solubility of  $\text{CaSO}_4$  in sea water at temperatures over  $100^\circ$ .  $t^\circ$  = temp.; P = pressure in atmospheres; % = per cent  $\text{CaSO}_4$  in sat solution.

$t^\circ$	P	%	$t^\circ$	P	%
103	1	0.500	118.5	1.50	0.226
103.8	1	0.477	121.2	1.5	0.183
105.15	1	0.432	124	2	0.140
108.6	1.25	0.395	127.9	2	0.097
111	1.25	0.355	130	2.5	0.060
113.2	1.25	0.310	133.3	2.5	0.023
115.8	1.50	0.267			

(Cousté, Ann. Min. (5) 5, 80.)

Solubility of  $\text{CaSO}_4$  in  $\text{H}_2\text{O}$  at various pressures.

100 g. sat.  $\text{CaSO}_4 + \text{Aq}$  at 1 atm. pressure and  $15^\circ$  contain 0.206 g.  $\text{CaSO}_4$ , at 20 atm. pressure and  $15^\circ$  contain 0.227 g.  $\text{CaSO}_4$ , at 1 atm. pressure and  $16.2^\circ$  contain 0.213 g.  $\text{CaSO}_4$ . (Möller, Pogg. 117, 386.)

*Soluble anhydrite.*

1 l.  $\text{H}_2\text{O}$  dissolves 22.8 milliequivalents at  $100^\circ$ .

1 l.  $\text{H}_2\text{O}$  dissolves 6.4 milliequivalents at  $156^\circ$ .

*Anhydrite:*

1 l.  $\text{H}_2\text{O}$  dissolves 9.2 milliequivalents at  $100^\circ$ .

1 l.  $\text{H}_2\text{O}$  dissolves 2.7 milliequivalents at  $156^\circ$ .

1 l.  $\text{H}_2\text{O}$  dissolves 0.7 milliequivalents at  $218^\circ$ .

(Melcher, J. Am. Chem. Soc. 1910, 32, 63.)

See also under gypsum, p. 953.

Maximum solubility is at  $37.5^\circ$ . (Cameron, J. phys. Chem. 1901, 5, 572.)

Sp. gr. of sat.  $\text{CaSO}_4 + \text{Aq}$  at  $15^\circ = 1.0022$ . (Stolba, J. pr. 97, 503.)

Sp. gr. of sat.  $\text{CaSO}_4 + \text{Aq}$ . at  $31^\circ = 1.0031$ .

1 pt  $\text{CaSO}_4$  is sol. in 218 pts.  $\text{H}_2\text{O}$  containing  $\text{CO}_2$ . (Beyer, Arch. Pharm. (2) 150, 193.)

Sl. sol. in cold  $\text{HCl} + \text{Aq}$ ; completely sol. in boiling dil  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . (Rose, Pogg. 95, 108.)

Solubility of  $\text{CaSO}_4$  in  $\text{HCl} + \text{Aq}$ .

$t^\circ$	% $\text{HCl}$	100 cc dissolve g. of $\text{CaSO}_4$	$t^\circ$	% $\text{HCl}$	100 cc dissolve g. of $\text{CaSO}_4$
25	0.77	0.6405	25	6.12	1.6539
25	1.56	0.8821	101	0.77	1.1209
25	3.06	1.2639	102	3.06	3.1780
25	4.70	1.5342	103	6.12	4.6902

(Lunge, J. Soc. Chem Ind 4, 31.)

Solubility in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$ .

g $\text{HNO}_3$ per 100 cc	g $\text{CaSO}_4$ per 100 cc solution	g $\text{HNO}_3$ per 100 cc	g $\text{CaSO}_4$ per 100 cc solution
0	0.208	6	1.48
1	0.56	8	1.70
2	0.82	10	1.84
3	1.02	12	1.98
4	1.20		

(Banthisch, J. pr. 1884, 29, 52.)

For solubility in  $\text{H}_2\text{SO}_4$  see  $\text{CaH}_2(\text{SO}_4)_2$ .

Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$

G. $\text{P}_2\text{O}_5$ per l	G $\text{CaSO}_4$ per l	Sp gr. $25^\circ/25^\circ$
0.0	2.126	
5.0	3.138	1.002
10.5	3.734	1.007
21.4	4.456	1.016
46.3	5.760	1.035
105.3	7.318	1.075
145.1	7.920	1.106
204.9	8.383	1.145
312.0	7.965	1.221
395.7	6.848	1.230
494.6	5.573	1.344

(Taber, J. phys Chem 1906, 10, 628.)

Solubility in formic acid at  $25^\circ$ .

100 cc. of solution of acid containing 4%

dissolve 0.24 g.  $\text{CaSO}_4$  (Banthisch, J. pr. 1884, 29. 52.)

Solubility of  $\text{CaSO}_4$  in chloroacetic acid at 25°. 100 cc. of solution of acid containing 4% dissolve 0.22 g.  $\text{CaSO}_4$ ; 10%, 0.25 g. (Banthisch, J. pr. 1884, 29. 52.)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of  $\text{NH}_4\text{Cl}$  (Vogel, J. pr. 1. 196), ammonium succinate (Wittstein, Report 57. 18),  $(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{B}_4\text{O}_7$  (Popp, A. Suppl. 8. 11); also  $\text{KNO}_3$  (Vogel, Jun.),  $\text{Na}_2\text{SO}_4$  (Henry, J. Pharm. 12. 31),  $\text{NaCl}$  (Trommsdorff, N. J. Pharm 13. 1. 234.)

Decomp by alkali carbonates + Aq. (See Storer's Diet.)

1 g.  $\text{CaSO}_4$  is sol in 162 ccm. sat.  $\text{KCl}$  + Aq at 8°; in 147 ccm. sat.  $\text{NaCl}$  + Aq at 8.5°; in 93 ccm. sat.  $\text{NH}_4\text{Cl}$  + Aq at 12.5°; in 94 ccm. sat.  $\text{KNO}_3$  + Aq; in 92 ccm. sat.  $\text{NaNO}_3$  + Aq; in 320 ccm. sat.  $\text{NH}_4\text{NO}_3$  + Aq; in 54 ccm.  $\frac{1}{2}$  sat.  $\text{NH}_4\text{NO}_3$  + Aq; in about 2000 ccm. sat.  $\text{K}_2\text{SO}_4$  + Aq. (Droezig)

More sol. in  $\text{Fe}_2\text{Cl}_6$ ,  $\text{Cr}_2\text{Cl}_6$ ,  $\text{CuCl}_2$ ,  $\text{ZnCl}_2$  + Aq than in  $\text{H}_2\text{O}$ , but not more sol. in  $\text{CaCl}_2$  + Aq. (Gladstone.)

$\text{NH}_4\text{Cl}$  + Aq.

1 g.  $\text{CaSO}_4$  is sol. in 92 ccm. sat.  $\text{NH}_4\text{Cl}$  + Aq at 13.5°; in 94 ccm.  $\frac{1}{2}$  sat.  $\text{NH}_4\text{Cl}$  + Aq at 13.5-15.5°; in 200 ccm.  $\frac{1}{2}$  sat.  $\text{NH}_4\text{Cl}$  + Aq at 13.5°; in 183 ccm.  $\frac{1}{3}$  sat.  $\text{NH}_4\text{Cl}$  + Aq at 100°. (Fassbender, B. 9. 1360)

Solubility of  $\text{CaSO}_4$  in 25%  $\text{NH}_4\text{Cl}$  + Aq

t°	% $\text{CaSO}_4$	t°	% $\text{CaSO}_4$
8	1 030	60	1 333
9	1 023	80	1 026
25	1 096	120	1 000
39	1 126		

(Tilden and Shenstone, Roy. Soc. Proc. 38. 335.)

Solubility in  $\text{NH}_4\text{Cl}$  + Aq increases with percentage of  $\text{NH}_4\text{Cl}$ , but if solution contains more than 60 g.  $\text{NH}_4\text{Cl}$  per l. more  $\text{CaO}$  dissolves than  $\text{SO}_3$ . With 333 g.  $\text{NH}_4\text{Cl}$  per l. the solution contains 4.9 g.  $\text{SO}_3$  and 4.4 g.  $\text{CaO}$ , while the  $\text{SO}_3$  content requires only 3.4 g.  $\text{CaO}$  (Ditte, C. R. 1898, 126. 694.)

Solubility of  $\text{CaSO}_4$  in  $\text{NH}_4\text{Cl}$  + Aq at 25°

Grams $\text{NH}_4\text{Cl}$ per liter	Grams $\text{CaSO}_4$ per liter
10 8	3 90
24 4	5 38
46 7	7 07
94 5	8 80
149 7	10 30
198.6	10 85
210 0	10 88
275 0	10 60
325 0	9 40
375.3 (saturated)	7 38

(Cameron and Brown, J. phys. Chem. 1905, 9. 211.)

$\text{CaCl}_2$  + Aq

Solubility of  $\text{CaSO}_4$  in  $\text{CaCl}_2$  + Aq at t°.

t°	% $\text{CaCl}_2$	100 ccm dissolve g of $\text{CaSO}_4$	t°	% $\text{CaCl}_2$	100 ccm dissolve g of $\text{CaSO}_4$
23	3 54	0.1225	25	16 91	0 0702
24	6 94	0.0963	101 0	3 54	0 1370
25	10 36	0.0886	102 5	10 36	0 1423
25	15 90	0.0734	103 5	16 91	0.1301

(Lunge, l c.)

Solubility of  $\text{CaSO}_4$  in  $\text{H}_2\text{O}$  containing various amts. of  $\text{CaCl}_2$  at 20° 100 pts  $\text{H}_2\text{O}$  containing pts  $\text{CaCl}_2$  dissolve pts  $\text{CaSO}_4$

Pts $\text{CaCl}_2$	Pts $\text{CaSO}_4$	Pts $\text{CaCl}_2$	Pts $\text{CaSO}_4$
0 00	0 225	19 80	0 041
11 50	0 078	51 00	0 000
14 39	0 063	67 05	0.000

(Tilden and Shenstone)

Solubility of  $\text{CaSO}_4$  in  $\text{CaCl}_2$  + Aq at t°

t°	% $\text{CaCl}_2$	% $\text{CaSO}_4$	t°	% $\text{CaCl}_2$	% $\text{CaSO}_4$
15	15 00	0 063	94	15 16	0 110
21	14 70	0 068	138	14 70	0 071
39	15 00	0 091	170	14 82	0 081
72	14 90	0 100	195	14 70	0 022

(Tilden and Shenstone, l c.)

Solubility in  $\text{CaCl}_2$  + Aq at 25°

g per l of solution		g per l of solution	
$\text{CaCl}_2$	$\text{CaSO}_4$	$\text{CaCl}_2$	$\text{CaSO}_4$
0 00	2.06	51 53	1 02
7 49	1 24	97 02	0 84
11 96	1 13	192 71	0 47
25.77	1 10	280 30	0 20
32 05	1 08	367 85	0 03

(Cameron and Seidell, J. phys. Ch. 1901, 5. 643)

1000 pts. of 1%  $\text{CaCl}_2$  + Aq. dissolve 1.1414 pts.  $\text{CaSO}_4$ ; 40%  $\text{CaCl}_2$ , 0.2130 pts.  $\text{CaSO}_4$ . (Orloff, Chem. Soc. 1903, 84, (2) 211.)

Solubility in  $\text{CaO}_2\text{H}_2 + \text{Aq}$  at  $25^\circ$ .

G $\text{CaSO}_4$ per l	G $\text{CaO}$ per l	Solid phase
0 0	1 166	$\text{Ca(OH)}_2$
0 391	1.141	"
0 666	1 150	"
0 955	1 215	"
1 214	1 242	"
1 588	1 222	$\text{Ca(OH)}_2$ and $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
1 634	0 939	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
1 722	0 611	"
1 853	0 349	"
1 918	0 176	"
2 030	0 062	"
2 126	0.0	"

(Cameron and Bell, J. Am. Chem. Soc. 1906, 28, 1221)

 $\text{MgCl}_2 + \text{Aq}$ 

Sol. in 324 pts.  $\text{MgCl}_2 + \text{Aq}$  (34.1%  $\text{MgCl}_2$ ) at  $19^\circ$ . (Karsten.)

1 g.  $\text{CaSO}_4$  is sol. in 146 ccm  $\frac{1}{2}$  sat.  $\text{MgCl}_2 + \text{Aq}$  at  $13.5^\circ$ . (Fassbender.)

1 l.  $\frac{1}{2}$  sat.  $\text{MgCl}_2 + \text{Aq}$  dissolves 6.83 g.  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  at  $13.5^\circ$ . (Droezc.)

Solubility of  $\text{CaSO}_4$  in  $\text{MgCl}_2 + \text{Aq}$ 

$t^\circ$	% $\text{MgCl}_2$	% $\text{CaSO}_4$
9	19.7	0.765
39	11.1	2.744
80	9.99	1.038

(Tilden and Shenstone, l. c.)

Solubility in  $\text{MgCl}_2 + \text{Aq}$  at  $26^\circ$ 

g per l of solution			g per l of solution		
$\text{MgCl}_2$	$\text{CaSO}_4$	$\text{H}_2\text{O}$	$\text{MgCl}_2$	$\text{CaSO}_4$	$\text{H}_2\text{O}$
0 0	2 08	997.9	121.38	8.62	972.2
8 50	4 26	990.5	206.98	6.57	949.9
19 18	5 69	994.5	337.0	2.77	908.7
46 64	7 59	989.1	441.0	1.39	878.6

(Cameron and Seidell, J. phys. Ch. 1901, 5, 645)

1 l. sat.  $\text{MgCl}_2 + \text{Aq}$  at  $25^\circ$  containing 476.5 g.  $\text{MgCl}_2$  dissolves 1.09 g.  $\text{CaSO}_4$ . (Cameron and Brown, J. phys. Ch. 1905, 9, 214.)

 $\text{NH}_4\text{NO}_3 + \text{Aq}$ 

1 g.  $\text{CaSO}_4$  is sol in 320 ccm sat  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $8-9^\circ$ ; in 54 ccm.  $\frac{2}{3}$  sat  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $13.5^\circ$ ; in 103 ccm  $\frac{1}{2}$  sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $13.5^\circ$ . (Fassbender)

Solubility of  $\text{CaSO}_4$  in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $25^\circ$ 

G $\text{NH}_4\text{NO}_3$ per l	G $\text{CaSO}_4$ per l
10	3.18
25	3.93
55	5.80
100	7.65
150	8.88
200	9.85
300	10.80
400	11.40
550	12.02
750	12.20
1000	11.81
1200	11.10
1400	10.02
saturated	7.55

(Cameron and Brown, J. phys. Chem. 1905, 9, 213)

 $\text{Ca(NO}_3)_2 + \text{Aq}$ 

Solubility of  $\text{CaSO}_4$  in  $\text{Ca(NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Weight of 1000 cc of solution	G $\text{Ca(NO}_3)_2$ per l	G $\text{CaSO}_4$ per l
998.1	0	2.084
1013.8	25	1.238
1031.7	50	1.196
1067.3	100	1.134
1136.9	200	0.929
1203.5	300	0.759
1265.6	400	0.569
1328.1	500	0.403
1352.0	514	0.346

(Seidell and Smith, J. phys. Chem. 1904, 8, 498)

 $\text{Mg(NO}_3)_2 + \text{Aq}$ 

Solubility of  $\text{CaSO}_4$  in  $\text{Mg(NO}_3)_2 + \text{Aq}$  at  $25^\circ$

Weight of 1000 cc of solution grams	G. $\text{Mg(NO}_3)_2$ per l	G $\text{CaSO}_4$ per l
998.1	0	2.084
1020.5	25	5.772
1039.8	50	7.884
1078.6	100	9.920
1149.8	200	13.340
1219.0	300	14.000
1282.1	400	14.683
1355.3	514	15.040

(Seidell and Smith, J. phys. Chem. 1904, 8, 497.)

1 l. sat.  $\text{Mg(NO}_3)_2 + \text{Aq}$  at  $25^\circ$  containing 615.1 g.  $\text{Mg(NO}_3)_2$  dissolves 15.26 g.  $\text{CaSO}_4$ . (Cameron and Brown, J. phys. Ch. 1905, 9, 214.)

$\text{KNO}_3 + \text{Aq.}$

1 g.  $\text{CaSO}_4$  is sol. in 94 ccm. sat.  $\text{KNO}_3 + \text{Aq}$  at  $13.5^\circ$ , in 82 ccm. sat.  $\text{KNO}_3 + \text{Aq}$  at  $15.5^\circ$ , in 68 ccm. nearly sat.  $\text{KNO}_3 + \text{Aq}$  at  $20^\circ$ . (Fassbender.)

Solubility in  $\text{KNO}_3 + \text{Aq}$  at  $25^\circ$ .

Wt of 1000 ccm of solution grams	G $\text{KNO}_3$ per l	G $\text{CaSO}_4$ per l
998 1	0 0	2 084
1008 1	12 5	3 284
1015 4	25 0	4 080
1032 1	50 0	5 255
1062 5	100 0	6 855
1092 4	150 0	7 907
1122 4	200 0	8 688
1153 9	260 0	9 678
		12 112

\* Probably due to formation of double salt of calcium and potassium sulphates,  $\text{CaK}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$

(Seidell and Smith, J. phys. Chem. 1908. 8. 496.)

$\text{NaNO}_3 + \text{Aq.}$

1 g.  $\text{CaSO}_4$  is sol. in 92 ccm. sat.  $\text{NaNO}_3 + \text{Aq}$  at  $8.5^\circ$ ; in 318 ccm.  $\frac{1}{2}$  sat.  $\text{NaNO}_3 + \text{Aq}$  at  $13.5^\circ$ . (Fassbender.)

100 ccm. sat.  $\text{NaNO}_3 + \text{Aq}$  dissolve 1.086 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$ ; 100 ccm.  $\frac{1}{2}$  sat.  $\text{NaNO}_3 + \text{Aq}$  dissolve 0.314 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  (Droeze, B. 10. 338.)

Solubility in  $\text{NaNO}_3 + \text{Aq}$  at  $25^\circ$ .

Wt of 1000 ccm of solution grams	G $\text{NaNO}_3$ per l	G $\text{CaSO}_4$ per l
998 1	0	2 084
1016 3	25	4 252
1034 0	50	5 500
1058 4	100	7 100
1133 6	200	8 790
1191 0	300	9 282
1303 9	600	7 886
1390 4	655	7 238

(Seidell and Smith, J. phys. Chem. 1904. 8. 495.)

1 l. sat.  $\text{NaNO}_3 + \text{Aq}$  at  $25^\circ$ , containing 668 g.  $\text{NaNO}_3$ , dissolves 5.52 g.  $\text{CaSO}_4$ . (Cameron and Brown, J. phys. Ch. 1905. 9. 214.)

Solubility in  $\text{KBr} + \text{Aq}$  at  $21^\circ$

G $\text{KBr}$ per l	G $\text{CaSO}_4$ per l	G $\text{KBr}$ per l	G $\text{CaSO}_4$ per l
0	2 05	100	6 3
10	3 1	125	6 7
20	3 6	150	7 0
40	4 5	200	7 3
60	5 2	250	Double salt
80	5 9		

(Ditte, A. ch. 1898, (7) 14. 294.)

$\text{KCl} + \text{Aq.}$

1 g.  $\text{CaSO}_4$  is sol. in 162 ccm. sat.  $\text{KCl} + \text{Aq}$  at  $8^\circ$ , in 295 ccm.  $\frac{1}{2}$  sat.  $\text{KCl} + \text{Aq}$  at  $9^\circ$ .

Solubility in  $\text{KCl} + \text{Aq}$  at  $21^\circ$

g per l.		g per l	
KCl	$\text{CaSO}_4$	KCl	$\text{CaSO}_4$
0	2 05	60	6 6
10	3 6	80	7 2
20	4 5	100	7 5
40	5 8	125	Double Salt

(Ditte, A. ch. 1898, (7) 14. 294)

Solubility in  $\text{KI} + \text{Aq}$  at  $21^\circ$

G $\text{KI}$ per l	G $\text{CaSO}_4$ per l	G $\text{KI}$ per l	G $\text{CaSO}_4$ per l
0	2 05	100	5 1
10	2 8	125	5 45
20	3 2	150	5 8
40	3 9	200	5 95
60	4 5	250	6 00
80	4 85	300	Double salt.

(Ditte, l. c.)

$\text{NaCl} + \text{Aq}$

Sol in 122 pts. sat.  $\text{NaCl} + \text{Aq.}$  (Anthon.) Insol in sat.  $\text{NaCl} + \text{Aq.}$  but more sol. in dil.  $\text{NaCl} + \text{Aq.}$  than in  $\text{H}_2\text{O}$ . Maximum solubility in  $\text{NaCl} + \text{Aq}$  is when the sp. gr. is 1.033

1 g.  $\text{CaSO}_4$  is sol. in 147 ccm of sat.  $\text{NaCl} + \text{Aq}$  at  $8.5^\circ$ , in 150 ccm of sat.  $\text{NaCl} + \text{Aq}$  at  $13.5^\circ$ ; in 149 ccm of  $\frac{1}{2}$  sat.  $\text{NaCl} + \text{Aq}$  at  $13.5^\circ$ ; in 244 ccm. of  $\frac{1}{2}$  sat.  $\text{NaCl} + \text{Aq}$  at  $13.5^\circ$ . (Fassbender)

100 ccm. sat.  $\text{NaCl} + \text{Aq}$  dissolve 0.0785 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $8.5^\circ$ , 0.0665 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $13.5^\circ$  100 ccm.  $\frac{1}{2}$  sat.  $\text{NaCl} + \text{Aq}$  dissolve 0.671 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $13.5^\circ$ ,  $\frac{1}{2}$  sat.  $\text{NaCl} + \text{Aq}$  dissolve 0.4085 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $13.5^\circ$  (Droeze)

Solubility of  $\text{CaSO}_4$  in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	$\frac{g}{100 \text{ NaCl}}$	$\frac{g}{100 \text{ CaSO}_4}$	$t^\circ$	$\frac{g}{100 \text{ NaCl}}$	$\frac{g}{100 \text{ CaSO}_4}$
20	19 90	0 823	130	19 92	0 392
44	19 93	0 830	165	20 04	0 250
67	19 95	0 832	199	20 05	0 244
85	19 90	0 823	179	20 10	0 229
101	20 08	0 682	225	21 00	0 178

(Tilden and Shenstone, Roy. Soc. Proc. 33. 331.)

Solubility of  $\text{CaSO}_4$  in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% NaCl	100 ccm. dissolve g. of $\text{CaSO}_4$	$t^\circ$	% NaCl	100 ccm. dissolve g. of $\text{CaSO}_4$
21.5	3.53	0.5115	17.5	17.46	0.7369
19.5	7.35	0.6429	101.0	3.53	0.4891
21	11.12	0.7215	102.5	14.18	0.6248
18	14.18	0.7340	103	17.46	0.6299

(Lunge, J. Soc. Chem. Ind. 4. 31.)

100 pts  $\text{H}_2\text{O}$  containing pts  $\text{NaCl}$  dissolve pts  $\text{CaSO}_4$  at  $20^\circ$ .

Pts. NaCl	Pts. $\text{CaSO}_4$	Pts. NaCl	Pts. $\text{CaSO}_4$	Pts. NaCl	Pts. $\text{CaSO}_4$
0.00	0.225	5.05	6.34	24.40	0.820
0.52	0.301	10.00	7.38	35.10	0.734
2.03	0.441	20.00	0.823	35.86	0.709
5.02	6.15	.	.	.	.

(Tilden and Shenstone.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $26^\circ$ 

g per l		wt. of 1 cc solution	g per l		wt of 1 cc solution
NaCl	$\text{CaSO}_4$		NaCl	$\text{CaSO}_4$	
0.00	2.12	0.9998	176.50	7.12	1.1196
9.11	6.66	1.0644	228.76	6.79	1.1488
143.99	7.18	1.0981	264.17	6.50	1.1707
148.34	7.16	1.012	320.49	5.72	1.2034

(Cameron, J. phys. Ch. 1901, 5. 556.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $15^\circ$ .

G. $\text{CaSO}_4$ per l	G. NaCl per l
2.3	0.6
2.5	1.1
3.1	5.1
3.7	10.6
4.8	31.1
5.6	51.4
7.4	139.9

(Cameron, J. phys. Ch. 1901, 5. 559.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $26^\circ$ 

NaCl in 100 g $\text{H}_2\text{O}$	$\text{CaSO}_4$ in 100 g $\text{H}_2\text{O}$
0.0000	0.2126
9.4307	0.6886
15.2056	0.7581
15.6859	0.7575
18.8570	0.7605
25.0478	0.7439
29.3509	0.7219
36.5343	0.6515

(Cameron, J. phys. Ch. 1901, 5. 564.)

Solubility in  $\text{NaCl} + \text{Aq}$ .

30°		52°		70°		82°	
G NaCl per l.	G $\text{CaSO}_4$ per l.	G NaCl per l.	G $\text{CaSO}_4$ per l.	G NaCl per l.	G $\text{CaSO}_4$ per l.	G NaCl per l.	G $\text{CaSO}_4$ per l.
0.5	2.5	0.5	2.3	0.5	2.2	0.0	2.07
10.3	3.6	1.1	2.4	10.0	3.4	1.0	2.18
30.3	5.0	5.0	2.9	29.6	4.9	5.0	2.65
47.3	6.1	10.1	3.5	48.8	5.8	10.1	3.30
73.4	6.9	29.6	5.0	132.7	7.4	29.5	4.68
126.9	7.3	48.3	5.8	195.0	7.6	48.8	5.54
192.4	7.7	75.7	6.6	.	.	74.9	6.23
.	.	131.6	7.1	.	.	128.7	7.00
.	.	195.9	7.4	.	.	195.1	7.15

(Cameron, J. phys. Ch. 1901, 5. 562.)

1 l. sat.  $\text{NaCl} + \text{Aq}$  at  $25^\circ$  containing 318.3 g.  $\text{NaCl}$  dissolves 5.52 g.  $\text{CaSO}_4$ . (Cameron and Brown, J. phys. Ch. 1905, 9. 214.)Solubility in  $\text{NaCl} + \text{Aq}$ .

G. NaCl per l of $\text{NaCl} + \text{Aq}$	G anhydrous $\text{CaSO}_4$ dissolved per litre	
	at $14^\circ$	at $20^\circ$
0.0	1.70	2.10
2.925	2.32	2.70
5.850	2.79	3.15
11.70	3.41	3.75
14.62	3.68	4.00
29.25	4.40	4.70
58.50	5.72	6.00
87.75	6.58	6.85
102.3	6.90	7.15
117.0	7.10	7.30
131.6	7.20	7.30
146.2	7.10	7.13
160.8	7.00	7.05
175.6	6.80	6.80
204.7	6.30	6.30
234.0	5.90	5.90
263.2	5.50	5.52
292.6	5.30	5.30

(d'Anselme, Bull. Soc. 1903, (3) 29. 373.)

Solubility in  $\text{NaCl} + \text{Aq}$ .

G. NaCl in 100 cc solution	G. $\text{CaSO}_4 + 2\text{H}_2\text{O}$
0.00	0.200 g.
2.44 g.	0.635 g.
4.77 g.	0.826 g.
9.50 g.	1.056 g.
14.22 g.	1.193 g.
23.15 g.	1.275 g.
31.30 g.	1.583 g.

(Cloe, Bull. Soc. 1903, (3) 29. 167.)

## Solubility in NaCl + Aq at t°

When a sat. solution of NaCl is shaken with a mixture of solid NaCl and  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ , the calcium sulphate dissolved, calculated from the amount of CaO in solution, is always greater than that calculated from the sulphuric acid in solution. Similar results are obtained when solid calcium sulphate alone is shaken with a sat. solution of NaCl.

t°	In 100 g of the solution		
	Cl	$\text{CaSO}_4$ calc from CaO	$\text{CaSO}_4$ calc from $\text{SO}_4$
0	15 253	0 4464	0 4334
10	15 920	0 4477	0 4426
25	15 987	0 4609	0 4542
40	16 123	0 4938	0 4730
50	16 270	0 5093	0 4832
60	16 324	0 5305	0 5047
62.5	16 361	0 5091	0 5091
65	16 459	0 5435	0 3749
71	16 486	0 5578	0 3631
75	16 524	0 5803	0 3587
85	16 670	0 5399	0 3519
99	17 128	0 4086	0 3414

(Arth, Bull. Soc. 1906, (3) 35. 780)

Within a temp. range from 25°–80°  $\text{CaSO}_4$  forms no double salt in solutions of NaCl. At any concentration with respect to the latter maximum solubility occurs with 155 g. NaCl per l. and amounts to 7.3 g.  $\text{CaSO}_4$  at 80°. (Cameron, J. phys. Chem. 1907, 11. 496.)

See also under Gypsum, p. 653.

Solubility of  $\text{CaSO}_4$  in NaCl + Aq in contact with solid  $\text{Ca}(\text{HCO}_3)_2$ .

G. $\text{CaSO}_4$ per l.	G. $\text{Ca}(\text{HCO}_3)_2$ per l.	G. NaCl per l.
1.9298	0 0603	0 000
2.7200	0 0724	3.628
3.4460	0 0885	11.490
5 1560	0 1006	39 620
6 4240	0 0603	79.520
5.2720	0 0563	121 900
4 7880	0 0482	193 800
4 4620	0 0402	267 600

(Cameron and Seidell, J. phys. Chem. 1901, 5. 653)

$(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$

Sol in 287 pts.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (14). (Fresenius, Z. anal. 30 593.)

1 g  $\text{CaSO}_4$  is sol in 327 ccm  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at 9°, in 369 ccm  $\frac{1}{2}$  sat.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at 13.5° (Fassbender.)

Solubility in sat.  $(\text{NH}_4)_2\text{SO}_4$  or  $\text{Na}_2\text{SO}_4$  is the same as in  $\text{H}_2\text{O}$  (Droeze, B. 10. 330.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at 25°.

g. per l. solution			g. per l.		
$(\text{NH}_4)_2\text{SO}_4$	$\text{CaSO}_4$	wt of 100 cc solution	$(\text{NH}_4)_2\text{SO}_4$	$\text{CaSO}_4$	wt. of 100 cc solution
0 00	0 208	99.91	6 575	0 144	100 36
0 129	0 204	99.91	13.15	0 146	100 82
0.258	0 199	99.92	26.30	0 162	101 76
0.821	0 181	99.95	84.9	0 233	105 34
1 643	0 166	99.99	169.8	0 333	110 32
3 287	0 154	100 10	339.6	0.450	119.15

(Sullivan, J. Am. Chem. Soc. 1905, 27. 529.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at 50°

Sp. gr.	$(\text{NH}_4)_2\text{SO}_4$ per l.	$\text{CaSO}_4$ per l.	Solid phase
...	0	2 168	$\text{CaSO}_4 + 2\text{H}_2\text{O}$
1.0026	15.65	1 609	
1.0113	30.67	1 750	
1.0440	91.6	2 542	
1.0819	160.4	3 402	
1.1108	221.6	4 068	
1.1385	280.6	4 690	
1.1653	340.6	5 084	
1.1972	415.6	5 336	
1.1964	416.5	5 354	
1.2043	428.4	4.632	$\text{CaSO}_4, (\text{NH}_4)_2\text{SO}_4 + 2\text{H}_2\text{O}$
1.2187	479.4	3 524	
1.2437	530.8	2 152	$(\text{NH}_4)_2\text{SO}_4$
1.2480	558.0	1 986	
1.2502	564.7	1 98	
1.2508	566.0	1 08	
1.2510	566.7	0	

(Bell and Taber, J. phys. Chem. 1906, 10. 120.)

Solubility of  $\text{CaSO}_4$  in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at t°.

Excess of $(\text{NH}_4)_2\text{SO}_4$			Excess of $\text{CaSO}_4$		
t°	$\frac{\text{g}}{\text{cc}}$ $\text{CaSO}_4$	$\frac{\text{g}}{\text{cc}}$ $(\text{NH}_4)_2\text{SO}_4$	t°	$\frac{\text{g}}{\text{cc}}$ $\text{CaSO}_4$	$\frac{\text{g}}{\text{cc}}$ $(\text{NH}_4)_2\text{SO}_4$
6	0.1529	41.82	3	0.3782	36.62
40.5	0 1569	44.55	31	0 4070	35.50
58	0 1662	46.07	60	0 5083	34.97
78	0.1968	47.51	75	0 5898	34.86
100	0.2546	49.45	80	0.6108	34.88
			84	0.5725	32.40
			100	0 4895	25.97

(Barre, C. R. 1909, 148. 1605.)

The solubility of  $\text{CaSO}_4$  in  $\text{H}_2\text{O}$  is considerably increased by the presence of  $(\text{NH}_4)_2\text{SO}_4$ .

but decreased by the presence of  $K_2SO_4$ .  
(Barre, C. R. 1909, 148. 1606.)

$CuSO_4 + Aq.$

Solubility in  $CuSO_4 + Aq$  at  $25^\circ$

Sp. gr. of the solution $25^\circ/25^\circ$	g $CuSO_4$ per l.	g $CuSO_4$ per l.
1.002	1.144	2.068
1.005	3.564	1.986
1.007	6.048	1.944
1.009	7.279	1.858
1.016	14.814	1.760
1.021	19.729	1.736
1.030	29.543	1.688
1.041	39.407	1.718
1.051	49.382	1.744
1.061	58.880	1.782
1.098	97.950	1.931
1.146	146.725	2.048
1.192	196.021	2.076
1.218	224.916	2.088

(Bell and Taber, J. phys. Ch. 1907, 11. 637.)

$MgSO_4 + Aq$

Insol. in sat.  $MgSO_4 + Aq$

1 g.  $CaSO_4$  is sol. in 1162 cc.  $\frac{1}{10}$  sat.  $MgSO_4 + Aq$  at  $13.5^\circ$ . (Fassbender, B. 9. 1360.)

Sol. in 635 pts. sat.  $MgSO_4 + Aq$  at  $10^\circ$  (Karsten)

Absolutely insol. in sat.  $MgSO_4 + Aq$ , and pptd. from aqueous solution by the addition of  $HgSO_4$ . (Droze, B. 10. 340.)

1 l.  $\frac{1}{10}$  sat.  $MgSO_4 + Aq$  dissolves 0.86 g.  $CaSO_4 + 2H_2O$  (Droze)

Solubility in  $MgSO_4 + Aq$  at  $25^\circ$ .

g. per l.		Sp. gr. at $25^\circ/25^\circ$	g. per l.		Sp. gr. at $25^\circ/25^\circ$
$MgSO_4$	$CaSO_4$		$MgSO_4$	$CaSO_4$	
0.0	2.046	1.0032	149.67	1.597	1.1377
3.20	1.620	1.0055	165.7	1.549	1.1479
6.39	1.507	1.0090	171.2	1.474	1.1537
10.64	1.471	1.0118	198.8	1.422	1.1813
21.36	1.478	1.0220	232.1	1.254	1.2095
42.68	1.558	1.0419	265.6	1.070	1.2382
64.14	1.608	1.0626	298.0	1.860	1.2624
85.67	1.617	1.0833	330.6	0.647	1.2877
128.28	1.627	1.1190	355.0	0.501	1.3023

(Cameron and Bell, J. phys. Ch. 1906, 10. 210.)

$K_2SO_4 + Aq.$

1 g.  $CaSO_4$  is sol. in 2325 cc. sat.  $K_2SO_4 + Aq$  at  $13.5^\circ$ ; in 664 cc.  $\frac{1}{2}$  sat.  $K_2SO_4 + Aq$  at  $13.5^\circ$ .

Solubility in  $K_2SO_4 + Aq$  at  $25^\circ$

g. per l.		wt. of 1 cc. of solution
$K_2SO_4$	$CaSO_4$	
0.0	2.08	0.9981
4.88	1.60	1.0036
5.09	1.56	1.0038
9.85	1.45	1.0075
19.57	1.49	0.151
28.35	1.55	1.0220
30.66	1.57	1.0236
32.47*	1.58	

\*Solid phase syngenite.  
(Cameron and Breazeale, J. phys. Ch. 1904, 8. 335.)

Solubility in  $K_2SO_4 + Aq.$  at  $25^\circ$ .

In 1000 g. of the solution

mole  $K_2SO_4$  mole  $CaSO_4$

3.223 0.223

(D'Ans, Z. anorg. 1909, 62. 151.)

Solubility of  $CaSO_4$  in  $K_2SO_4 + Aq$  at  $t^\circ$ .

Excess of $K_2SO_4$			Excess of $CaSO_4$	
$t^\circ$	$\frac{CaSO_4}{K_2SO_4}$	$\frac{CaSO_4}{K_2SO_4}$	$\frac{CaSO_4}{K_2SO_4}$	$\frac{CaSO_4}{K_2SO_4}$
0	0.1296	2.00	0.0229	6.99
18	0.1531	2.79	0.0271	9.81
51	0.1754	4.21	0.0300	14.18
80	0.1922	5.00	0.0349	17.55
99	0.1980	5.39	0.0371	19.70

(Barre, C. R. 1909, 148. 1606.)

$Ag_2SO_4 + Aq.$

1 l. of the solution contains 2.31 g.  $CaSO_4 + 7.23$  g.  $Ag_2SO_4 = 9.54$  g. mixed salts at  $17^\circ$ . Sp. gr. = 1.0083.

1 l. of the solution contains 2.61 g.  $CaSO_4 + 8.11$  g.  $Ag_2SO_4 = 10.72$  g. mixed salts at  $25^\circ$ . Sp. gr. = 1.010. (Euler, Z. phys. Ch. 1904, 49. 313.)

$Na_2SO_4 + Aq$

1 g.  $CaSO_4$  is sol. in 398 cc. sat.  $Na_2SO_4 + Aq$  at  $10.5^\circ$

Solubility of  $CaSO_4$  in  $Na_2SO_4 + Aq$  at  $22^\circ$

G $CaSO_4$ per l.	G $Na_2SO_4$ per l.
2.084	0.000
1.583	2.771
1.433	13.820
1.408	16.360
1.569	39.310
1.841	77.320
2.185	133.00
2.414	193.800
*2.578	*222.580

\*Both  $CaSO_4$  and  $Na_2SO_4$  as solid phases in contact with the solution  
(Cameron and Seidell, J. phys. Chem. 1901, 5. 650.)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

wt of 1000 ccm of solution grams	g $\text{Na}_2\text{SO}_4$ per l	g $\text{CaSO}_4$ per l
1001 26	2 390	1 650
1007 59	9 535	1 457
1011 45	14 132	1 388
1020 46	24 369	1 471
1031 48	36 979	1 563
1039 12	46 150	1 650
1079 47	94 220	1 980
1096 47	115 084	2 096
1142 06	146 612	2 234
1176 47	205 105	2 503
1212 00	257 100	2 650

(Cameron and Breazeale, J. phys. Chem. 1904, 8 340)

1 l. sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$  containing 254.06 g.  $\text{Na}_2\text{SO}_4$  dissolves 2.58 g.  $\text{CaSO}_4$ . (Cameron and Brown, J. phys. Ch. 1905, 9 214.)

Hydration is retarded by dil. solutions and accelerated by conc. solution of sodium, potassium, ammonium and magnesium sulphates. (Rohland, Z. Elektrochem. 1908, 14, 422.)

More than 10 times as much  $\text{CaSO}_4$  dissolves in sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  as in  $\text{H}_2\text{O}$ . (Diehl. Insol. in alcohol. of 0.905 sp. gr. or less. (Anthon, J. pr. 14, 125.)

Solubility in 10% alcohol = 0.0970 g.  $\text{CaSO}_4$  per 100 g. solution. (Magnanini, Gazz. Ch. it. 1901, 31, (2) 544.)

Sol. in dil. alcoholic solutions of  $\text{NH}_4\text{NO}_3$ ,  $\text{KNO}_3$ ,  $\text{NaNO}_3$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$ , and  $\text{NaCl}$  (Margueritte, C. R. 38, 308.)

Sol. to considerable extent in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ , especially if freshly pptd. More sol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  than in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Weppen, J. pr. 11, 182.)

More sol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  than in other  $\text{NH}_4$  salts (Cohn, J. pr. (2) 35, 43.)

More sol. in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$  or  $\text{KCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Mulder)

Solubility in N/200 potassium hydrogen tartrate +  $\text{Aq}$  = 0.2323 g.  $\text{CaSO}_4$  per 100 g. solution. (Magnanini, Gazz. ch. it. 1901, 31, (2) 544.)

72.61 millimols per l of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  are sol at  $25^\circ$  in ammonium citrate +  $\text{Aq}$  (concentration = 0.5 millimols. per l.)

38.39 millimols per l. of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  are sol. at  $25^\circ$  in sodium citrate +  $\text{Aq}$  (Concentration = 0.25 millimols per l. (Randell, Z. phys. Ch. 1910, 70, 452.)

100 pts. glycerine dissolve 0.957 pt.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$ , and solubility increases with the temp. (Asselin, C. R. 76, 884.)

100 g. glycerine (sp gr. 1.256) dissolve 5.17 g.  $\text{CaSO}_4$  at  $15-18^\circ$ . (Ossendowski, Pharm. J 1907, 79, 575.)

Solubility in 10% alcoholic N/200  $\text{KHC}_2\text{H}_3\text{O}_2 + \text{Aq}$  = 0.0866 g.  $\text{CaSO}_4$  per 100 g. solution.

Solubility in N/200  $\text{KHC}_2\text{H}_3\text{O}_2 + \text{Aq}$  + 5% tartaric acid = 0.2556 g.  $\text{CaSO}_4$  per 100 g. solution.

Solubility in 10% alcoholic N/400  $\text{KHC}_2\text{H}_3\text{O}_2 + 5\%$  tartaric acid = 0.1086 g.  $\text{CaSO}_4$  in 100 g. solution. (Magnanini.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethylacetate. (Naumann, B. 1910, 43, 314.)

Solubility in sugar +  $\text{Aq}$  at  $t^\circ$ 

°C sugar	G $\text{CaSO}_4$ dissolved in 1 l sugar solutions					
	30°	40°	50°	60°	70°	80°
0		2.157	1.730	1.730	1.652	1.710
10	2.041	1.730	1.730	1.574	1.574	1.613
20	1.808	1.652	1.419	1.380	1.419	1.263
27	1.550	1.438	1.361	1.283	1.283	0.972
35	1.263	1.050	1.088	1.108	0.914	
42	1.030		0.777	0.816	0.855	0.729
49		0.564	0.739	0.564	0.603	0.486
55		0.486	0.505	0.486	0.369	0.330

(Stolle, Z. Ver. Zuckerind, 1900, 50, 331)

Min. Anhydride.

+  $2\text{H}_2\text{O}$ . Min. Gypsum.

Gypsum. A sat. aq. solution of gypsum of particles not less than  $2\mu$  contains 2.085 g.  $\text{CaSO}_4$  per litre at  $25^\circ$ .

A sat. aq. solution of gypsum of particles not smaller than  $0.3\mu$  contains 2.476 g.  $\text{CaSO}_4$  per liter at  $25^\circ$  ( $\mu = 0.0001$  cm.) (Hulett and Allen, Z. phys. Ch. 1901, 37, 391 and 393.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. $\text{CaSO}_4$ in 100 ccm of the solution	Density of the solution at $t^\circ$
0	0.17590	1.001970
10	0.19283	1.001727
18	0.20160	1.000590
25	0.20805	0.999109
30	0.20935	0.997891
35	0.20960	0.996122
40	0.20970	0.994390
45	0.20835	0.992370
55	0.20095	0.987960
65 3	0.19320	0.982560
75	0.18475	0.977724
100	0.16195	

(Hulett and Allen, J. Am. Chem. Soc. 1902, 24, 674)

1 l  $\text{H}_2\text{O}$  dissolves 2.13 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $25^\circ$ . (Euler, Z. phys. Ch. 1904, 49, 314.)

2023 mg. are dissolved in 1 l of sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64, 168.)

1 l.  $\text{H}_2\text{O}$  dissolves 2.267 g  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $0^\circ$ ; 2.684 g. at  $35^\circ$ ; 2.662 g. at  $50^\circ$ ; and 2.155 g. at  $100^\circ$ . (Cavazzi, C. C. 1905, I, 1693.)

1 l.  $\text{H}_2\text{O}$  dissolves 29.5 milliequivalents at  $18^\circ$ ; 30 at  $50^\circ$ ; 23.3 at  $190^\circ$ . (Melcher, J. Am. Chem. Soc. 1910, 32, 63.)

See also under  $\text{CaSO}_4$ .

Solubility of pulverized gypsum in  $\text{NaCl} + \text{Aq}$  at  $23^\circ$ .

Grams gypsum	G. NaCl per l	G $\text{CaSO}_4$ per l
* 2 99	0 99	2 37
3 82	4 95	3 02
4 48	10.40	3 54
6 31	30 19	4 97
7 51	49 17	5 94
8 53	75 58	6 74
9 42	129 50	7 50
9 17	197 20	7.25
8 88	229 70	7 03
7 19	306.40	5 68
6 79	315.55	5 37

(Cameron, J phys Chem 1901, 5, 559)

See also under  $\text{CaSO}_4$ .

+  $\frac{1}{2}\text{H}_2\text{O}$  Plaster of Paris contains  $\frac{1}{2}\text{H}_2\text{O}$  according to Chatelier (C. C. 1889, 1, 203).

**Calcium hydrogen sulphate,  $\text{CaH}_2(\text{SO}_4)_2$ .**

100 pts.  $\text{H}_2\text{SO}_4$  of 1.82 sp gr dissolve about 2 pts  $\text{CaSO}_4$ ; 100 pts fuming  $\text{H}_2\text{SO}_4$  dissolve 10.17 pts  $\text{CaSO}_4$  (Struve, Z anal. 9, 34); 100 pts  $\text{H}_2\text{SO}_4$  dissolve 2.5 pts  $\text{CaSO}_4$  (Lies-Bodart and Jacquemin, C R 46, 1206);  $\text{CaSO}_4$  is precipitated by  $\text{H}_2\text{O}$  from  $\text{H}_2\text{SO}_4$  solution

100 pts. boiling  $\text{H}_2\text{SO}_4$  dissolve 10 pts.  $\text{CaSO}_4$ . (Schultz, Pogg. 133 137)

Solubility of  $\text{CaSO}_4$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

wt. of 1000 cons. of solution at $25^\circ$	g $\text{H}_2\text{SO}_4$ per l	g $\text{CaSO}_4$ per l. at		
		$25^\circ$	$35^\circ$	$43^\circ$
999.1067	0.00	2.126		2.145
1002.493	0.48	2.128		2.236
1002.553	4.87	2.144	2 209	2 456
1005.091	8.11	2 203		2.760
1009.787	16.22	2 382		3 116
1030 151	48.67	2.727	3 397	3 843
1043 470	75 00	2.841		4.146
1075 613	97 35	2.779	3.606	
	146 01	2.571	3.150	4.139
1113 392	194 70	2 313		3.551
1141.755	243 35	1 901		2.959
1168 143	292 02	1 541		2.481

(Cameron and Breazeale, J. phys. Chem 1903, 7, 574.)

100 pts. hot conc.  $\text{H}_2\text{SO}_4$  dissolve approx. 10 pts  $\text{CaSO}_4$ . (Rohland, Z. anorg. 1910, 66, 206.)

Decomp. by  $\text{H}_2\text{O}$ .

**Calcium hexahydrogen sulphate,  $\text{CaH}_6(\text{SO}_4)_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Schultz, Pogg. 133, 137.)

**Calcium cupric potassium sulphate,  $\text{Ca}_2\text{K}_2\text{Cu}(\text{SO}_4)_4 + 2\text{H}_2\text{O}$ .**

(D'Ans, B. 1908, 41, 1778.)

**Calcium magnesium potassium sulphate,  $2\text{CaSO}_4, \text{MgSO}_4, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .**

Min. *Polyhalite*. Sol. in  $\text{H}_2\text{O}$  with residue of  $\text{CaSO}_4$ .

$4\text{CaSO}_4, \text{MgSO}_4, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ . Min. *Krugite*. Decomp. by  $\text{H}_2\text{O}$ .

**Calcium potassium sulphate,  $\text{CaK}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$ .**

Min. *Syngenite*. Sol in 400 pts.  $\text{H}_2\text{O}$ . (Zepharovitch.) Less sol. than  $\text{K}_2\text{SO}_4$ . Decomp. by heating with separation of  $\text{CaSO}_4$ . Decomp. by  $\text{H}_2\text{O}$  until 25 g.  $\text{K}_2\text{SO}_4$  are dissolved in a litre, after which there is no decomposition. (Ditte, C. R. 84, 86.)

Easily sol. in dil. acids. (Phillips.)

Solubility of syngenite,  $\text{CaK}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$  in  $\text{K}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Wt of 1000 cons of solution at $25^\circ$	g. $\text{K}_2\text{SO}_4$ per l.	g $\text{CaSO}_4$ per l
1013 08	16 31	*1 495
1015 78	19 87	1 529
1020.01	25.01	1 537
1021.54	30 83	1 565
1036 82	46.99	0 810
1058 10	75 45	0 451
1085 91	112 87	0 330

\*In first four determinations syngenite completely decomposed.

(Cameron and Breazeale, J. phys. Chem. 1904, 8 339.)

This double salt is stable between  $0^\circ$  and  $99^\circ$  in the presence of an excess of either  $\text{CaSO}_4$  or  $\text{K}_2\text{SO}_4$ . In this temp interval the double sulphate,  $2\text{CaSO}_4, \text{K}_2\text{SO}_4, 3\text{H}_2\text{O}$  described by Ditte (C. R. 84, 867) does not exist. (Barre, C. R. 1909, 148, 1607.)

$\text{Ca}_2\text{K}_2(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . (Ditte, C. R. 84, 867.)

$5\text{CaSO}_4, \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$ . Slowly decomp. by  $\text{H}_2\text{O}$ . (van't Hoff and Geiger, B. A. B. 1904, 935)

**Calcium potassium zinc sulphate,  $\text{Ca}_2\text{K}_2\text{Zn}(\text{SO}_4)_4 + 2\text{H}_2\text{O}$**

(D'Ans, B. 1908, 41, 1778.)

**Calcium rubidium sulphate,  $\text{Ca}_2\text{Rb}_2(\text{SO}_4)_4$ .**

(D'Ans, B. 1907, 40, 4913.)

+  $3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Ditte, C. R. 84, 86.)

$\text{CaRb}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$ . (D'Ans.)

Calcium sodium sulphate,  $\text{CaNa}_2(\text{SO}_4)_2$ .

Min. *Glauberite*. Gradually sol. in  $\text{H}_2\text{O}$ , but crystals of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  soon separate out. (Fritzsche.)

Insol. in alcohol, and conc.  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ ; decomp. by  $\text{H}_2\text{O}$  (Folkhard, C. N. 43. 6.)

$\text{CaNa}_2(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Fritzsche.)

Calcium titanium sulphate,  $\text{CaSO}_4, \text{Ti}(\text{SO}_4)_2$ .

Ppt.; decomp. by  $\text{H}_2\text{O}$  giving titanic acid. (Weinland, Z. anorg. 1907, 54. 254.)

Calcium uranium sulphate.

Min. *Uranochalcite*

Min. *Medjideite*. Easily sol. in dil.  $\text{HCl} + \text{Aq}$ .

Cerous sulphate,  $\text{Ce}_2(\text{SO}_4)_3$ .

Anhydrous cerous sulphate is much more sol. in  $\text{H}_2\text{O}$  than the hydrated salt.

Easily sol. in cold  $\text{H}_2\text{O}$  if added thereto in small amounts. If large amount of  $\text{Ce}_2(\text{SO}_4)_3$  is treated with a little  $\text{H}_2\text{O}$  it hardens with evolution of heat, and becomes very difficultly soluble. 100 pts.  $\text{H}_2\text{O}$  dissolve 161 pts.  $\text{Ce}_2(\text{SO}_4)_3$  at  $0^\circ$  and 17.86 pts. at  $19^\circ$ .

$\text{Ce}_2(\text{SO}_4)_3 + \text{Aq}$  sat. in cold deposits  $\text{Ce}_2(\text{SO}_4)_3$  at  $75^\circ$ , and only 2.25 pts. remain in solution at  $100^\circ$ . (Jolin, Bull. Soc. (2) 21. 536.)

100 pts.  $\text{H}_2\text{O}$  dissolve 8.31 pts.  $\text{Ce}_2(\text{SO}_4)_3$  at  $20^\circ$ ; 8.08 pts. at  $45^\circ$ ; 4.95 pts. at  $60^\circ$ ; 0.504 pt. at  $100^\circ$ . (Bühlig, J. pr. (2) 12. 240.)

60 pts. anhydrous salt dissolve quickly at  $0-3^\circ$  in 100 pts.  $\text{H}_2\text{O}$ .

At  $15^\circ$  the solution solidifies, and the mother liquor contains only 27.88%  $\text{Ce}_2(\text{SO}_4)_3$ . At  $15^\circ$  the maximum attainable strength is 31.82%  $\text{Ce}_2(\text{SO}_4)_3$ . (Brauner, Chem. Soc. 53. 887.)

100 pts.  $\text{H}_2\text{O}$  dissolve 10.747 pts.  $\text{Ce}_2(\text{SO}_4)_3$  at  $18^\circ$ ; 9.648 pts. at  $19^\circ$ ; 6.949 pts. at  $33^\circ$ .

The solubility of  $\text{Ce}_2(\text{SO}_4)_3$  in  $\text{H}_2\text{O}$  is diminished by the addition of  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$  or  $\text{Na}_2\text{SO}_4$ . (Barre, C. R. 1910, 161. 872.)

Sp. gr. of  $\text{Ce}_2(\text{SO}_4)_3 + \text{Aq}$  was found to be constant whether  $\text{Ce}_2(\text{SO}_4)_3$  or  $\text{Ce}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  was used. The following results were obtained at  $15^\circ$ .

Pts. $\text{Ce}_2(\text{SO}_4)_3$ to 100 pts. $\text{H}_2\text{O}$	Sp. gr.	Pts. $\text{Ce}_2(\text{SO}_4)_3$ to 100 pts. $\text{H}_2\text{O}$	Sp. gr.
3 17	1.03005	12 66	1.11917
6 11	1.05812	14 56	1.13665
8 35	1.07910	15 64	1.14623
9 61	1.09085	21 19	1.19640
10 55	1.09939	31 62	1.28778
11 66	1.10987		

(Brauner, Chem. Soc. 53. 357.)

4.5 pts.  $\text{Ce}_2(\text{SO}_4)_3$  dissolve in 100 pts.  $\text{H}_2\text{SO}_4$ . (Wyruboff, Bull. Soc. (3) 2. 745.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $16^\circ$ .

Per 100 pts $\text{H}_2\text{O}$	
$(\text{NH}_4)_2\text{SO}_4$	$\text{Ce}_2(\text{SO}_4)_3$
0 00	10 747
3 464	1 026
9 323	0 782
19 240	0 748
29 552	0 701
45 616	0 497
55.083	0.194
63.920	0.090
72.838	0.035

(Barre, A. ch. 1911, (8) 24. 252.)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $19^\circ-20^\circ$ .

Per 100 pts $\text{H}_2\text{O}$	
$\text{Na}_2\text{SO}_4$	$\text{Ce}_2(\text{SO}_4)_3$
0 00	9 64
0 328	0 637
0 684	0 259
1 091	0 0937
1 392	0 057
1.699	0 0303
2 640	0 012
3 589	0 0065
5 660	0 0046
7 710	0 0037

(Barre, A. ch. 1911, (8) 24. 251.)

Solubility in  $\text{K}_2\text{SO}_4 + \text{Aq}$  at  $16^\circ$ .

Per 100 pts $\text{H}_2\text{O}$	
$\text{K}_2\text{SO}_4$	$\text{Ce}_2(\text{SO}_4)_3$
0 00	10.747
0 178	0.956
0 510	0.432
0.726	0.250
1.290	0.0419

(Barre, A. ch. 1911, (8) 24. 248.)

$+4\text{H}_2\text{O}$  100 g.  $\text{H}_2\text{O}$  dissolve at:

$35^\circ$   $40^\circ$   $50^\circ$   $57^\circ$   
8.5 6.04 3.43 2.34 g.  $\text{Ce}_2(\text{SO}_4)_3$ .

$65^\circ$   $70^\circ$   $82^\circ$   $100.5^\circ$  bpt. of sat. solution.  
1.883 1.38 1.01 0.43 g.  $\text{Ce}_2(\text{SO}_4)_3$ .

(Koppel, Z. anorg. 1904, 41. 399.)

+5H <sub>2</sub> O. 100 pts. H <sub>2</sub> O dissolve pts. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> at t°.	
t°	Pts. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
100	0 775
80	1 70
60	3 45
50	5 56
40	8 20

(Muthmann and Rolig, Z. anorg. 1898, 16, 453.)

100 g. H <sub>2</sub> O dissolve at:		
45°	60°	70°
8 833	3 247	1 929 g. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> .
80°	90°	100.5° bpt. of sat. solution.
1.207	0.8355	0.469 g. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> .

Muthmann and Rolig's determinations are inaccurate (Koppel.)  
+8H<sub>2</sub>O. 100 pts. H<sub>2</sub>O dissolve 14.92 pts. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> at 20° from Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O<sub>2</sub> (John.)

100 pts. H <sub>2</sub> O dissolve pts. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> at t°			
t°	Pts. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	t°	Pts. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
0	19 10	50	12 48
18	17 32	60	9 40
30	16 13	70	4 24

(Muthmann and Rolig.)

100 g. H <sub>2</sub> O dissolve at.			
0°	15°	20 4°	
10 09	11 06	9.525 g. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> ,	
30°	40°	50°	60°
7.388	5.947	4.785	4 064 g. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> .

Previous determinations are inaccurate. (Koppel, Z. anorg. 1904, 41, 395.)

100 g. sat. solution at 25° contain 7.60 g. anhydrous salt. (Wirth, Z. anorg. 76, 174.)

Solubility in H<sub>2</sub>SO<sub>4</sub>+Aq at 25° Solid phase  
Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O

Normality H <sub>2</sub> SO <sub>4</sub>	In 100 g. of the liquid are dissolved	
	g. Ce <sub>2</sub> O <sub>3</sub>	g. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
0	4 604	7 60
0 1	4 615	7 618
1 1	3 64	6 00
2 10	3 01	5 018
4 32	2.0	3 301
6 685	0 9115	1 505
9 68	0 4339	0 733
15 15	0 145	0 239

(Wirth, Z. anorg. 1912, 76, 191.)

+9H<sub>2</sub>O. 100 pts. H<sub>2</sub>O dissolve 17.52 pts. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> from Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+9H<sub>2</sub>O. (Brauner.

100 g. H <sub>2</sub> O dissolve at.					
0°	15°	21°	30°	31 2°	
20.98	11 87	9 725	7.353	7.185 g. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> ,	
31.6°	45°	50°	60°	65°	
7.164	5.13	4 673	3.88	3.595 g. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> .	
(Koppel)					

+12H<sub>2</sub>O  
100 pts. H<sub>2</sub>O dissolve pts. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> at t°.

t°	Pts. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
0	21 40
18	18 44
25	16 22

(Muthmann and Rolig, Z. anorg. 1898, 16, 457.)

100 g. H<sub>2</sub>O dissolve at:  
0° 18.8° 19.2°  
16.56 17.52 17.70 g. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.  
Previous determinations are inaccurate. (Koppel.)

Ceroceric sulphate, Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2Ce(SO<sub>4</sub>)<sub>2</sub>+24H<sub>2</sub>O.

Decomp. by H<sub>2</sub>O. Sol. in HCl+Aq with decomp. (Mendeleeff, A. 168, 45.)  
Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3Ce(SO<sub>4</sub>)<sub>2</sub>+31H<sub>2</sub>O. (John.)

Ceric sulphate, basic, CeO<sub>2</sub>, SO<sub>3</sub>+2H<sub>2</sub>O.

Very sl. sol. in H<sub>2</sub>O.  
Sol. in 2500 pts. H<sub>2</sub>O (Mosander.)  
Boiling H<sub>2</sub>O gradually dissolves out H<sub>2</sub>SO<sub>4</sub>. (Ert.)

Sol. in acids.  
8CeO<sub>2</sub>, 7SO<sub>3</sub>+12H<sub>2</sub>O; 8CeO<sub>2</sub>, 7SO<sub>3</sub>+15H<sub>2</sub>O; 6CeO<sub>2</sub>, 5SO<sub>3</sub>+5H<sub>2</sub>O; 4CeO<sub>2</sub>, 3SO<sub>3</sub>+7H<sub>2</sub>O; and 3Ce(SO<sub>4</sub>)<sub>2</sub>, 5Ce(OH)<sub>4</sub>. All are insol ppts.

Ceric sulphate, Ce(SO<sub>4</sub>)<sub>2</sub>.

Anhydrous. Very slowly sol. in cold, more rapidly in hot H<sub>2</sub>O. When solution has once begun, almost unlimited quantities may be dissolved. Insol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Meyer, B. 1904, 37, 144.)

+4H<sub>2</sub>O Sol. in H<sub>2</sub>O with immediate decomp. (Rammelsberg.)

Decomp by H<sub>2</sub>O. (Muthmann, B. 1900, 33, 1764.)

Cerous hydrogen sulphate, Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3H<sub>2</sub>SO<sub>4</sub>.

Decomp by H<sub>2</sub>O. (Wyruboff, Bull. Soc. (3) 2, 745; Brauner, Z. anorg. 1904, 38, 329.)

Ceroceric hydrogen sulphate, Ce<sub>2</sub>H(SO<sub>4</sub>)<sub>4</sub>+13H<sub>2</sub>O.

Sol. in H<sub>2</sub>O Forms very supersat solutions.

Solubility in H<sub>2</sub>SO<sub>4</sub> decreases with increase in concentration of the acid. (Meyer, B. 1904, 37, 146.)

Cerous potassium sulphate,  $\text{Ce}_2(\text{SO}_4)_3 \cdot \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$ , insol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq.}$  (Czudnowicz, J. pr. 80. 26.)  
 $2\text{Ce}_2(\text{SO}_4)_3 \cdot 3\text{K}_2\text{SO}_4$ . As above (Hermann, J. pr. 80. 188.)

+  $8\text{H}_2\text{O}$ . (Barre, A. ch. 1911, (8) 24. 249.)  
 $\text{Ce}_2(\text{SO}_4)_3 \cdot 2\text{K}_2\text{SO}_4 + 3\text{H}_2\text{O}$ . As above. (Jolin)

$\text{Ce}_2(\text{SO}_4)_3 \cdot 3\text{K}_2\text{SO}_4$ . Sol in about 56 pts.  $\text{H}_2\text{O}$  at  $9-20^\circ$ . Easily sol. in acidified  $\text{H}_2\text{O}$ . Nearly insol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq.}$  (Jolin.)  
 $\text{Ce}_2(\text{SO}_4)_3 \cdot 5\text{K}_2\text{SO}_4$ . Insol. in  $\text{K}_2\text{SO}_4 + \text{Aq.}$  (Barre, l.c.)

Ceric potassium sulphate,  $\text{Ce}(\text{SO}_4)_2 \cdot 2\text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  with decomp. Insol in sat  $\text{K}_2\text{SO}_4 + \text{Aq.}$

Ceric silver sulphate,  $10\text{Ce}(\text{SO}_4)_2 \cdot 6\text{Ag}_2\text{SO}_4$

Only sl. sol. in cold  $\text{H}_2\text{O}$ ; decomp. by hot  $\text{H}_2\text{O}$  in which it is readily sol (Pozzi-Escot, C. R. 1913, 156. 1074.)

Cerous sodium sulphate,  $\text{Ce}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ , and still less in  $\text{Na}_2\text{SO}_4 + \text{Aq.}$  100 cem. sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  dissolve an amount corresponding to 6.2 mg.  $\text{Ce}_2\text{O}_3$  (Jolin)

Sl. sol. in  $\text{HCl} + \text{Aq.}$  (Czudnowicz)

Cerous thallous sulphate,  $\text{Ce}_2(\text{SO}_4)_3 \cdot 3\text{Tl}_2\text{SO}_4$ .

Ppt.  
 $\text{Ce}_2(\text{SO}_4)_3 \cdot \text{Tl}_2\text{SO}_4 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Zschiesche, J. pr. 107. 98.)

+  $4\text{H}_2\text{O}$ . Very sl. sol. in cold, somewhat more in warm  $\text{H}_2\text{O}$ . (Wyruboff, Bull. Soc. Min. 14. 83.)

Cerous tin (stannic) hydrogen sulphate,  $\text{CeHSn}(\text{SO}_4)_4$

Decomp. by  $\text{H}_2\text{O}$ . Sol. in very dil.  $\text{HCl}$ . (Weinland, Z. anorg. 1907, 54. 251.)

Chromous sulphate,  $\text{CrSO}_4 \cdot 7\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 12.35 pts.  $\text{CrSO}_4 + 7\text{H}_2\text{O}$ . Aqueous solution can be boiled without decomp. Sl. sol. in alcohol.

+  $\text{H}_2\text{O}$  (Moissan, Bull. Soc. 37. 296.)

Chromic sulphate, basic,  $3\text{Cr}_2\text{O}_3 \cdot 2\text{SO}_4 + 12\text{H}_2\text{O} = 2\text{Cr}_2(\text{SO}_4)(\text{OH})_4 \cdot \text{Cr}_2(\text{OH})_6 + 5\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Slowly decomp. by  $\text{KOH} + \text{Aq}$  or  $\text{K}_2\text{CO}_3 + \text{Aq.}$

$5\text{Cr}_2\text{O}_3 \cdot 3\text{SO}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Recoura, C. R. 112. 1439.)

$\text{Cr}_2\text{O}_3 \cdot \text{SO}_3 = \text{Cr}_2\text{O}_3(\text{SO}_4)$ . Ppt. (Schiff, A. 124. 167.)

+  $10\text{H}_2\text{O}$  or  $[\text{Cr}(\text{OH})_2(\text{OH})_2]_2\text{SO}_4$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Werner, B. 1908, 41. 3451.)  
 $5\text{Cr}_2\text{O}_3 \cdot 8\text{SO}_3$  (?). (Siewert, A. 126. 97.)

$\text{Cr}_2\text{O}_3 \cdot 2\text{SO}_3 = \text{Cr}_2\text{O}_3(\text{SO}_4)_2$ . Easily sol. in a little  $\text{H}_2\text{O}$ , but a precipitate is thrown down

by further addition of  $\text{H}_2\text{O}$ , which redissolves on evaporation.

$5\text{Cr}_2\text{O}_3 \cdot 12\text{SO}_3$  (?). (Siewert.)

$2\text{Cr}_2\text{O}_3 \cdot 5\text{SO}_3 + 15\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ ; insol. in alcohol and acetone by which it is ppt. from aqueous solution. (Nicolardot, C. R. 1907, 145. 1338.)

Chromic sulphate,  $\text{Cr}_2(\text{SO}_4)_3$ .

Anhydrous. Insol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , aqua regia, and  $\text{NH}_4\text{OH} + \text{Aq.}$  Decomp. by boiling caustic alkalies, and slowly by alkali carbonates +  $\text{Aq.}$  (Schrotter.) According to Traube (A. 71. 92) and Siewert (A. 126. 94), Schrotter's salt is an acid sulphate,  $\text{Cr}_2(\text{SO}_4)_3(\text{OSO}_3\text{H})_2 = 2\text{Cr}_2(\text{SO}_4)_3 \cdot \text{H}_2\text{SO}_4$ . According to Etard (Bull. Soc. (2) 31. 200) both salts exist, and formula of above salt is  $\text{Cr}_2(\text{SO}_4)_3\text{Cr}_2$ . Formula is  $2[(\text{Cr}_2\text{O}_3)_2 \cdot (\text{SO}_4)_3]$ ,  $17\text{H}_2\text{SO}_4$  (?). (Cross and Higgins, Chem. Soc. 41. 113.)

Insol in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate (Naumann, B. 1910, 43. 314.)

+  $6\text{H}_2\text{O}$  (?). Green modification. Readily sol in  $\text{H}_2\text{O}$  or alcohol. Sol in conc  $\text{H}_2\text{SO}_4$ .  $\text{H}_2\text{O}$  solution is converted into the violet modification by standing 3-4 weeks. (Schrotter.)

+  $11\text{H}_2\text{O}$  (?). Extremely deliquescent; becomes liquid in moist air in 2 minutes. Not pptd. by  $\text{BaCl}_2 + \text{Aq.}$  (Recoura, C. R. 113. 857.)

+  $18\text{H}_2\text{O}$ . Violet modification. Sol. in 0.833 pt.  $\text{H}_2\text{O}$  at  $20^\circ$ . When the  $\text{H}_2\text{O}$  solution is heated to  $65-70^\circ$  it begins to be converted into the green modification. This conversion is also brought about by cold  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{PCl}_5$ . (Etard, C. R. 84. 1090.)

Sp. gr. of aqueous solution of violet modification of  $\text{Cr}_2(\text{SO}_4)_3$  containing:

5	10	20%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1.0275	1.0560	1.1150	
30	40	50%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1.1785	1.2480	1.3250	

Sp. gr. of aqueous solution of green modification of  $\text{Cr}_2(\text{SO}_4)_3$  containing:

10	20	30%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1.0510	1.1070	1.1680	
40	50	60%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1.2340	1.3055	1.3825	

70	80%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1.4650	1.5535	

(Gerlach, Z. anal. 28. 404)

See also Chromosulphuric acid.

Chromic hydrogen sulphate,  $\text{Cr}_2(\text{SO}_4)_3 \cdot \text{H}_2\text{SO}_4 + 16\text{H}_2\text{O}$ .

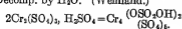
Two modifications

a. Violet Decomp. by  $\text{H}_2\text{O}$ .

b. Green. Obtained from violet modification on heating. Sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1906, 49. 157.)

+24H<sub>2</sub>O. Decomp. by alcohol, giving the normal sulphate. (Weinland.)

Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2H<sub>2</sub>SO<sub>4</sub>+18H<sub>2</sub>O. Hygroscopic. Decomp. by H<sub>2</sub>O. (Weinland.)



Correct composition of Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> (Traube), which see.

See also Chromosulphuric acid.

Chromic cupric sulphate, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2CuSO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>.

Insol. in H<sub>2</sub>O, but gradually decomp. thereby. (Étard, C. R. 87. 602.)



Insol. in H<sub>2</sub>O. (Recoura, C. R. 1893, 117. 39.)

Chromous hydrazine sulphate, CrSO<sub>4</sub>, 2N<sub>2</sub>H<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>.

Only sl. sol. in H<sub>2</sub>O. Sol. in acids. (Traube B. 1913, 46. 1507.)

Chromic hydroxylamine sulphate, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, (NH<sub>2</sub>OH)<sub>2</sub>SO<sub>4</sub>+24H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Meyerinhg.)

Chromic iron (ferrous) sulphate, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2FeSO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>+2H<sub>2</sub>O.

As above (Étard, l.c.)

Chromic iron (ferric) sulphate, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Insol. in H<sub>2</sub>O. (Étard, C. R. 86. 1399.)

Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>. Insol. in H<sub>2</sub>O (Étard.)

Chromic lithium sulphate, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3Li<sub>2</sub>SO<sub>4</sub>.

Resembles the corresponding K salt. (Wernicke.)

Chromic manganous sulphate, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3MnSO<sub>4</sub>.

(Étard, C. R. 86. 1402.)

Chromic manganic sulphate, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Insol. in H<sub>2</sub>O. (Étard, C. R. 86. 1399.)

Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2H<sub>2</sub>SO<sub>4</sub>. Sl. deliquescent. Sol. in H<sub>2</sub>O with decomp. (Étard.)

Chromic nickel sulphate, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, NiSO<sub>4</sub>, 2H<sub>2</sub>SO<sub>4</sub>+3H<sub>2</sub>O.

Insol. in H<sub>2</sub>O, but gradually decomp. thereby. (Étard, C. R. 87. 602.)

Chromous potassium sulphate, CrSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, +6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O; less sol. in alcohol. (Peligot, A. ch. (3) 12. 546.)

Chromic potassium sulphate, K<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>.

Anhydrous. α. Sol. in H<sub>2</sub>O when not heated over 350°

β. Insol. in cold H<sub>2</sub>O and cold acids. When ignited is insol. in hot H<sub>2</sub>O and acids, except slightly in boiling conc. H<sub>2</sub>SO<sub>4</sub>. (Fischer.)

+2H<sub>2</sub>O (?). Insol. in cold H<sub>2</sub>O or dil. acids. Sol. by long boiling with H<sub>2</sub>O, and more quickly when HCl is added. (Hertwig.)

+4H<sub>2</sub>O. Is potassium chromosulphate, which see.

+24H<sub>2</sub>O. *Chrome-alum*. *Violet modification*. Efflorescent at 29°. Sol. in 6-7 pts. cold H<sub>2</sub>O. When the H<sub>2</sub>O solution is heated to 60-70° it is partially decomp. into a green modification, which is more sol. in H<sub>2</sub>O. The green modification on standing in H<sub>2</sub>O solution is very slowly converted back into violet modification. The green modification may also be formed by heating dry salt to 100°, at which temp. it melts in its crystal H<sub>2</sub>O. When all crystal H<sub>2</sub>O has been expelled at 300-350°, it still dissolves in hot H<sub>2</sub>O, but when heated above 350° it becomes insol. in H<sub>2</sub>O. (Löwel, A. ch. (3) 44. 313.)

125.1 g. anhydrous, or 243.9 g. hydrated salt, or 0.441 g. mols. anhydrous salt are sol. in 1 l. H<sub>2</sub>O at 25°. (Locke, Am. Ch. J. 1901, 28. 175.)

Melts in crystal H<sub>2</sub>O at 89°. (Tilden, Chem. Soc. 45. 409.)

Sp. gr. of aqueous solution of violet modification at 15° containing:

5	10	15%	K <sub>2</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O.
1.02725	1.05500	1.08350	

Sp. gr. of sat. solution at 15° = 1.0985.

Sp. gr. of aqueous solution of green modification at 15° containing:

10	20	30%	K <sub>2</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O,
1.050	1.103	1.161	
40	50	60%	K <sub>2</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O,
1.225	1.295	1.371	

70	80	90%	K <sub>2</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O.
1.453	1.541	1.635	

(Gerlach, Z. anal. 28. 497.)

Sp. gr. of chrome-alum solutions at 15° containing:

5	10	15	20	25	% salt,
1.0174	1.0342	1.0524	1.0746	1.1004	
30	35	40	45	50	% salt,
1.1274	1.1572	1.1896	1.2352	1.2594	

55	60	65	70	% salt.
1.3704	1.4566	1.5462	1.6362	

(Franz, J. pr. (2) 5. 298.)

Insol. in alcohol.

3K<sub>2</sub>SO<sub>4</sub>, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. Insol. in H<sub>2</sub>O, acids, or dil. alkalis. Decomp. by boiling with conc. KOH+Aq. (Wernicke, Pogg. 159. 576.)

Chromic rubidium sulphate, Rb<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Pettersson.)

Solubility in  $H_2O$ 

Temp.	G anhydrous salt per l	G mols of anhydrous salt per l
25°	25.7	0.079
30°	31.7	0.096
35°	41.1	0.128
40°	59.7	0.181

Melts in crystal  $H_2O$  at 107°

(Loeche, *Am Ch J* 1901, 26. 180.)

Chromic sodium sulphate,  $Na_2Cr_2(SO_4)_4 + 10H_2O$

Is sodium chromosulphate, which see.  
+24 $H_2O$  More efflorescent than K or  $NH_4$  salt. Sol. in  $H_2O$ , and properties resemble the corresponding K salt.  
 $Cr_2(SO_4)_3, 3Na_2SO_4$ . Resembles the corresponding K salt.

Chromic thallos sulphate,  $Tl_2Cr_2(SO_4)_4 + 24H_2O$ .

0.212 mols. of anhydrous salt are sol. in 1 l.  $H_2O$  at 25°. 1 l.  $H_2O$  dissolves 104.8 g. of anhydrous or 163.8 g. hydrated salt at 25°. Melts in crystal  $H_2O$  at 92°. (Loeche, *Am. Ch J* 1901, 26. 175.)

Chromic sulphate chloride,  $Cr_2(SO_4)_2Cl_2 + 2H_2O$ .

Slightly hygroscopic. Sol. in  $H_2O$ . (Scheff, *A.* 124. 176.)

$[CrSO_4, 5H_2O]/Cl$ . Sol. in  $H_2O$ . (Weinland, *Z. anorg.* 1908, 58. 176.)

Chromyl sulphate,  $(CrO_3)_2SO_4$ .

Decomp. by  $H_2O$ . (Pictet and Karl, *Bull. Soc.* 1908, (4) 3. 1114.)

Cobaltous sulphate, basic.

Ppt. Insol. in  $H_2O$ . (Berzelius)  
 $6CoO, SO_3 + 10H_2O$ . (Athanasesco, *C. R.* 103 271.)

$5CoO, SO_3 + 4H_2O$ . Ppt. Very sl. sol. in  $H_2O$  (Habeimann, *M Ch* 5. 432.)

Cobaltous sulphate,  $CoSO_4$ .

100 pts.  $H_2O$  dissolve at:

3° 10° 20° 24° 29°  
26.2 30.5 36.4 38.9 40 pts. anhydrous salt,

35° 44° 50° 60° 70°  
46.3 60.4 55.2 60.4 65.7 pts. anhydrous salt.

(Tobler, *A.* 95. 193.)

100 pts.  $H_2O$  at 11–14° dissolve 23.88 pts. anhydrous salt (v. Hauer, *J pr* 103 114.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ , using  $CoSO_4 + 7H_2O$ .

$t^\circ$	Pts $CoSO_4$	$t^\circ$	Pts $CoSO_4$	$t^\circ$	Pts $CoSO_4$
0	24.6	36	43.5	72	65.0
1	25.0	37	44.0	73	65.6
2	25.5	38	44.6	74	66.2
3	26.0	39	45.2	75	66.8
4	26.5	40	45.8	76	67.4
5	27.0	41	46.4	77	68.0
6	27.5	42	47.0	78	68.6
7	28.0	43	47.6	79	69.2
8	28.5	44	48.2	80	69.8
9	29.0	45	48.8	81	70.4
10	29.5	46	49.4	82	71.0
11	30.0	47	50.0	83	71.6
12	30.5	48	50.6	84	72.2
13	31.0	49	51.2	85	72.8
14	31.5	50	51.8	86	73.4
15	32.0	51	52.4	87	74.0
16	32.5	52	53.0	88	74.6
17	33.0	53	53.6	89	75.2
18	33.5	54	54.2	90	75.8
19	34.0	55	54.8	91	76.4
20	34.5	56	55.4	92	77.0
21	35.1	57	56.0	93	77.6
22	35.6	58	56.6	94	78.2
23	36.2	59	57.2	95	78.8
24	36.8	60	57.8	96	79.4
25	37.4	61	58.4	97	80.0
26	38.0	62	59.0	98	80.6
27	38.5	63	59.6	99	81.2
28	39.1	64	60.2	100	81.8
29	39.6	65	60.8	101	82.4
30	40.2	66	61.4	102	83.0
31	40.7	67	62.0	103	83.6
32	41.3	68	62.6	104	84.2
33	41.8	69	63.2	105	84.8
34	42.4	70	63.8	106	85.4
35	42.9	71	64.4	106.4	86.0

(Mulder, calculated from his own and Tobler's determinations, Scheik. Verhandel 1864. 68.)

100 g.  $H_2O$  dissolve 37.8 g.  $CoSO_4$  at 25°. (Wagner, *Z. phys. Ch.* 1910, 71. 430.)  
See also +7 $H_2O$ .

Sp. gr. of  $CoSO_4 + Aq$  at  $t^\circ$ . S = pts.  $CoSO_4$  in 100 pts. solution;  $S_1$  = mols  $CoSO_4$  in 100 mols of solution

S	$S_1$	Sp. gr.
6.8910	0.852	1.0765
5.8140	0.711	1.0641
4.7095	0.570	1.0517
3.5792	0.429	1.0392
2.4273	0.288	1.0263
1.2099	0.141	1.0131

(Charpy, *A. ch.* (6) 29. 26.)

Sp. gr. of  $\text{CoSO}_4 + \text{Aq}$  at room temp. containing:

7.239 14.156 21.167%  $\text{CoSO}_4$   
1.0860 1.1591 1.2398

(Wagner, W. Ann. 1883, 18. 269.)

Sp. gr. of  $\text{CoSO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{CoSO}_4$ +Aq	Sp. gr.
1-normal	1.0750
$\frac{1}{2}$ " "	1.0383
$\frac{1}{3}$ " "	1.0193
$\frac{1}{4}$ " "	1.0110

(Wagner, Z. phys. Ch. 1890, 5. 37.)

100 pts. sat. solution of  $\text{CoSO}_4$  and  $\text{CuSO}_4$  contain 22.70 pts. of the two salts

Solubility of  $\text{CoSO}_4 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ , 10  $\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$  100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$

$t^\circ$	grams $\text{CoSO}_4$	grams $\text{Na}_2\text{SO}_4$
0	21.855	10.07
5	23.94	13.155
10	25.41	16.665

(Koppel, Z. phys. Ch. 1905, 52. 396.)

See also under  $\text{CoNa}_2(\text{SO}_4)_2 + 4\text{H}_2\text{O}$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

$\text{HCl} \cdot \text{H}_2\text{O}$  ppt. it completely from  $\text{CoSO}_4 + \text{Aq}$ . (Persoz.)

100 pts. absolute methyl alcohol dissolve 1.04 pts.  $\text{CoSO}_4$  at  $18^\circ$ . (de Bruyn, Z. phys. Ch. 10. 784.)

100 pts. absolute methyl alcohol dissolve 54.5 pts.  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at  $18^\circ$ ; 100 pts. abs. methyl alcohol dissolve 42.8 pts.  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at  $3^\circ$ ; 100 pts. 93.5% methyl alcohol dissolve 13.3 pts.  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at  $3^\circ$ ; 100 pts. 50% methyl alcohol dissolve 1.8 pts.  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at  $3^\circ$ .

100 pts. absolute ethyl alcohol dissolve 2.5 pts.  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at  $3^\circ$ . (de Bruyn, Z. phys. Ch. 10. 786.)

100 g. solution in glycol contain 2.5 g.  $\text{CoSO}_4$ . (de Coninck, Bull. Ac. Belg. 1905. 359.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3602.)

+  $\text{H}_2\text{O}$  Sol. in cold, and only very slowly sol. in hot  $\text{H}_2\text{O}$ . (Vortmann, B. 15. 1888.)

+  $4\text{H}_2\text{O}$ . (Frohde, Arch. Pharm. (2) 127. 92.)

+  $6\text{H}_2\text{O}$  (Marignac.)

+  $7\text{H}_2\text{O}$ . Sol. in 24 pts. cold  $\text{H}_2\text{O}$  Insol. in alcohol. (Persoz.)

Solubility of  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ . 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$ .

$t^\circ$	g. $\text{CoSO}_4$	$t^\circ$	g. $\text{CoSO}_4$	$t^\circ$	g. $\text{CoSO}_4$
0	25.53	15	33.045	30	42.26
5	28.05	20	36.21	35	45.80
10	30.55	25	39.35	40	48.85

(Koppel, Z. phys. Ch. 1905, 52. 395.)

M-pt. of  $\text{CoSO}_4 + 7\text{H}_2\text{O} = 96-98^\circ$  (Tilden, Chem. Soc. 45. 409.)

Cobaltocobaltic sulphate,  $\text{Co}_2\text{O}_3$ ,  $6\text{CoO}$ ,  $\text{SO}_3 + 15\text{H}_2\text{O}$ .

Precipitate Insol. in boiling  $\text{CoSO}_4 + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Gentile, J. pr. 69. 130.)

Cobaltic sulphate,  $\text{Co}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with immediate decomp. and liberation of O. Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  without immediate decomp. Sol. in conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Marshall, Chem. Soc. 59. 760.)

Cobaltous cupric sulphate,  $2\text{CoSO}_4$ ,  $\text{CuSO}_4 + 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (v. Hauer, Pogg. 125. 637.)

+  $36\text{H}_2\text{O}$ . (Liebig.)  
 $2\text{CoSO}_4$ ,  $2\text{CuSO}_4$ ,  $\text{H}_2\text{SO}_4$ . (Etard.)

Cobaltous cupric magnesium potassium zinc sulphate,  $\text{CoSO}_4$ ,  $\text{CuSO}_4$ ,  $\text{MgSO}_4$ ,  $4\text{K}_2\text{SO}_4$ ,  $\text{ZnSO}_4 + 24\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

Cobaltous cupric potassium sulphate,  $\text{CoSO}_4$ ,  $\text{CuSO}_4$ ,  $2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)  
Does not exist. (Aston and Pickering, Chem. Soc. 49. 123.)

Cobaltous hydrazine sulphate,  $\text{CoH}_2(\text{SO}_4)_2$ ,  $2\text{N}_2\text{H}_4$ .

1 pt. is sol. in 305.16 pts.  $\text{H}_2\text{O}$  at  $12^\circ$ . Sol. in  $\text{HNO}_3$  with decomp. Insol. in  $\text{HCl}$ . (Curtius, J. pr. 1894, (2) 50. 331.)

Cobaltous iron (ferrous) potassium sulphate,  $\text{CoSO}_4$ ,  $\text{Fe}_2\text{SO}_4$ ,  $2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)  
 $2\text{CoSO}_4$ ,  $2\text{FeSO}_4$ ,  $\text{H}_2\text{SO}_4$ . (Etard.)

Cobaltous magnesium sulphate,  $3\text{CoSO}_4$ ,  $\text{MgSO}_4 + 28\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Winkelblech.)

Cobaltous magnesium potassium sulphate,  $\text{CoSO}_4 \cdot \text{MgSO}_4 \cdot \text{K}_2\text{SO}_4 \cdot 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Does not exist. (Aston and Pickering, Chem. Soc. 49. 123.)

Cobaltous manganous potassium sulphate,  $\text{CoSO}_4 \cdot \text{MnSO}_4 \cdot 2\text{K}_2\text{SO}_4 \cdot 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Cobaltous nickel potassium sulphate,  $\text{CoSO}_4 \cdot \text{NiSO}_4 \cdot 2\text{K}_2\text{SO}_4 \cdot 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Does not exist. (Thomson, Rep. Brit. Assn. Adv. Sci. 1877. 209.)

Cobaltous potassium sulphate,  $\text{CoSO}_4 \cdot \text{K}_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ .

Less sol. in  $\text{H}_2\text{O}$  than  $\text{CoSO}_4$ .

100 pts.  $\text{H}_2\text{O}$  dissolve at.

0° 12° 15° 20° 25°  
19.1 30 32.5 39.4 45.3 pts. anhydrous salt,

30° 35° 40° 49°  
51.9 55.4 64.6 81.3 pts. anhydrous salt.

(Tobler, A. 96. 126.)

100 pts saturated solution contain at:

20° 40° 60° 80°  
14 19.5 24.4 31.8 pts. anhydrous salt  
(v. Hauer, J. pr. 74. 433.)

1 l.  $\text{H}_2\text{O}$  dissolves 128.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

Cobaltic potassium sulphate,  $\text{K}_2\text{Co}_2(\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Marshall, Chem. Soc. 59. 760.)

Cobaltous potassium zinc sulphate,  $\text{CoSO}_4 \cdot 2\text{K}_2\text{SO}_4 \cdot \text{ZnSO}_4 \cdot 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Cobaltous rubidium sulphate,  $\text{CoSO}_4 \cdot \text{Rb}_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Tutton.)

1 l.  $\text{H}_2\text{O}$  dissolves 92.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

Cobaltic rubidium sulphate,  $\text{Rb}_2\text{Co}_2(\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ . Decomp. by conc.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . (Howe and O'Neal, J. Am. Chem. Soc. 1898, 20. 762.)

Melts in crystal  $\text{H}_2\text{O}$  at 47°. (Locke, Am. Ch. J. 1901, 26. 183.)

Cobaltous sodium sulphate,  $\text{CoNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$ .

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°. 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$ .

t°	g $\text{CoSO}_4$	g $\text{Na}_2\text{SO}_4$
20	26.65	24.91
25	25.365	23.325
30	23.13	21.61
35	22.55	20.85
40	20.975	20.055

(Koppel, Z. phys. Ch. 1905, 52. 397.)

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{CoSO}_4 \cdot 7\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°. 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$ .

t°	g $\text{CoSO}_4$	g $\text{Na}_2\text{SO}_4$	t°	g $\text{CoSO}_4$	g $\text{Na}_2\text{SO}_4$
18.5	28.61	23.82	30	32.695	18.17
20	29.42	23.015	35	34.065	15.61
25	30.73	20.575	40	35.01	13.715

(Koppel, Z. phys. Ch. 1905, 52. 397.)

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°. 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$ .

t°	g $\text{CoSO}_4$	g. $\text{Na}_2\text{SO}_4$
18.5	25.50	25.65
20	23.18	27.20
25	16.07	35.18
30	9.20	43.74

(Koppel.)

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$  (anhydrous) in  $\text{H}_2\text{O}$  at t°. 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$ .

t°	g $\text{CoSO}_4$	g $\text{Na}_2\text{SO}_4$
35	7.204	50.79
40	7.456	50.095

(Koppel.)

See also  $\text{CoSO}_4 + \text{Na}_2\text{SO}_4$  under  $\text{CoSO}_4$ .

Cobaltous zinc sulphate.

Efflorescent. Decomp. on air. (Link, Crell. Ann. 1790, 1. 32.)

Cobaltous sulphate ammonia,  $\text{CoSO}_4 \cdot 6\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$  with separation of ppt. (Rose, Pogg. 20. 162.) Very easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Fremy.)

Decomp. by alcohol

Cobaltous sulphate hydrazine,  $\text{CoSO}_4 \cdot 3\text{N}_2\text{H}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$ . Very sol. in dil. acids and  $\text{NH}_4 + \text{Aq.}$  (Franzen, Z. anorg. 1908, 60. 272.)

Cobaltous sulphate hydroxylamine,  $\text{CoSO}_4 \cdot \text{NH}_2\text{OH} \cdot 2\text{H}_2\text{O}$ .

Insol. in cold; sol. in hot  $\text{H}_2\text{O}$  with decomp. (Feldt, B. 1894, 27. 403.)

Columbium sulphate.

Sol. in  $\text{H}_2\text{O}$ . (Blomstrand.)

Cuprous sulphate,  $\text{Cu}_2\text{SO}_4$ .

Decomp by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl}$ , in ammonia and sl. sol. in glacial acetic acid. (Recoura, C. R. 1909, 148. 1107)

Cupric sulphate, basic,  $10\text{CuO} \cdot \text{SO}_3$ .

(Pickering, Chem. Soc. 1907, 91. 1984.)

$8\text{CuO} \cdot \text{SO}_3 \cdot 12\text{H}_2\text{O}$ . Ppt. (Kane, A. ch. 72. 269.)

$5\text{CuO} \cdot \text{SO}_3 \cdot 6\text{H}_2\text{O}$ . Ppt. (Smith, Phil. Mag. J. 23. 196.)

$4\text{CuO} \cdot \text{SO}_3 \cdot 3\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$ . (Roucher, J. Pharm. (3) 37. 50.)

Min. *Brochantite*. Sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq}$ .

$+3\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids, even  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Sl. sol. in  $\text{CuSO}_4 + \text{Aq}$ . Insol in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Caselmann, Z. anal. 4. 24.)

$+4\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$  (Proust.) Sol. in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ , and more easily in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Lea.)

11 cold  $\text{H}_2\text{O}$  dissolves 0.017 g. (Pickering, C. N. 1883, 47. 182)

$+5\text{H}_2\text{O}$ . Min. *Langite*

$+16\text{H}_2\text{O}$ . (André, C. R. 100. 1138.)

$7\text{CuO} \cdot 2\text{SO}_3 \cdot 5\text{H}_2\text{O}$  (Reindel, J. pr. 100. 1)

$+6\text{H}_2\text{O}$ . Wholly insol. in cold or hot  $\text{H}_2\text{O}$ . (Habermann, M. ch. 5. 432.)

$+7\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. Insol. in boiling  $\text{CuSO}_4 + \text{Aq}$  (Reindel.)

$8\text{CuO} \cdot \text{SO}_3 \cdot 11\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Steinmann, B. 15. 1412.)

$+2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Shenstone, Chem. Soc. 47. 375.)

$+2\frac{1}{2}\text{H}_2\text{O}$ . (Reindel, J. pr. 102. 204.)

$+4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Grimbert and Barré, J. Pharm. (6) 21. 414.)

$5\text{CuO} \cdot 2\text{SO}_3 \cdot 3\text{H}_2\text{O}$ . (Wibel, Dissert. 1864.)

$11\text{CuO} \cdot 4\text{SO}_3 \cdot 8\text{H}_2\text{O}$ . (Clowes, C. N. 1898, 78. 155.)

$8\text{CuO} \cdot 3\text{SO}_3 \cdot 10\text{H}_2\text{O}$ . (Marohlewski and Sachs, Z. anorg. 1892, 1. 405.)

$7\text{CuO} \cdot 3\text{SO}_3 \cdot 12\text{H}_2\text{O}$ . (Étard, C. R. 1887, 104. 1615.)

$5\text{CuO} \cdot 2\text{SO}_3 \cdot 5\text{H}_2\text{O}$ . (Sabatier, Gm. K. 5. 1. 839.)

$6\text{H}_2\text{O}$ . Min. *Arzmitte*. (Weisbach, J. B. 1886. 2253.)

$2\text{CuO} \cdot \text{SO}_3$ . Decomp. by cold  $\text{H}_2\text{O}$  into  $\text{CuSO}_4$  and  $4\text{CuO} \cdot \text{SO}_3$ . (Roucher.)

Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Pozzi-Escot, Bull. Soc. 1913 (4) 13. 816.)

According to Pickering (C. N. 47. 181) only

$3\text{CuO} \cdot \text{SO}_3 \cdot 2\frac{1}{2}\text{H}_2\text{O}$  and  $4\text{CuO} \cdot \text{SO}_3 \cdot 4\text{H}_2\text{O}$  are true chemical compounds.

There is at  $25^\circ$  no definite basic sulphate of copper, all the basic sulphates being solid solutions. The solutions in contact with these basic sulphates contain  $\text{SO}_3$  and  $\text{CuO}$  in equivalent quantities and are all sl. acid in reaction. (Bell, J. phys. Chem. 1908, 12. 179.)

Cupric sulphate,  $\text{CuSO}_4$ .

*Anhydrous*. Absorbs  $\text{H}_2\text{O}$  from the air. Combines with, and dissolves in  $\text{H}_2\text{O}$  with great evolution of heat

$+ \text{H}_2\text{O}$  Permanent Sol. in  $\text{H}_2\text{O}$  (Étard, C. R. 87. 602)

$+ 2\text{H}_2\text{O}$  (?) (Storer's Dict.)

$+ 3\text{H}_2\text{O}$  (Étard, C. R. 104. 1614.)

Does not exist. (Cross, C. N. 49. 220)

See Foote, p. 965

$+ 5\text{H}_2\text{O}$ . Superficially efflorescent in dry air

Sol. in 234 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and sat. solution has sp. gr. 1.2147. (Schiff, A. 109. 326)

100 pts.  $\text{CuSO}_4 + \text{Aq}$  sat. at b. pt.  $102.2^\circ$ , contain 45 pts. of the dry salt, or 100 pts.  $\text{H}_2\text{O}$  at  $102.2^\circ$  dissolve 81.82 pts.  $\text{CuSO}_4$ . (Griffiths, Q. J. Sci. 18. 90.)

Sol. in less than 4 pts.  $\text{H}_2\text{O}$  at ord. temp., and much more sol. in boiling  $\text{H}_2\text{O}$ . (Bergmann.)

Sol. in 4 pts. cold, and 2 pts. hot  $\text{H}_2\text{O}$ . (Schubarth.)

100 pts.  $\text{H}_2\text{O}$  dissolve 33.103 pts.  $\text{CuSO}_4 + 5\text{H}_2\text{O}$  at  $15^\circ$ , and solution has sp. gr. = 1.1859 (Michel and Kraft, A. ch. (3) 41. 478)

$\text{CuSO}_4 + \text{Aq}$  sat. at  $8^\circ$  has 1.17 sp. gr. (Anthon, A. 24. 210)

1 pt.  $\text{CuSO}_4 + 6\text{H}_2\text{O}$  dissolves at

$4^\circ$	$19^\circ$	$31^\circ$	$37.5^\circ$	$50^\circ$
in 3.32	2.71	1.51	1.7	1.14 pts. $\text{H}_2\text{O}$ .

$62.5^\circ$	$75^\circ$	$87.5^\circ$	$100^\circ$	$104^\circ$
in 1.27	1.07	0.75	0.55	0.47 pts. $\text{H}_2\text{O}$

(Brandes and Gruner, 1826)

Sol. at 17.5 in 2412 pts.  $\text{H}_2\text{O}$  (Karsten)

100 pts.  $\text{H}_2\text{O}$  dissolve at.

$9^\circ$	$10^\circ$	$20^\circ$	$30^\circ$
31.61	36.95	42.31	48.81 pts. $\text{CuSO}_4 + 5\text{H}_2\text{O}$ ,

$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$
56.90	65.83	77.39	94.60 pts. $\text{CuSO}_4 + 5\text{H}_2\text{O}$ ,

$80^\circ$	$90^\circ$	$100^\circ$
118.03	156.44	203.32 pts. $\text{CuSO}_4 + 5\text{H}_2\text{O}$ .

(Poggiale, A. ch. (3) 8. 463.)

100 pts.  $\text{H}_2\text{O}$  dissolve at

$0^\circ$	$20^\circ$	$35^\circ$	$54^\circ$
17	24.3	28.6	36.1 pts. anhydrous $\text{CuSO}_4$ .

(Tobler, A. 95. 193.)

100 pts.  $\text{CuSO}_4 + \text{Aq}$  sat. at  $11-14^\circ$  contain 16.23 pts. anhydrous  $\text{CuSO}_4$ . (v. Hauer, J. pr. 103. 114)

100 pts.  $\text{H}_2\text{O}$  dissolve 15.107 pts.  $\text{CuSO}_4$  at  $0^\circ$ . (Pfaff, A. 99. 224.)

100 pts. H <sub>2</sub> O dissolve pts CuSO <sub>4</sub> at t°.	
t°.	Pts CuSO <sub>4</sub>
0	14 99
17 9	20 16
24 1	22 37

(Dracon, J. B 1866. 61)

If solubility S=pts anhydrous CuSO<sub>4</sub> in 100 pts solution, S=11.6+0.2614t from -2° to 55°, S=26.5+0.3700t from 55° to 105°; S=45.0-0.0293t from 105° to 190°. (Étard, C. R. 104. 1614)

Solubility decreases above 120°, owing to formation of basic salt (Tilden and Shenstone, Phil. Trans 1884. 23)

100 cem. H<sub>2</sub>O dissolve 14 92 g CuSO<sub>4</sub> at 0°.

(Engel, C. R. 102. 113.)

100 cem H<sub>2</sub>O dissolve 22 28-22.30 g. CuSO<sub>4</sub> at 20°. (Trevor, Z. phys. Ch. 7. 468)

100 pts H <sub>2</sub> O dissolve pts CuSO <sub>4</sub> at t°					
t°	Pts CuSO <sub>4</sub>	t°	Pts CuSO <sub>4</sub>	t°	Pts CuSO <sub>4</sub>
0	14 15	40	28 50	80	54 53
10	17 50	50	33 31	90	64 35
20	20 53	60	39 01	100	75 22
30	24 34	70	45 74		

(Patrick and Aubert, Transactions of Kansas Acad. of Sci. 1874. 19)

Solubility in 100 pts H<sub>2</sub>O at t°.

t°	Pts CuSO <sub>4</sub>	t°	Pts CuSO <sub>4</sub>	t°	Pts CuSO <sub>4</sub>
0	15 5	35	27 5	70	45 7
1	16 3	36	27 9	71	46 4
2	16 6	37	28 3	72	47.2
3	16 9	38	28 7	73	47 9
4	17 2	39	29 1	74	48 7
5	17 5	40	29 5	75	49 5
6	17 8	41	29 9	76	50 3
7	18 1	42	30 3	77	51 1
8	18 4	43	30 7	78	51 9
9	18 7	44	31 1	79	52 7
10	19 1	45	31 5	80	53 5
11	19 3	46	31 9	81	54 3
12	19 6	47	32 3	82	55.1
13	19 9	48	32 7	83	55.9
14	20 2	49	33 2	84	56.8
15	20 5	50	33 6	85	57 8
16	20 8	51	34 1	86	58 7
17	21 1	52	34 5	87	59 7
18	21 4	53	35 0	88	60 7
19	21 7	54	35 5	89	61 7
20	22 0	55	36 0	90	62 7
21	22 3	56	36 6	91	63.7
22	22 6	57	37 2	92	64 8
23	23 0	58	37 8	93	65.8
24	23 3	59	38 4	94	66 9
25	23 7	60	39 0	95	68 0
26	24 0	61	39 6	96	69 1
27	24 4	62	40 2	97	70 2
28	24 7	63	40 9	98	71 3
29	25 1	64	41 5	99	72 4
30	25 5	65	42 2	100	73 5
31	25 9	66	42 9	101	74 6
32	26 3	67	43 6	102	75 7
33	26 7	68	44.3	103	76 8
34	27 1	69	45.0	104	77.95

(Mulder, Scheik. Verhandel. 1864. 79)

Sat CuSO<sub>4</sub>+Aq contains % CuSO<sub>4</sub> at t°

t°	% CuSO <sub>4</sub>	t°	% CuSO <sub>4</sub>
-1	12 1	88	38 8
+7	14 1	89	38 9
9	14 5	94	41 8
13	16 9	96	41 9
20	17 2	97	42 0
20	17 4	100	43 6
35	21 3	108	43 8
39	21 8	110	43 4
45	23 9	116	43 8
54	26 9	116	44 0
54	26 6	120	44 8
61	28 8	132	44.8
63	29 1	133	44 7
65	30 0	143	45.0
70	31 6	160	44 2
71 7	32 6	165	44 5
76	34.5	179	42 9
80	36 6	189	42 2
86	37.8		

(Étard, A. ch. 1894, (7) 2. 554)

Solubility in H<sub>2</sub>O at t°.

t°	g CuSO <sub>4</sub> per 100 g H <sub>2</sub> O
0	14.15
10	17.68
15	19 25
20	20 78
25	22 29 (by interpolation)

(Cohen, Z. phys. Ch. 1907, 60. 713.)

1.399 mol. are sol. in 1 l H<sub>2</sub>O at 25°.

(Herz, Z. anorg. 1910, 67. 366)

100 g CuSO<sub>4</sub>+Aq sat. at 30° contain 20.32 anhyd. CuSO<sub>4</sub>. (Schrenemakers, Z. phys. Ch. 1910, 71. 110)

+7H<sub>2</sub>O. (Boisbaudran, C. R. 65. 1249.)

+6H<sub>2</sub>O (Boisbaudran, C. R. 66. 487.)

Sp. gr of  $\text{CuSO}_4 + \text{Aq}$  at  $18^\circ$  % = %  
 $\text{CuSO}_4 + 5\text{H}_2\text{O}$ .

%	Sp gr	%	Sp gr	%	Sp gr
1	1.0063	11	1.0716	21	1.1427
2	1.0126	12	1.0785	22	1.1501
3	1.0190	13	1.0854	23	1.1585
4	1.0254	14	1.0923	24	1.1659
5	1.0319	15	1.0993	25	1.1738
6	1.0384	16	1.1063	26	1.1817
7	1.0450	17	1.1135	27	1.1898
8	1.0516	18	1.1208	28	1.1980
9	1.0582	19	1.1281	29	1.2063
10	1.0649	20	1.1354	30	1.2146

(Scheff, calculated by Gerlach, Z anal. 8. 288.)

Sp. gr of  $\text{CuSO}_4 + \text{Aq}$  at  $23.9^\circ$ . a=no of  $\frac{1}{2}$  mols in grms dissolved in 1000 grms  $\text{H}_2\text{O}$ , b=sp gr if a is  $\text{CuSO}_4 + 5\text{H}_2\text{O}$  ( $\frac{1}{2}$  mol wt.=125); c=sp gr if a is  $\text{CuSO}_4$  ( $\frac{1}{2}$  mol wt.=80)

a	b	c
1	1.076	1.080
2	1.142	1.154
3	1.200	1.225

(Fayre and Valson, C R. 79. 968.)

Sp. gr of  $\text{CuSO}_4 + \text{Aq}$  at  $15^\circ$   
 % = %  $\text{CuSO}_4 + 5\text{H}_2\text{O}$

%	Sp gr	%	Sp gr
5	1.0335	20	1.1443
10	1.0688	25	1.1848
15	1.1060	mother liquor	1.185

(Gerlach, Dingl 181. 131.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at  $18^\circ$ .

% $\text{CuSO}_4$	Sp gr.	% $\text{CuSO}_4$	Sp gr.
5	1.0513	15	1.1675
10	1.1073	17.5	1.2003

(Kohlrausch, W. Ann 1879. 1.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at  $0^\circ$ . S=pts.  $\text{CuSO}_4$  in 100 pts solution

S	Sp gr.	S	Sp gr.
11.9315	1.1371	5.2181	1.0578
9.8159	1.1108	2.6460	1.0290
7.5474	1.0833		

(Charpy, A. ch (6) 29. 26.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at room temp.

% $\text{CuSO}_4$	Sp gr
6.79	1.055
12.57	1.1151
17.49	1.1635

(Wagner, W. Ann 1883, 18. 265.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{CuSO}_4 + \text{Aq}$	Sp. gr
1-normal	1.0790
$\frac{1}{2}$ " "	1.0402
$\frac{1}{3}$ " "	1.0205
$\frac{1}{4}$ " "	1.0103
$\frac{1}{10}$ " "	1.0050

(Wagner, Z. phys. Ch 1890, 5. 38.)

B-pt  $\text{CuSO}_4 + \text{Aq}$  containing pts.  $\text{CuSO}_4$  to 100 pts  $\text{H}_2\text{O}$ .

B-pt	Pts $\text{CuSO}_4$	B-pt	Pts. $\text{CuSO}_4$
100.5°	21.3	103.0°	69.0
101.0	36.9	103.5	74.9
101.5	48.0	104.0	80.1
102.0	56.2	104.2	82.2
102.5	63.0		

(Gerlach, Z. anal 26. 434.)

Sat  $\text{CuSO}_4 + \text{Aq}$  boils at  $102.2^\circ$ , and contains 81.8 pts  $\text{CuSO}_4$  to 100 pts  $\text{H}_2\text{O}$ . (Griffiths)

Crust forms at  $102.3^\circ$ , and solution contains 60.3 pts.  $\text{CuSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp. observed,  $104.8^\circ$  (Gerlach, Z, anal 26. 426.)

Sol. in  $\text{HCl} + \text{Aq}$ , causing a reduction of temperature of about  $17^\circ$ .

Very al sol. in conc.  $\text{H}_2\text{SO}_4$ . (Schulz.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $0^\circ$ .

G per 100 g $\text{H}_2\text{O}$		Sp gr
$\text{H}_2\text{SO}_4$	$\text{CuSO}_4$	
0.00	14.85	1.144
2.03	14.29	1.143
7.16	15.65	1.158
15.20	9.90	1.170
26.57	6.43	1.195
27.57	6.19	1.211
35.2	3.99	1.224

(Engel, C R. 1887, 104. 507.)

Solubility in  $\text{H}_2\text{SO}_4$  + Aq at 25°.

Solution			Solid phase
Sp. gr.	% $\text{CuO}$	% $\text{SO}_3$	
1.2142	9.17	9.26	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
1.2248	5.91	15.90	
1.2593	3.39	23.09	
1.2934	1.82	28.75	
1.4061	1.32	39.74	
1.4256	.	41.29	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot 3\text{H}_2\text{O}$
1.4249	.	41.04	
1.4516	1.38	43.63	$\text{CuSO}_4 \cdot 3\text{H}_2\text{O}$
1.4915	1.02	47.82	
1.5124	.	49.07	
1.5408	0.38	51.46	$\text{CuSO}_4 \cdot \text{H}_2\text{O}$
1.5643	0.368	53.51	
1.6824	0.109	62.14	
1.7752	0.105	68.34	
1.8118	0.15	72.41	
1.8268	0.07	74.26	$\text{CuSO}_4$

These results show that the hydrates of  $\text{CuSO}_4$ , which are stable at 25° are  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ,  $\text{CuSO}_4 \cdot 3\text{H}_2\text{O}$  and  $\text{H}_2\text{O}$ .

(Bell and Taber, J. phys. Chem. 1908, 12, 175.)

Solubility in  $\text{H}_2\text{SO}_4$  + Aq at 25°

Solution contains		Solid phase
% $\text{CuSO}_4$	% $\text{H}_2\text{SO}_4$	
18.47	none	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
12.62	11.14	
5.92	25.53	
3.25	36.77	
2.63	42.15	
2.59	47.66	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot 3\text{H}_2\text{O}$
2.83	49.00	
2.83	49.20	
2.84	49.29	$\text{CuSO}_4 \cdot 3\text{H}_2\text{O}$
2.70	50.23	
2.19	54.78	$\text{CuSO}_4 \cdot 3\text{H}_2\text{O}$ and $\text{CuSO}_4 \cdot \text{H}_2\text{O}$
2.11	55.84	
2.15	55.60	$\text{CuSO}_4 \cdot \text{H}_2\text{O}$
0.95	61.79	
0.17	77.93	
0.15	83.29	$\text{CuSO}_4 \cdot \text{H}_2\text{O}$
0.19	85.46	
0.44	85.72	$\text{CuSO}_4 \cdot \text{H}_2\text{O}$ and $\text{CuSO}_4$
0.42	85.81	
0.40	86.04	$\text{CuSO}_4$
0.19	92.70	

These results show that the hydrates of  $\text{CuSO}_4$ , which are stable at 25° are  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ,  $\text{CuSO}_4 \cdot 3\text{H}_2\text{O}$  and  $\text{H}_2\text{O}$ . (Foote, J. Am. Chem. Soc. 1915, 37, 290.)

Sl. sol. in sat.  $\text{NH}_4\text{Cl}$  + Aq, with separation of a double sulphate.

Solubility of  $\text{CuSO}_4$  in  $\text{CuCl}_2$  + Aq at 30°.

% $\text{CuCl}_2$	% $\text{CuSO}_4$	Solid phase
0	20.32	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
6.58	13.62	"
15.68	8.93	"
25.67	4.77	"
39.48	3.21	"
42.47	2.90	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ + $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
43.26	1.14	$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
43.95	0	"

(Schreinemakers, Arch. Néerl. Sci. 1910, (2) 16, 117.)

Solubility of  $\text{CuSO}_4$  in  $\text{LiCl}$  + Aq at 25°.

Solid phase,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .  
(G. mols. per l. of solution.)

$\text{LiCl}$	$\text{CuSO}_4$
0	1.399
0.73	1.257
1.40	1.176
2.83	1.067

(Herz, Z. anorg. 1910, 67, 366.)

Solubility of  $\text{CuSO}_4$  in  $\text{KCl}$  + Aq at 25°.

Solid phase,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .  
(G. mols. per l. of solution.)

$\text{KCl}$	$\text{CuSO}_4$
0.56	1.496
1.17	1.561
2.34	1.819

(Herz.)

Solubility of  $\text{CuSO}_4$  in  $\text{NaCl}$  + Aq at 25°.

Solid phase,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .  
(G. mols. per l. of solution.)

$\text{NaCl}$	$\text{CuSO}_4$
0	1.399
0.36	1.404
1.32	1.426
2.53	1.507

(Herz.)

Solubility of  $\text{CuSO}_4$  in  $\text{RbCl}$  + Aq at 25°, containing 1.094 g. mols. per l. = 1.568 g. mols. (Herz.)

Slowly sol. in sat.  $\text{KNO}_3$  + Aq, with separation of a double sulphate.

Very slowly sol. in sat.  $\text{NaNO}_3$  + Aq, with separation of a double sulphate. (Karsten, Berl. Abhandl. 1840, 10.)

Solubility of  $\text{CuSO}_4$  in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $0^\circ$ .

g per 100 cc solution		Sp. gr.	g per 100 cc solution		Sp. gr.
$(\text{NH}_4)_2\text{SO}_4$	$\text{CuSO}_4$		$(\text{NH}_4)_2\text{SO}_4$	$\text{CuSO}_4$	
0	14.79	1.144	5.59	5.13	1.081
3.61	16.09	1.190	7.51	2.95	1.071
4.63	8.38	1.108	12.31	0.94	1.082
4.90	7.26	1.099	20.65	0.80	1.116

(Engel, C. R. 1886, 102, 114.)

See also under  $(\text{NH}_4)_2\text{SO}_4$ .Solubility of  $\text{CuSO}_4$  in  $\text{Li}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt. $\text{CuSO}_4$	% by wt. $\text{Li}_2\text{SO}_4$	
20.32	0	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
17.50	3.54	"
16.10	6.08	"
13.55	11.94	"
12.14	15.72	"
11.04	17.92	"
10.05	20.55	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
10.08	20.51	"
10.07	20.49	"
6.41	22.28	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
3.39	23.59	"
0	25.24	"

(Schrenemakers, Z. phys. Ch. 1909, 66, 692.)

Sol. in  $\text{CuCl}_2$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $30^\circ$ . (Schrenemakers, Z. phys. Ch. 1909, 69, 565.)Sol. in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Li}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ . (Schrenemakers, Z. phys. Ch. 1909, 66, 694.)100 pts. sat. solution of  $\text{CuSO}_4$  and  $\text{FeSO}_4$  contain 17.43 pts. of the salts at  $11-14^\circ$ . (v. Hauer, J. pr. 103, 114.)100 pts.  $\text{H}_2\text{O}$  dissolve 10.85 pts.  $\text{CuSO}_4$ , 17.47 pts.  $\text{MgSO}_4$ , and 5.78 pts.  $\text{Na}_2\text{SO}_4$  at  $0^\circ$ . (Diacon.)100 pts.  $\text{H}_2\text{O}$  dissolve 7.169 pts.  $\text{CuSO}_4$ , 21.319 pts.  $\text{MgSO}_4$ , and 6.830 pts.  $\text{Na}_2\text{SO}_4$  at  $0^\circ$ . (Plaff.)Slowly and sl. sol. in sat.  $\text{MgSO}_4 + \text{Aq}$ . (Karsten.)Solubility of  $\text{CuSO}_4$  in  $\text{H}_2\text{O}$  in presence of  $\text{MgSO}_4$ . 100 pts.  $\text{H}_2\text{O}$  dissolve—

No.	$\text{CuSO}_4$	$\text{MgSO}_4$	No.	$\text{CuSO}_4$	$\text{MgSO}_4$
1	0	23.37	5	12.03	15.67
2	2.64	25.91	6	13.61	8.64
3	4.75	25.30	7	14.99	0
4	9.01	23.54	.	.	...

In 1, 2, and 3,  $\text{MgSO}_4$  was in excess and given amt.  $\text{CuSO}_4$  added; in 4, both  $\text{CuSO}_4$  and $\text{MgSO}_4$  were in excess; in 5, 6, and 7,  $\text{CuSO}_4$  was in excess. (Diacon, l. c.)100 pts. sat. solution of  $\text{CuSO}_4$  and  $\text{MgSO}_4$  contain 28.58 pts. of the salts at  $11-14^\circ$ . (v. Hauer, J. pr. 103, 114.)100 pts. sat. solution of  $\text{CuSO}_4$  and  $\text{MnSO}_4$  contain 37.90 pts. of the salts at  $11-14^\circ$ . (v. Hauer.)Solubility of  $\text{CuSO}_4 + \text{MnSO}_4$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

G per 100 g $\text{H}_2\text{O}$		G per 100 g $\text{H}_2\text{O}$	
$\text{CuSO}_4$	$\text{MnSO}_4$	$\text{CuSO}_4$	$\text{MnSO}_4$
20.2	0	9.39	46.77
19.76	3.69	6.47	53.39
13.65	31.52	3.01	58.93
11.61	39.41	0.0	61.83

(Stortenbecker, Z. phys. Ch. 1900, 34, 112.)

100 pts. sat. solution of  $\text{CuSO}_4$  and  $\text{NiSO}_4$  contain 31.03 pts. of the salts at  $11-14^\circ$ . (v. Hauer.)Solubility of  $\text{CuSO}_4 + \text{NiSO}_4$  in  $\text{H}_2\text{O}$ .

t°	g per 100 g $\text{H}_2\text{O}$		Mol. % $\text{CuSO}_4$	
	$\text{CuSO}_4$	$\text{NiSO}_4$	Solution	Solid phase
35	9.62	583.9	1.57	0.35
	41.66	484.4	7.09	2.12
	75.39	553.5	11.66	4.77
	106.40	506.5	16.92	6.52
	172.0	483.8	25.6	13.88
67	186.9	468.8	27.90	18.77
				94.91
	20.04	729.3	2.65	0.93
	66.01	706.2	8.31	2.86
	88.08	501.6	13.55	3.92
	147.94	675.0	16.39	6.66
	240.9	747.8	24.46	23.32

(Fock, Z. Kryst. Min. 1897, 28, 387.)

More easily sol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$  than in  $\text{Na}_2\text{SO}_4$  or  $\text{MgSO}_4 + \text{Aq}$ , forming a double sulphate, which separates out. (Karsten.) $\text{K}_2\text{SO}_4$  and  $\text{CuSO}_4$  mutually displace each other in saturated solutions. (Rüdorff, Pogg. 148, 555.)When  $\text{K}_2\text{SO}_4$  and  $\text{CuSO}_4$  both in excess, are dissolved in  $\text{H}_2\text{O}$ , a maximum of solubility of 15.61 pts. of the two salts in 100 pts.  $\text{H}_2\text{O}$  at  $25^\circ$  is reached in 30 minutes, after which the solubility decreases. This result is obtained either by treating excess of the two salts with  $\text{H}_2\text{O}$  at  $25^\circ$ , or cooling solutions of the two salts sat. at higher temp. to  $25^\circ$ . The salts are in the proportion of 5.2 pts.  $\text{K}_2\text{SO}_4$  to 10.4 pts.  $\text{CuSO}_4$ . If present in the same proportion as in their saturated solutions, 5.41 pts.  $\text{K}_2\text{SO}_4$  to 10.13 pts.  $\text{CuSO}_4$ , would be required.

If sat. solution of one salt is added to sat. solution of the other,  $K_2Cu(SO_4)_2 \cdot 6H_2O$  separates, as it is less sol. than either simple salt, until a state of equilibrium is reached, after which there is no separation, contrary to Rüdorff (see above) (Trevor, Z. phys. Ch. 7. 486.)

### $CuSO_4 + Na_2SO_4$

Solubility of  $CuSO_4$  in presence of  $Na_2SO_4$  at 0° 100 pts  $H_2O$  dissolve—

No	$CuSO_4$	$Na_2SO_4$	No	$CuSO_4$	$Na_2SO_4$
1	0	4.53	5	15.84	3.55
2	6.01	5.34	6	15.33	1.98
3	9.81	5.73	7	14.99	0
4	16.67	6.48			

In 1, 2, and 3,  $Na_2SO_4$  was in excess and given amt.  $CuSO_4$  added; in 4, both  $CuSO_4$  and  $Na_2SO_4$  were in excess; in 5, 6, and 7,  $CuSO_4$  was in excess and  $Na_2SO_4$  added. (Dracon, J. B. 1866, 61.)

100 pts.  $H_2O$  dissolve 8.038 pts  $CuSO_4$  and 6.31 pts  $Na_2SO_4$  at 0° (Pfaff, A. 99. 224.)

100 pts.  $H_2O$  dissolve 20.7 pts.  $CuSO_4$  and 15.9 pts.  $Na_2SO_4$  at 15°. (Rüdorff, B. 6. 484.)

### Solubility of $CuSO_4 + Na_2SO_4$

1. Solid phase, 3 mol.  $CuSO_4 + 1$  mol.  $Na_2SO_4$ .

2. Solid phase, 1 mol  $CuSO_4 + 1$  mol.  $Na_2SO_4$ .

3. Solid phase, 1 mol  $CuSO_4 + 3$  mol.  $Na_2SO_4$ .

(G. in 100 g.  $H_2O$ .)

t°	1		2		3	
	$CuSO_4$	$Na_2SO_4$	$CuSO_4$	$Na_2SO_4$	$CuSO_4$	$Na_2SO_4$
10	19.75	12.49	19.70	12.50	19.69	12.55
15	20.69	15.88	20.75	15.90	20.70	15.92
30	22.03	16.36	21.00	20.14	15.28	22.70
50	32.37	11.75	31.45	13.41	28.76	15.25

(Massol and Malmes, C. R. 1901, 133. 287.)

### Solubility of $CuSO_4 \cdot 5H_2O + Na_2SO_4 \cdot 10H_2O$

t°	% $CuSO_4$	% $Na_2SO_4$
0	13.40	6.23
12	14.83	9.82
15	15.00	...

(Koppel, Z. phys. Ch. 1903, 42. 8.)

See also under  $Na_2(SO_4)_2 \cdot 6H_2O$ .

### $CuSO_4 + ZnSO_4$

Very slowly sol. in sat.  $ZnSO_4 + Aq$ , forming a double salt which separates. (Karsten.) 100 pts. sat. solution of  $CuSO_4$  and  $ZnSO_4$  contain 32.70 pts. of the salts at 11–14°. (v. Hauer.)

### Solubility of $CuSO_4 + ZnSO_4$ in $H_2O$ at 25°.

Mols per 100 mols $H_2O$		Mols per 100 mols $H_2O$	
Cu	Zn	Cu	Zn
2.28	0	0.82	5.03
1.83	2.08	0.51	5.59
1.41	3.60	0.30	5.56
1.19	5.01	0.00	6.42
1.86	3.36	1.19	5.01
1.22	4.45	0.51	5.59
1.01	4.72	0.267	5.77
		0.00	5.94

(Stortenbecker, Z. phys. Ch. 1897, 22. 62.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in liquid  $CO_2$ . (Buchner, Z. phys. Ch. 1906, 54. 674.)

100 pts. of a sat. solution in 40% alcohol contains 0.25 pt.  $CuSO_4 + 5H_2O$ ; 20% alcohol, 3.1 pts.; 10% alcohol, 13.3 pts. (Schiff, A. 118. 362.)

Anhydrous  $CuSO_4$  is sol. in absolute methyl alcohol, but insol. in absolute ethyl alcohol.  $CuSO_4 + xH_2O$  is insol. in methyl or ethyl alcohol. (Kiepl, J. pr. (2) 26. 526.)

100 pts. absolute methyl alcohol dissolve 1.05 pts. anhydrous  $CuSO_4$  at 18°.

100 pts. absolute methyl alcohol dissolve 15.6 pts.  $CuSO_4 + 5H_2O$  at 18°, 100 pts. 93.5% methyl alcohol dissolve 0.93 pt.  $CuSO_4 + 5H_2O$  at 18°; 100 pts. 50% methyl alcohol dissolve 0.4 pt.  $CuSO_4 + 5H_2O$  at 18°; 100 pts. absolute ethyl alcohol dissolve 13.4 pts.  $CuSO_4 + 5H_2O$  at 3°.

100 pts. absolute ethyl alcohol dissolve 1.1 pts.  $CuSO_4 + 5H_2O$  at 3°. (de Bruyn, Z. phys. Ch. 10. 786.)

Methyl alcohol dissolves 11.5%  $CuSO_4 + 5H_2O$  at 0°. (Auger, C. R. 1906, 142. 1272.)

Glacial acetic acid precipitates  $CuSO_4$  completely from  $CuSO_4 + Aq$ .

100 g. 95% formic acid dissolve 0.05 g.  $CuSO_4 + 5H_2O$  at 18.5°. (Aschan, Ch. Ztg. 1913, 37. 1117.)

Sol. in glycerine (Pelouse), proline (Unverdorben)

100 g. glycerine dissolve 36.3 g.  $CuSO_4 + 5H_2O$  at 15–16°. (Ossendowski, Pharm. J. 1907, 79. 575.)

100 g. glycerine dissolve 30.0 g.  $CuSO_4$  at 15.5°.

100 g. solution of  $CuSO_4$  in glycol contain 7.6 g. at 14.6° (de Coninck, Bull. Ac. Belg. 1906. 257.)

Anhydrous  $CuSO_4$  is insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014); methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314); benzonitrile. (Naumann, B. 1914, 47. 1370.)

Mm. *Chalcantite*.

Cupric glucinum sulphate,  $\text{CuSO}_4 \cdot 4\text{GISO}_4 + 20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Klatzo, J. B. 1868. 205.)

Does not exist. (Marignac, A. ch. (4) 30. 45.)

$9\text{CuSO}_4 \cdot \text{GISO}_4 + 50\text{H}_2\text{O}$ . As above.

Does not exist. (Marignac, l. c.)

Cupric hydrazine sulphate,  $\text{CuH}_4(\text{SO}_4)_2 \cdot 2\text{N}_2\text{H}_4$ .

1 pt. is sol. in 1148 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ .

Decomp. by acids.

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp. (Curtaus, J. pr. 1894, (2) 50. 331.)

Cupric iron (ferrous) sulphate,  $\text{CuSO}_4 \cdot \text{FeSO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 87. 602.)

$+ 2\text{H}_2\text{O}$ . (Étard)

$\text{CuSO}_4 \cdot 2\text{FeSO}_4 + 21\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (v. Hauer.)

$\text{CuSO}_4 \cdot 3\text{FeSO}_4 + 28\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 75 pts. salt at  $7^\circ$  (Lefort)

$4\text{CuSO}_4 \cdot \text{FeSO}_4 + 34\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 75.91 pts. (Thomson)

Cupric iron (ferric) sulphate,  $\text{CuSO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Bastick.)

Cupric iron (ferrous) potassium sulphate,  $\text{CuSO}_4 \cdot \text{FeSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Vohl)

Cupric lead sulphate,  $\text{CuO} \cdot \text{PbO} \cdot \text{SO}_3 + \text{H}_2\text{O}$ .

Min. *Linarite*

$3\text{CuO} \cdot 7\text{PbO} \cdot 5\text{SO}_3 + 5\text{H}_2\text{O}$ . Min. *Caledontite* Sol. in  $\text{HNO}_3 + \text{Aq}$ .

Cupric magnesium sulphate,  $\text{CuSO}_4 \cdot \text{MgSO}_4 + 14\text{H}_2\text{O}$ .

Efflorescent. Sol. in  $\text{H}_2\text{O}$  (Vohl, A. 94. 57.)

$+ 2\text{H}_2\text{O}$ . (Arnot, 1834.)

$\text{CuSO}_4 \cdot 2\text{MgSO}_4 + 21\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (v. Hauer, Pogg. 125. 638.)

$\text{CuSO}_4 \cdot 7\text{MgSO}_4 + 56\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (Schiff, A. 107. 64)

Cupric magnesium manganous potassium sulphate,  $\text{CuSO}_4 \cdot \text{MgSO}_4 \cdot \text{MnSO}_4 \cdot 3\text{K}_2\text{SO}_4 + 18\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

Cupric magnesium potassium sulphate,  $\text{CuSO}_4 \cdot \text{MgSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Does not exist. (Aston and Pickering, Chem. Soc. 49. 123.)

Cupric magnesium potassium zinc sulphate,  $\text{CuSO}_4 \cdot \text{MgO} \cdot 3\text{K}_2\text{SO}_4 \cdot \text{ZnSO}_4 + 18\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

Cupric manganous sulphate,  $5\text{CuSO}_4 \cdot 2\text{MnSO}_4 + 35\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Schäuffele, J. B. 1852. 340.)

$2\text{CuSO}_4 \cdot 3\text{MnSO}_4 + 25\text{H}_2\text{O}$ . As above (S.)

$\text{CuSO}_4 \cdot \text{MnSO}_4 + \text{H}_2\text{O}$  (Étard, C. R. 87. 602.)

Cupric manganous potassium sulphate,  $\text{CuSO}_4 \cdot \text{MnSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl)

Cupric nickel sulphate,  $\text{CuSO}_4 \cdot \text{NiSO}_4 + 3\text{H}_2\text{O}$ . (Étard, C. R. 87. 602.)

$\text{CuSO}_4 \cdot 2\text{NiSO}_4 + 21\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$

(v. Hauer.)  $+ 18\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ . (Bonsbaudran, C. R. 66. 497)

$2\text{CuSO}_4 \cdot 2\text{NiSO}_4 \cdot 3\text{H}_2\text{SO}_4$ . (Étard)

Cupric nickel potassium sulphate,  $\text{CuSO}_4 \cdot \text{NiSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vohl.)

Sol in 4 pts.  $\text{H}_2\text{O}$ , insol. in alcohol (Bette)

$4\text{CuSO}_4 \cdot \text{K}_2\text{SO}_4 + 4\text{H}_2\text{O}$ . Very sl sol in  $\text{H}_2\text{O}$

$\text{K}_2\text{O}$ ,  $4\text{CuO}$ ,  $4\text{SO}_3 + 4\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$ , but decomp. by boiling  $\text{H}_2\text{O}$  into  $3\text{CuO}$ ,  $\text{SO}_3$

Cupric potassium sulphate,  $\text{K}_2\text{Cu}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve 66.666 pts at  $102.8^\circ$  (Griffiths)

Much more sol. in hot than cold  $\text{H}_2\text{O}$ . (Pierre.)

Easily sol in  $\text{H}_2\text{O}$ , by boiling, de comp into basic salt (Persoz, A. ch. (3) 25. 272)

100 pts  $\text{H}_2\text{O}$  dissolve 11.14 pts anhydrous salt at  $25^\circ$  (Trevor, Z. phys. Ch. 7. 470)

1 l.  $\text{H}_2\text{O}$  dissolves 116.9 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

See also  $\text{CuSO}_4 + \text{K}_2\text{SO}_4$ .

\* Min. *Cyanochroite*.

Cupric potassium zinc sulphate,  $\text{CuSO}_4 \cdot 2\text{K}_2\text{SO}_4 \cdot \text{ZnSO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

Cupric rubidium sulphate,  $\text{CuSO}_4 \cdot \text{Rb}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Tutton.)

1 l.  $\text{H}_2\text{O}$  dissolves 102.8 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459)

Cupric sodium sulphate, basic,  $\text{Na}_2\text{SO}_4 \cdot \text{Cu}(\text{OH})_2 \cdot 3\text{CuSO}_4 + 2\text{H}_2\text{O}$ .

Min. *Natrochalcite*.

Sl sol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Pallache and Warren, Am. J. Sci. 1908, (4) 26. 346.)

**Cupric sodium sulphate,  $\text{CuSO}_4$ ,  $\text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$** Solubility of the pure double salt  $\text{CuSO}_4 \cdot \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ 

°	100 grams solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
17.7	14.34	13.34
19.5	14.54	12.90
23	14.36	12.76
30	14.07	12.37
40.15	13.73	12.26

(Koppel, Z. phys. Ch 1903, 42. 8.)

Solubility of the mixture of  $\text{CuSO}_4$ ,  $\text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$  and  $\text{CuSO}_4$ .

°	100 g solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
17.7	14.99	13.48 <sup>9</sup>
19.5	15.62	12.06
23	16.41	11.35
30	17.97	9.95
40.15	20.56	8.00

(Koppel.)

Solubility of the mixture of  $\text{CuSO}_4$ ,  $\text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$  and  $\text{Na}_2\text{SO}_4$ .

°	100 g solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
18	13.53	13.844
19.5	11.847	15.116
20	11.339	15.697
23	8.185	18.723
25	6.284	21.198
26	5.507	22.44
28	3.746	24.963
28.3	3.051	
30	2.607	28.383
30.2	2.422	
32.2	1.465	32.442
33.9	1.475	32.299
35.3	1.471	32.072
37.2	1.494	31.96

(Koppel.)

Solubility of  $\text{CuSO}_4$ ,  $\text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$  in presence of varying amounts of  $\text{Na}_2\text{SO}_4$ .

°	100 g. solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
30	5.38	22.17
30	5.41	21.92
30.1	3.69	25.37
40.15	3.97	23.90
30	1.57	32.09

(Koppel.)

Copper sulphate and sodium sulphate unite to form a double salt,  $\text{CuSO}_4 \cdot \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ , which is stable in the presence of the solution above 16.7°. In the presence of copper sulphate the solubility of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is greater than that of the pure salt. (Koppel.)

**Cupric thallous sulphate,  $\text{CuSO}_4$ ,  $\text{Tl}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .**Decomp. by recrystallising from  $\text{H}_2\text{O}$ . (Willm, A. ch. (4) 5. 55.)1 l.  $\text{H}_2\text{O}$  dissolves 81 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)**Cupric zinc sulphate,  $\text{CuSO}_4$ ,  $3\text{ZnSO}_4 + 28\text{H}_2\text{O}$** Efflorescent. 100 pts.  $\text{H}_2\text{O}$  dissolve 80 pts. salt at 8°. Sol. in all proportions in boiling  $\text{H}_2\text{O}$ . (Lefort.) $\text{CuSO}_4$ ,  $2\text{ZnSO}_4 + 21\text{H}_2\text{O}$ . (v. Hauer, Pogg. 125. 637.) $\text{CuSO}_4$ ,  $\text{ZnSO}_4 + 12\text{H}_2\text{O}$ . (Boisbaudran.) $2\text{CuSO}_4$ ,  $2\text{ZnSO}_4$ ,  $\text{H}_2\text{SO}_4$ . (Etard)**Cuprous sulphate ammonia,  $\text{Cu}_2\text{SO}_4$ ,  $4\text{NH}_3$ .**Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  decomp. by pure  $\text{H}_2\text{O}$ . (Péchar, C. R., 1903, 136. 504.) $+ \text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . (Foerster and Blankenburg, B. 1906, 39. 4434.)**Cupric sulphate ammonia, basic,  $\text{CuSO}_4$ ,  $3\text{CuO}$ ,  $2\text{NH}_3 + 5\text{H}_2\text{O}$ .**Decomp. by hot  $\text{H}_2\text{O}$ . (Pickering, Chem. Soc. 43. 336.)**Cupric sulphate ammonia (Cuprammonium sulphate),  $\text{CuSO}_4$ ,  $\text{NH}_3$ .**Decomp. by  $\text{H}_2\text{O}$ . (Kane.)Decomp. by  $\text{H}_2\text{O}$  giving a basic sulphate. (Bouzat, C. R. 1902, 135. 535.) $\text{CuSO}_4$ ,  $2\text{NH}_3$  [ $\text{CuSO}_4$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$ . (Mendelejeff, B. 3. 422.)]. Decomp. by excess of  $\text{H}_2\text{O}$  into— $\text{CuSO}_4$ ,  $4\text{NH}_3 + \text{H}_2\text{O}$ . Sol. in 15 pts.  $\text{H}_2\text{O}$ , but decomp. by much  $\text{H}_2\text{O}$ . Insol. in alcohol.Insol. in conc.  $\text{NH}_4\text{OH} + \text{Aq.}$  (André, C. R. 100. 1138.)Sol. in small quantity of  $\text{H}_2\text{O}$ ; decomp. in dil. solution. (Bouzat.)100 g.  $\text{H}_2\text{O}$  dissolve 44.56 g. anhydrous comp. at 25°. (Pudschies, Dissert.)100 g.  $\text{H}_2\text{O}$  dissolve 18.05 g. at 21–22°. (Horn and Taylor, Am. Ch. J. 1904, 32. 268.) $\text{CuSO}_4$ ,  $5\text{NH}_3$ . Completely sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 20. 150.)Sol. in small amt. of  $\text{H}_2\text{O}$ ; decomp. in dil. solution. Insol. in liquid  $\text{NH}_3$ . (Bouzat, C. R. 1902, 135. 535.)**Cuprous sulphate carbon monoxide,  $\text{Cu}_2\text{SO}_4$ ,  $2\text{CO} + \text{H}_2\text{O}$ .**

Very unstable. (Joannis, C. R. 1903, 136. 615.)

Cupric sulphate zinc oxide,  $\text{CuSO}_4 \cdot 2\text{ZnO} + 21\text{H}_2\text{O}$ .

(Laasen, Ch. Z. Repert. 1896, 20, 317.)

$2\text{CuSO}_4 \cdot 3\text{ZnO} + 12\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27, 169.)

Didymium sulphate, basic,  $\text{Dy}_2\text{O}_3 \cdot \text{SO}_3 = (\text{DyO})_2\text{SO}_4$

Insol. in cold or boiling  $\text{H}_2\text{O}$ . (Marignac)  
Slowly sol. in hot dil.  $\text{HCl} + \text{Aq}$  Easily sol. in conc. acids.

$+8\text{H}_2\text{O}$ . Precipitate (Hermann).

Composition is  $2\text{Dy}_2\text{O}_3 \cdot 3\text{SO}_3 + 3\text{H}_2\text{O}$  or  $\text{Dy}_2(\text{SO}_4)_3 + \text{Dy}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . (Friedrichs and Smith.)

Composition is  $5\text{Dy}_2\text{O}_3 \cdot 3\text{SO}_3 + 2\text{H}_2\text{O}$  (Cleve, B. 11, 910.)

Didymium sulphate,  $\text{Dy}_2(\text{SO}_4)_3$ .

Anhydrous. By saturating cold  $\text{H}_2\text{O}$  and warming the solution, the following results were obtained—100 pts  $\text{H}_2\text{O}$  dissolve at.

12° 18° 25° 38° 50°

43.1 25.8 20.6 13.0 11.0 pts.  $\text{Dy}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}$   $\text{H}_2\text{O}$  dissolves this salt very slowly; 100 pts  $\text{H}_2\text{O}$  dissolve 13 pts  $\text{Dy}_2(\text{SO}_4)_3$  in 24 hours, and 16.4 pts in 2 days. If solution is evap. in vacuo until  $\text{Dy}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  separates out, 34 pts.  $\text{Dy}_2(\text{SO}_4)_3$  remain dissolved in 100 pts.  $\text{H}_2\text{O}$

$+5\text{H}_2\text{O}$  (Cleve.)

$+8\text{H}_2\text{O}$  Solutions of this salt contain at

19° 40° 50° 100°

11.7 8.8 6.5 1.6 pts.  $\text{Dy}_2(\text{SO}_4)_3$ .

(Marignac, A. ch. (3) 38, 170.)

$+9\text{H}_2\text{O}$ . (Zschiesche, J. Pr. 107, 75)

Didymium potassium sulphate,  $\text{K}_2\text{SO}_4 \cdot \text{Dy}_2(\text{SO}_4)_3 + 2\text{H}_2\text{O}$

Sol. in 63 pts  $\text{H}_2\text{O}$ . Insol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ . (Marignac.)

$3\text{K}_2\text{SO}_4 \cdot \text{Dy}_2(\text{SO}_4)_3$  Sol. in 83 pts.  $\text{H}_2\text{O}$  at 18° Insol. in cold, sl. sol. in boiling sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ , 100 ccm. of which retain 55 mg.  $\text{Dy}_2\text{O}_3$  in solution. (Cleve.)

$4\text{K}_2\text{SO}_4 \cdot \text{Dy}_2(\text{SO}_4)_3$  (Cleve.)

$9\text{K}_2\text{SO}_4 \cdot 2\text{Dy}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$  (Cleve)

Didymium sodium sulphate,  $\text{Dy}_2(\text{SO}_4)_3 \cdot \text{Na}_2\text{SO}_4$  and  $+2\text{H}_2\text{O}$

Sol. in 200 pts.  $\text{H}_2\text{O}$  (Marignac), and still less in sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$ , 100 ccm. of which dissolve only 70 mg.  $\text{Dy}_2\text{O}_3$  at ord. temp (Cleve)

Didymium thallous sulphate,  $(\text{Dy}_2\text{SO}_4)_2 \cdot 3\text{Tl}_2\text{SO}_4$ .

Ppt.

$\text{Dy}_2(\text{SO}_4)_3 \cdot \text{Tl}_2\text{SO}_4 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Zschiesche, J. pr. 107, 98)

Erbium sulphate,  $\text{Er}_2(\text{SO}_4)_3$ .

Anhydrous. Easily and rapidly sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 43 pts. anhydrous salt at 0°.

$+8\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than anhydrous salt. 100 pts  $\text{H}_2\text{O}$  dissolve 30 pts.  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  (=23 pts.  $\text{Er}_2(\text{SO}_4)_3$ ) at about 20°; at 100°, 100 pts.  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  remain dissolved. Sat. solution deposits crystals when heated to 55°. (Höglund)

100 g. of sat. solution of  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  at 25° in  $\text{H}_2\text{O}$  contains 11.94 g. anhyd.  $\text{Er}_2(\text{SO}_4)_3$ . (Wirth, Z. anorg. 1912, 76, 174.)

Solubility of  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  in  $\text{H}_2\text{SO}_4$  at 25°.

N = equiv g  $\text{H}_2\text{SO}_4$  in 1 l. of solvent.

C = g oxide in 100 g of solution.

C' = g anhyd. salt in 100 g of solution

N	C	C'	N	C	C'
0	4 604	7 60	4 32	2 00	3.301
0 1	4 615	7 618	6 685	0 9115	1 505
1 1	3 64	6.00	9 68	0 4439	0.733
2 16	3 04	5 018	15 15	0 145	0 239

(Wirth, Z. anorg. 1912, 76, 174)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790)

Erbium potassium sulphate,  $\text{Er}_2(\text{SO}_4)_3 \cdot 3\text{K}_2\text{SO}_4$ .

Slowly sol. in  $\text{H}_2\text{O}$ . (Höglund.)

Erbium sodium sulphate,  $\text{Er}_2(\text{SO}_4)_3 \cdot 5\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

Europium sulphate,  $\text{Eu}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .

Stable in the air. (Urbain and Lacombe, C. R. 1904, 138, 628.)

Gadolinium sulphate,  $\text{Gd}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$

Temp	Pts of $\text{Gd}_2(\text{SO}_4)_3$ in 100 pts $\text{H}_2\text{O}$
0°	3.98
9 3-10 6°	3 33
14 0°	2 80
25 0°	2 40
34 4°	2 26

(Benedicks, Z. anorg. 1899, 22, 409-410.)

100 g. sat solution of  $\text{Gd}(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  at 25° in  $\text{H}_2\text{O}$  contain 2.981 g. anhyd.  $\text{Gd}_2(\text{SO}_4)_3$ . (Wirth, Z. anorg. 1912, 76, 174.)

Solubility in  $\text{H}_2\text{SO}_4$ . Solid phase,  $\text{Gd}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$

N = equiv. g  $\text{H}_2\text{SO}_4$  in 1 l. of solvent.

C = g. oxide in 100 g. of solution

$\text{C}_1$  = g anhyd  $\text{Gd}_2(\text{SO}_4)_3$  in 100 g of solution

	N	C	$\text{C}_1$		N	C	$\text{C}_1$
0	1 793	2 981		2 16	1 789	2 974	
0 1	1 98	3 291		6 175	0 528	0 8777	
0 505	2 365	3 931		12 6	0 0521	0 0867	
1 1	2 29	3 807					

(Wirth)

Sol in sat.  $\text{K}_2\text{SO}_4 + \text{Aq.}$

Gadolinium potassium sulphate,  $\text{Gd}_2(\text{SO}_4)_3 \cdot \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

100 grams sat. solution in  $\text{K}_2\text{SO}_4 + \text{Aq}$  contains 0.87—0.77 grams  $\text{Gd}_2\text{O}_3$ . (Benedicks, Z. anorg 1900, 22. 410.)

Gallium sulphate,  $\text{Ga}_2(\text{SO}_4)_3$ .

Not deliquescent, but very sol in  $\text{H}_2\text{O}$ . Sol. in 60% alcohol; insol. in ether. (Boisbaudran.)

Aqueous solution decomp into basic salt by boiling, which redissolves, however, on cooling

Gallium potassium sulphate,  $\text{Ga}_2\text{K}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

(Soret, Arch. sc. phys. nat. 1885, 14. 96.)

Gallium rubidium sulphate,  $\text{Rb}_2\text{Ga}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

(Soret, Arch. sc. phys. nat. 1885, 14. 96.)

Glucinum sulphate, basic,  $3\text{GIO} \cdot \text{SO}_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , but decomp. by heating or dilution. (Berzelius.)

$2\text{GIO} \cdot \text{SO}_3 + 3\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ .

$9\text{GIO} \cdot \text{SO}_3 + 14\text{H}_2\text{O}$  (?) Precipitate. Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)

According to Debray, this salt when carefully washed is  $\text{GIO}_2\text{H}_2$ .

Glucinum sulphate,  $\text{GIO}_2$ .

Anhydrous.

Nearly insol in  $\text{H}_2\text{O}$ , but slowly attacked by cold, rapidly by hot  $\text{H}_2\text{O}$ , and is converted into  $\text{GIO}_2 + 4\text{H}_2\text{O}$  before dissolving. (Parrons, Z. anorg. 1904, 42. 253.)

Sp. gr. of  $\text{GIO}_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{GIO}_2 + \text{Aq}$	Sp. gr.
1—normal	1.0451
$1/2$ —"	1.0229
$1/4$ —"	1.0114
$1/16$ —"	1.0027

(Wagner, Z. phys. Ch. 1890, 5. 35.)

Solubility of  $\text{GIO}_2$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$

$\text{H}_2\text{SO}_4 + \text{Aq}$ % $\text{H}_2\text{SO}_4$	100 g of the solution con- tain g $\text{GIO}_2$	Solid phase
	8 212	$\text{GIO}_2 + 6\text{H}_2\text{O}$
5 23	8 429	
9 61	7.944	
18 70	6.603	
34 00	5.631	
40 35	5.773	
45 51	6 628	$\text{GIO}_2 + 4\text{H}_2\text{O}$
50 63	5 438	
56 59	3 640	
63 24	2 244	
65 24	2 128	
73 64	2 185	

(Wirth, Z. anorg 1913, 79. 359)

See also under +2, 4, and  $6\text{H}_2\text{O}$ .

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J., 1898, 20. 828.)

+ $\text{H}_2\text{O}$ . (Levi-Malvano, Z. anorg 1906, 48. 447.)

+ $2\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G $\text{GIO}_2$ per 100 g.	
	$\text{H}_2\text{O}$	Solution
80	84 76	45.87
91 4	97.77	40.42
105	118 4	54.21
119	149 3	59.88

(Levi-Malvano.)

+ $4\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ .

Sol. in its own weight of  $\text{H}_2\text{O}$  at  $14^\circ$ , and in every proportion of boiling  $\text{H}_2\text{O}$ . Less sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  than in water. (Debray, A. ch. (3) 44. 25.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g $\text{GIO}_2$ per 100 g		$t^\circ$	g $\text{GIO}_2$ per 100 g	
	$\text{H}_2\text{O}$	solution		$\text{H}_2\text{O}$	solution
30	43 78	30 45	95 4	90 63	47 55
40	46 74	31 85	107 2	115.3	53 58
68	61 95	38 27	111	128.3	56 19
85	76 30	43.28	..	.	.

(Levi-Malvano)

Sl. sol. in dilute, insol in absolute alcohol. Can be completely pptd. from  $\text{GIO}_2 + \text{Aq}$  by  $\text{HC}_2\text{H}_3\text{O}_2$ . (Persson.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329)

+6H<sub>2</sub>OSolubility in H<sub>2</sub>O at t°

t°	g. GISO <sub>4</sub> per 100 g.	
	H <sub>2</sub> O	solution
31	52 23	34 32
50	60 67	37 77
72 2	74 94	42 85
77 4	81 87	45 01

(Levi-Malvano.)

100 g. of the aqueous solution contain at 25°, 8.212 g. GISO<sub>4</sub>. (Whith, Z. anorg. 1913, 79. 358.)

Glucinum iron (ferrous) sulphate, GISO<sub>4</sub>, FeSO<sub>4</sub> + 17½H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Klatzo, J. B. 1868. 204.)  
3GISO<sub>4</sub>, FeSO<sub>4</sub> + 28H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Klatzo.)

Do not exist. (Marignac, A. ch. (4) 30. 45.)

Glucinum nickel sulphate, (Gl,Ni)SO<sub>4</sub> + 4H<sub>2</sub>O, or 7H<sub>2</sub>O.

(Klatzo, J. B. 1868. 205.)  
Does not exist. (Atterberg, Sv. V. A. F. 1873, 4. 81.)

Glucinum potassium sulphate, GISO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> + 2H<sub>2</sub>O.

Sl. sol. in cold, slowly but more sol. in hot H<sub>2</sub>O. (Debray.)  
+ 3H<sub>2</sub>O. (Klatzo.)

Glucinum potassium hydrogen sulphate, GH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, 2K<sub>2</sub>SO<sub>4</sub> + 4H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O. Partly decomp. by recrystallisation. (Atterberg.)

Glucinum sodium sulphate, 2GISO<sub>4</sub>, 3Na<sub>2</sub>SO<sub>4</sub> + 18H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Atterberg.)

Glucinum zinc sulphate, 2GISO<sub>4</sub>, 3ZnSO<sub>4</sub> + 35H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Klatzo, J. B. 1868. 205.)  
Does not exist. (Atterberg.)

Gold (auroauric) sulphate, Au<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.

Decomp. by moist air, H<sub>2</sub>O, glacial acetic acid, or HNO<sub>3</sub> + Aq. (1.42 sp. gr.) Insol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Schottlander, A. 217. 375.)

Gold (auric) sulphate, Au<sub>2</sub>O<sub>3</sub>, 2SO<sub>3</sub> + H<sub>2</sub>O, or Auryl hydrogen sulphate, (AuO)HSO<sub>4</sub>.

Deliquescent. Decomp. by H<sub>2</sub>O. Sol. in HCl + Aq; not attacked by conc. HNO<sub>3</sub> + Aq. Sol. in 6 pts. conc. H<sub>2</sub>SO<sub>4</sub>. (Schottlander.)

Gold (auric) potassium sulphate, Au<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, K<sub>2</sub>SO<sub>4</sub>.

Not decomp. immediately by cold H<sub>2</sub>O. (Schottlander.)

Hydrazine mercuric sulphate hydrazine, (N<sub>2</sub>H<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 3HgSO<sub>4</sub>, 2N<sub>2</sub>H<sub>4</sub>.

Insol. in H<sub>2</sub>O. Sol. in H<sub>2</sub>O containing HCl. (Ferrati, Gazz. ch. it. 1912, 42. (1) 142.)

Hydroxylamine uranyl sulphate, (NH<sub>2</sub>OH)<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>, 2(UO<sub>2</sub>)SO<sub>4</sub> + 5H<sub>2</sub>O.

Extremely sol. in H<sub>2</sub>O from which it can be cryst. (Rambach, Dissert. 1904.)

Indium sulphate, In<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Easily sol. in H<sub>2</sub>O.

+ 9H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O.

Indium hydrogen sulphate, InH(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O.

Very deliquescent. (Meyer.)

Indium potassium sulphate, InK(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O.

Sol. in H<sub>2</sub>O, but decomp. by boiling. (Rossler, J. pr. (2) 7. 14.)  
(InO)<sub>2</sub>K(SO<sub>4</sub>)<sub>2</sub> + 3H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Rossler.)

Indium rubidium sulphate,

In<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Rb<sub>2</sub>SO<sub>4</sub> + 24H<sub>2</sub>O.

44.28 pts. are sol. in 100 pts. H<sub>2</sub>O at 15°. (Chabrie, C. R. 1901, 132. 473.)

Melts in crystal H<sub>2</sub>O at 42°. (Locke, Am. Ch. J. 1901, 26. 183.)

Indium sodium sulphate, InNa(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Rossler, J. pr. (2) 7. 14.)

Iodine sulphate, I<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.

Ppt. Decomp. by H<sub>2</sub>O. (Fichter, Z. anorg. 1915, 91. 140.)

Iodyl sulphate, (IO)<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.

Possible composition of Weber's (B. 20. 86) I<sub>2</sub>O<sub>5</sub>, 3SO<sub>3</sub>.

## Iridium sulphate.

Sol. in  $H_2O$  or alcohol. (Berzelius.)  
 $Ir(SO_4)_3$  Sol. in  $H_2O$ . (Rumbach, Z anorg. 1907, 52. 409)

Iridium potassium sulphate,  $Ir_2(SO_4)_3$ ,  
 $K_2SO_4 + 24H_2O$ .

Mpt. 102-103°.  
 Easily sol. in  $H_2O$ . (Marino, Z. anorg. 1904, 42. 220.)  
 $Ir_2(SO_4)_3 \cdot 3K_2SO_4$  Sol. in  $H_2O$  or dil  $H_2SO_4$  + Aq; nearly insol. in sat.  $K_2SO_4$  + Aq. (Boisbaudran, C. R. 96. 1406)

Iridium rubidium sulphate,  $Ir_2(SO_4)_3 \cdot Rb_3$ .

Sol. in cold; very sol. in hot  $H_2O$ . (Marino, Gazz. ch. it 1903, 32, (2) 511.)  
 Mpt. 108-109°. (Marino, Z. anorg. 1904, 42. 219.)

Iridium thallium sulphate,  $Ir_2(SO_4)_3 \cdot Tl_2SO_4 + 24H_2O$ .

Very sol. in  $H_2O$ . (Marino, Z. anorg. 1904, 42. 222.)

Iron (ferrous) sulphate,  $FeSO_4$ .

+ $H_2O$   
 + $2H_2O$  Not more sol. in  $H_2O$  than gypsum. (Mitscherlich)  
 + $3H_2O$  Sol. in  $H_2O$ . (Kane)  
 + $4H_2O$  Separates from conc  $FeSO_4$  + Aq at 80°  
 + $7H_2O$  Efflorescent at 33°.

1 pt  $FeSO_4 + 7H_2O$  dissolves in 16 pts cold, and 0.3 pt boiling  $H_2O$

1 pt  $FeSO_4 + 7H_2O$  dissolves at  
 10° 15° 25° 33° 46° 60° 84° 90° 100°  
 in 1.64 1.43 0.87 0.66 0.41 0.38 0.37 0.27 0.3 pts  $H_2O$   
 (Brandes and Fimhaber, Br Arch 7 83)

When boiled with insufficient  $H_2O$  for solution a white hydrate is formed which separates out. Solubility increases up to 87.5°, and then diminishes, owing to the above separation. (Brandes, Pogg 20 581)

Sol. in 2 pts cold, and 1 pt boiling  $H_2O$  (Fourcroy), sol. in 2 pts cold  $H_2O$  at 18.75° (Abt); sol. in 6 pts  $H_2O$  at moderate heat, and 0.75 pt at 100° (Bergmann)  
 100 pts  $H_2O$  at 15.5° dissolve 45-50 pts (Ure's Dict.)

100 pts  $H_2O$  dissolve pts  $FeSO_4$  at t°

t°	Pts $FeSO_4$	t°	Pts $FeSO_4$	t°	Pts $FeSO_4$
0	15 8	21	27 4	45	42 9
10	19 9	30	32 6	55	47 0
12	21 3	37	38 5	70	56 5
20	26 0				

(Tobler, A. 96 198)

100 pts  $FeSO_4$  + Aq sat. at 11-14° contain 17.02%  $FeSO_4$ . (v. Hauer, J pr 103. 114.)

100 pts  $FeSO_4$  + Aq sat at 15° contain 37.2%  $FeSO_4 + 7H_2O$ ; solution has sp. gr 1.2232. (Schiff, A. 118. 362.)

Solubility in 100 pts  $H_2O$  at t°.

t°	Pts $FeSO_4$	t°	Pts $FeSO_4$	t°	Pts $FeSO_4$
0	7 9	34	37.1	67	65 1
1	8 7	35	38 0	68	65 0
2	9 5	36	38.9	69	64.9
3	10.4	37	39 8	70	64.8
4	11.2	38	40 7	71	64.7
5	12 0	39	41 7	72	64.5
6	12 9	40	42 6	73	64.4
7	13 7	41	43 5	74	64.2
8	14 5	42	44 4	75	64 0
9	15 3	43	45.3	76	63.7
10	16 2	44	46 2	77	63 4
11	17 0	45	47.1	78	63.1
12	17 9	46	48 1	79	62 7
13	18 7	47	49 0	80	62.3
14	19 5	48	50 0	81	61 9
15	20.4	49	51 0	82	61.5
16	21 2	50	51 9	83	61 0
17	22 1	51	52 9	84	60.4
18	23 0	52	53 8	85	59.8
19	23 8	53	54 8	86	59.2
20	24 7	54	55 7	87	58 5
21	25 6	55	56 7	88	57 7
22	26 4	56	57 7	89	57 0
23	27 3	57	58 7	90	56.2
24	28 1	58	59 7	91	55 3
25	29 0	59	60 7	92	54 3
26	29 9	60	61 7	93	53 3
27	30 8	61	62 7	94	52 2
28	31 7	62	63 7	95	51 0
29	32 6	63	64 8	96	49 6
30	33 5	64	65 4	97	48 0
31	34 4	65	66 4	98	46 3
32	35 3	66	65 3	99	44 5
33	36 2	66	65 2	100	42 6

(Mulder, Scheik Verhandel 1864. 141)

If solubility  $S$  = pts. anhydrous  $FeSO_4$  in 100 pts solution,  $S = 13.5 + 0.3788t$  from -2° to +65°,  $S = 37.5$  constant from 65° to 98°,  $S = 37.5 - 0.6085t$  from 98° to 156°. Practically insol at 156°. (Etard, C. R. 106. 740.)

Sat.  $FeSO_4$  + Aq contains at:

-1°	+5°	24°	34°	52°
13.0	15 1	22 7	26 3	32.5% $FeSO_4$
60°	67°	77°	86°	94°
36 4	37 7	37.8	37.8	36 7% $FeSO_4$
102°	112°	130°	152°	
34 7	28 0	17 3	2.5% $FeSO_4$	

(Etard, A. ch. 1894, (7) 2. 553.)

100 g  $H_2O$  dissolve 26.69 g.  $FeSO_4$  at 25°. (Stortenbecker, Z. phys. Ch. 1900, 34. 109.)

Solubility of  $\text{FeSO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .  
100 g  $\text{H}_2\text{O}$  dissolve g  $\text{FeSO}_4$

$t^\circ$	G $\text{FeSO}_4$	$t^\circ$	G $\text{FeSO}_4$
0 00	15 65	52 00	50 20
10 00	20 51	54 03	52 07
15 25	23 86	60 01	54 95
20 13	26 56	65 00	55 59
25 02	29 60	68 02	52 31
30 03	32 93	70 04	56 08
35 07	36 87	77 00	45 90
40 05	40 20	80 41	43 58
45 18	44 32	85 02	40 46
50 21	48 60	90 13	37 27

$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  is stable from  $-1.82^\circ$  to  $+56.0^\circ$ ;  $\text{FeSO}_4 \cdot 4\text{H}_2\text{O}$  from  $56.6^\circ$  to  $64.4^\circ$ ,  $\text{FeSO}_4 \cdot \text{H}_2\text{O}$  above this point

(Fraenckel, Z anorg 1907, 55, 228.)

$\text{FeSO}_4 + \text{Aq}$  sat. at  $30^\circ$  contains 24.9 g.  $\text{FeSO}_4$  in 100 g. of solution. (Schreinemakers, Z. phys. Ch. 1912, 71, 110.)

Sp gr of  $\text{FeSO}_4 + \text{Aq}$  at  $15^\circ$   
 $\rho = \rho_{\text{FeSO}_4 \cdot 7\text{H}_2\text{O}}$

%	Sp gr	%	Sp gr	%	Sp gr
1	1.005	15	1.082	28	1.161
2	1.011	16	1.088	29	1.168
3	1.016	17	1.094	30	1.174
4	1.021	18	1.100	31	1.180
5	1.027	19	1.106	32	1.187
6	1.032	20	1.112	33	1.193
7	1.037	21	1.118	34	1.200
8	1.043	22	1.125	35	1.206
9	1.048	23	1.131	36	1.213
10	1.054	24	1.137	37	1.219
11	1.059	25	1.143	38	1.226
12	1.065	26	1.149	39	1.232
13	1.071	27	1.155	40	1.239
14	1.077				

(Gerlach, Z. anal. 8, 287.)

Sp. gr.  $16.6^\circ$  of sat. solution = 1.219. (Greenish and Smith, Pharm. J. 1903, 71, 881.)

Sat.  $\text{FeSO}_4 + \text{Aq}$  boils at  $102.2^\circ$  (Griffiths), and solution contains 64%  $\text{FeSO}_4$ . Crust forms at  $102.3^\circ$ ; highest temp. observed,  $104.8^\circ$ . (Gerlach, Z. anal. 26, 426.)

B.-pt of  $\text{FeSO}_4 + \text{Aq}$  containing pts.  $\text{FeSO}_4$  to 100 pts.  $\text{H}_2\text{O}$

B.-pt.	Pts $\text{FeSO}_4$	B.-pt	Pts $\text{FeSO}_4$
100.5°	17 7	101.5°	50 4
101 0	34 4	101 6	53 2

(Gerlach, Z. anal. 26, 433.)

100 g. of the sat. solution contain 22.84 g.  $\text{FeSO}_4$  at  $25^\circ$ . (Wirth, Z. anorg. 1913, 79, 364.)

Sol in hot  $\text{HCl} + \text{Aq}$  (Kane.)  
Somewhat sol. in conc  $\text{H}_2\text{SO}_4$ . (Bussy and Lecann.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

$\text{H}_2\text{SO}_4 + \text{Aq}$ Normality	100 g. of the solution contain g $\text{FeSO}_4$	Solid phase
0	22.84	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
2.25	19 03	
6 685	13 40	
10 2	10 30	
12 46	7 26	
15 15	4 015	$\text{FeSO}_4 + \text{H}_2\text{O}$
19 84	0 1522	

(Wirth, Z anorg. 1913, 79, 364.)

More sol in water containing NO than in pure  $\text{H}_2\text{O}$ . (Gay, Bull. Soc. (2) 44, 175.)

Completely pptd from  $\text{FeSO}_4 + \text{Aq}$  by glacial  $\text{HC}_2\text{H}_3\text{O}_2$ . (Persoz.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . See under  $(\text{NH}_4)_2\text{SO}_4$ .

Solubility in  $\text{Li}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt $\text{FeSO}_4$	% by wt $\text{Li}_2\text{SO}_4$	
24 87	0	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
22 45	4 00	"
21 15	5 58	"
18 79	11.16	"
16 51	15 81	"
16 18	16 52	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O} + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
16 04	16 49	"
15 39	16 80	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
12 68	18 31	"
5 32	22 15	"
3 74	23 15	"
0	25 1	"

(Schreinemakers, Z. phys Ch 1910, 71, 110.)

Solubility of  $\text{FeSO}_4$ ,  $\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ ,  $10\text{H}_2\text{O}$ , in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Grams $\text{FeSO}_4$	Grams $\text{Na}_2\text{SO}_4$
0	18 06	6.13
15 5	25 05	15 97

(Koppel, Z. phys. Ch. 1905, 52, 405.)

See also under  $\text{FeNa}_2(\text{SO}_4)_2$

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

Insol. in liquid  $\text{CO}_2$ . (Buehner, Z. phys. Ch. 1906, 54, 674.)

100 pts. sat. solution of  $\text{FeSO}_4$  in 40% alcohol contains 0.3%  $\text{FeSO}_4$ . (Schiff.)

Insol. in alcohol of 0.905 sp. gr or less. (Anthon, J. pr. 14, 125.)

Alcohol and  $H_2SO_4$  precipitate  $FeSO_4$  from  $FeSO_4 + Aq$ , also glacial acetic acid.

Anhydrous  $FeSO_4$ , is insol. in acetone. (Krug and McElroy, 1893.)

Insol in acetone (Eidmann, C. C. 1899, II, 1014.)

100 g. sat. solution in glycol contain 60 g  $FeSO_4$  at ord. temp. (de Coninck)

Insol in methyl acetate. (Naumann, B. 1909, 42, 3790); ethyl acetate (Naumann, B. 1904, 37, 3601.)

Iron (ferrous) sulphate, acid,  $2FeO$ ,  $3SO_3$ ,  $2H_2O$ .

This salt exists in contact with solutions containing  $SO_3 + 1.637 H_2O$  to about  $SO_3 + 2.186 H_2O$  (Kenrick, J. phys. Chem. 1908, 12, 704.)

$FeO$ ,  $2SO_3 + H_2O$  This compd exists with solutions containing  $SO_3 + 1.342 H_2O$  to (about)  $SO_3 + 1.595 H_2O$ . (Kenrick)

$FeO$ ,  $4SO_3 + 3H_2O$ . This compd. is stable with solutions containing from  $SO_3 + 1.122 H_2O$  to (about)  $SO_3 + 1.342 H_2O$ . Rapidly sol in  $H_2O$  with ppt. of  $FeSO_4 + H_2O$ . (Kenrick)

Min. *Melanterite*.

Iron (ferrous) sulphate, basic,  $10Fe_2O_3$ ,  $SO_3 + H_2O$

(Athanasesco, C. R. 103, 27.)

$6Fe_2O_3$ ,  $SO_3 + 10H_2O$  Insol in  $H_2O$  Sl. sol. in warm  $HCl + Aq$  (Scheerer, Pogg. 45, 188.)

$4Fe_2O_3$ ,  $SO_3 + 11H_2O$ . (Anthon, Repert. 81, 237.)

$3Fe_2O_3$ ,  $SO_3 + 4H_2O$ . Insol. in  $H_2O$ . Rather easily sol. in acids. (Scheerer, Pogg. 44, 453; Meiser, B. 8, 771.)

$2Fe_2O_3$ ,  $SO_3 + 6H_2O$ . When pptd. from cold solutions, is sol. in  $Fe_2(SO_4)_3 + Aq$ , but insol. therein when pptd. from hot solutions (Maus.)

Only basic sulphate which is a true chemical compound. (Pickering, Chem. Soc. 37, 807.)

Min. *Glockerite*. Insol. in  $H_2O$ . Sol. in conc.  $H_2SO_4$ .

+  $7H_2O$ . (Meister.)

+  $8H_2O$ . (Mühlhauser.)

+  $15H_2O$ . Min. *Pisophanite*.

$Fe_2O_3$ ,  $SO_3 = (FeO)_2SO_4 + 3H_2O$  Insol in  $H_2O$ . (Soubeiran, A. ch. 44, 329.)

$3Fe_2O_3$ ,  $4SO_3 + 9H_2O$ . (Athanasesco.)

$2Fe_2O_3$ ,  $3SO_3 + 8H_2O$ . Insol in  $H_2O$ . (Wittstein.)

+  $18H_2O$ . Min. *Fibroferrite*. Sl. sol in cold, more easily in hot  $H_2O$ .

$Fe_2O_3$ ,  $2SO_3 + 10H_2O$ . Min. *Stypticite*.

+  $15H_2O$ . Sol. in  $H_2O$ ; decomp. by heat or evaporation. (Muck, J. pr. 99, 103.)

$2Fe_2O_3$ ,  $5SO_3 + 13H_2O$ . Min. *Coptapite*

$Fe_2SiO_4 + 18H_2O = 2Fe_2O_3$ ,  $5SO_3 + 18H_2O$   $\alpha$ -Coptapit. This salt is in equilibrium at 25°

with solutions in which the molecular ratio  $Fe_2O_3 : SO_3$  lies between 1.2889 and 1.2614. (Wirth, Z. anorg. 1914, 87, 37.)

$(OH)Fe_2(SO_4)_3 + 13H_2O$   $\beta$ -Coptapit. This salt is in equilibrium at 25° with solutions in which the molecular ratio  $Fe_2O_3 : SO_3$  lies between 1.3472 and 1.2889. (Wirth, Z. anorg. 1914, 87, 37.)

According to Pickering (Chem. Soc. 37, 807), all basic ferric sulphates are mixtures excepting  $2Fe_2O_3$ ,  $SO_3$ .

Iron (ferric) sulphate,  $Fe_2(SO_4)_3$ .

Anhydrous. Slowly deliquescent. Nearly insol in  $H_2O$ , and  $HCl + Aq$ . Insol. in conc.  $H_2SO_4$ . Very rapidly sol. in  $FeSO_4 + Aq$ , even when very dil. (Barreswil, C. R. 20, 1365.)

Sp. gr. of  $Fe_2(SO_4)_3 + Aq$ . According to F = Franz at 17.5° (J. pr. (2) 5, 280); G = Gerlach at 15° (Z. anal. 28, 494); H = Hager at 18° (Z. anal. 27, 280).

	5	10	15	20	% $Fe_2(SO_4)_3$
F	1.0426	1.0854	1.1324	1.1826	
G		1.096		1.205	
H	1.046	1.097	1.151	1.208	
	25	30	35	40	% $Fe_2(SO_4)_3$
F	1.2426	1.3090	1.3782	1.4506	
G		1.331		1.478	
H	1.271	1.337	1.411	1.490	
	45	50	55	60	% $Fe_2(SO_4)_3$
F	1.5298	1.6148	1.7050	1.8006	
G		1.650		...	

Solubility in  $H_2SO_4 + Aq$  at 25°.

$H_2SO_4 + Aq$ Normality	100 g. of the solution contain g $Fe_2(SO_4)_3$
2 25	25 02
6 685	14 58
19 84	0 05

(Wirth, Z. anorg. 1913, 79, 364.)

Solubility in  $Al_2(SO_4)_3 + Aq$  at 25°

100 g. of the solution contain	
G. $Al_2(SO_4)_3$	G. $Fe_2(SO_4)_3$
	44 97
2 342	12 44
5 200	38 83
6 625	35 82
8 819	34 02
10 03	32 42
*10 23	31 90
10 70	31 91

\*Solution sat. with respect to both salts. (Wirth and Bakke, Z. anorg. 1914, 87, 48.)  
See also under  $Al_2(SO_4)_3$ .

Insol in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20, 828.)

Completely pptd from  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  by  $\text{HC}_2\text{H}_3\text{O}_2$ . Sol. to large extent in alcohol.

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1910, 43, 314)

Insol in acetone

+  $2\text{H}_2\text{O}$  Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Conc.  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  may be boiled without decomp., but dil. solutions are decomp. on heating. A solution containing 1 pt. salt to 100 pts  $\text{H}_2\text{O}$  becomes turbid at  $76^\circ$ ; 1 pt. to 200 pts., at  $56^\circ$ ; 1 pt. to 400 pts., at  $47^\circ$ ; 1 pt. to 800 pts., at  $40^\circ$ ; 1 pt. to 1000 pts., at  $38^\circ$ ; 1 pt. to 10,000 pts., at  $14^\circ$ . (Scheerer.)

+  $9\text{H}_2\text{O}$ . Min. *Cogumbe*.

81.43 pts. are sol in 1857 pts  $\text{H}_2\text{O}$ . (Wirth, Z. anorg. 1914, 87, 23)

This salt is stable at  $25^\circ$  only in contact with solutions in which the molecular ratio  $\text{Fe}_2\text{O}_3 : \text{SO}_3$  lies between 1:3.472 and 1:6.699. (Wirth, Z. anorg. 1914, 87, 35.)

+  $10\text{H}_2\text{O}$  Slowly sol in  $\text{H}_2\text{O}$ . (Oudemans, R. t. c. 3, 331.)

Iron (ferroferric) sulphate,  $6\text{FeSO}_4$ ,  $\text{Fe}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}$ .

Sol in all proportions in  $\text{H}_2\text{O}$ . (Poumarède, C. R. 18, 854)

$3\text{FeSO}_4$ ,  $2\text{Fe}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ . Easily sol in dil  $\text{HCl} + \text{Aq}$ . Insol in alcohol. (Abich, 1842.)

$\text{FeSO}_4$ ,  $\text{Fe}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$ . Min. *Voltaite*. Difficulty sol in  $\text{H}_2\text{O}$ .

$\text{FeO}$ ,  $\text{Fe}_2\text{O}_3$ ,  $6\text{SO}_3 + 15\text{H}_2\text{O}$ . Deliquescent. (Lefort, J Pharm. (4) 10, 87)

Iron (ferrous) pyrosulphate,  $\text{FeS}_2\text{O}_7$ .

Deliquescent. Decomp by  $\text{H}_2\text{O}$ . (Bolas, Chem. Soc. (2) 12, 212.)

Iron (ferric) hydrogen sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{H}_2\text{SO}_4 + 8\text{H}_2\text{O}$ .

This salt is in equilibrium at  $25^\circ$  only with solutions where the molecular ratio  $\text{Fe}_2\text{O}_3 : \text{SO}_3$  is more acid than 1:6.699 (Wirth and Bakke, Z. anorg. 1914, 87, 34.)

Sat. solution of  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{H}_2\text{SO}_4 + 8\text{H}_2\text{O}$  in abs. alcohol at  $25^\circ$  contains 8 g  $\text{Fe}_2\text{O}_3 + 17.18$  g.  $\text{SO}_3$  per 100 g. sat. solution. (Wirth and Bakke.)

Decomp. by  $\text{H}_2\text{O}$ . (Recouma, C. R. 1903, 137, 118.)

In contact with solutions containing 25% to 28%  $\text{SO}_3$  at  $25^\circ$ , the stable solid is  $\text{Fe}_2\text{O}_3$ ,  $3\text{SO}_3 + 10\text{H}_2\text{O}$ . In contact with solutions containing more than 28%, the stable solid is  $\text{Fe}_2\text{O}_3$ ,  $4\text{SO}_3 + 10\text{H}_2\text{O}$  (Cameron and Robinson, J. phys. Chem 1907, 11, 650.)

Iron (ferroferric) hydrogen sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{FeSO}_4$ ,  $2\text{H}_2\text{SO}_4$ .

Insol. in  $\text{H}_2\text{O}$ , but slowly decomp. thereby. Sol. in  $\text{H}_2\text{SO}_4$ . (Étard, C. R. 87, 602.)

Iron (ferrous) hydrazine sulphate,  $\text{FeH}_2(\text{SO}_4)_2$ ,  $2\text{N}_2\text{H}_4$ .

1 pt. is sol. in 325 pts  $\text{H}_2\text{O}$  at  $12^\circ$ . (Curtius, J. pr. 1894, (2) 50, 331.)

Iron (ferrous) magnesium sulphate,  $\text{FeSO}_4$ ,  $\text{MgSO}_4 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Schiff)

Iron (ferric) magnesium sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{MgSO}_4 + 24\text{H}_2\text{O}$ .

(Bastick)

Iron (ferrous) magnesium potassium sulphate,  $2\text{K}_2\text{SO}_4$ ,  $\text{FeSO}_4$ ,  $\text{MgSO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94, 57.)

Iron (ferric) manganous hydrogen sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $2\text{MnSO}_4$ ,  $\text{H}_2\text{SO}_4$ .

Insol in cold  $\text{H}_2\text{O}$ . (Étard.)

$\text{Fe}_2(\text{SO}_4)_3$ ,  $2\text{MnSO}_4$ ,  $3\text{H}_2\text{SO}_4$ . Sol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 86, 1399.)

Iron (ferric) manganic sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{Mn}_2(\text{SO}_4)_3$ .

Insol in cold  $\text{H}_2\text{O}$ ; decomp. by hot  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$  (Étard.)

Iron (ferrous) manganous potassium sulphate,  $\text{FeSO}_4$ ,  $\text{MnSO}_4$ ,  $2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94, 57)

Iron (ferrous) nickel sulphate,  $2\text{FeSO}_4$ ,  $2\text{NiSO}_4$ ,  $\text{H}_2\text{SO}_4$ .

(Étard, C. R. 87, 602.)

Iron (ferric) nickel sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{NiSO}_4$ ,  $2\text{H}_2\text{SO}_4$ .

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. thereby. (Étard, C. R. 87, 602.)

Iron (ferrous) nickel potassium sulphate,  $\text{FeSO}_4$ ,  $\text{NiSO}_4$ ,  $2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94, 57.)

Iron (ferrous) potassium sulphate,  $\text{FeSO}_4$ ,  $\text{K}_2\text{SO}_4$ .

+  $2\text{H}_2\text{O}$  (Marignac, Ann. Min. (5) 9, 19.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{FeK}_2(\text{SO}_4)_2$	$t^\circ$	% $\text{FeK}_2(\text{SO}_4)_2$
0	5	80	42.34
17	2	90	42.73
40	1	95	41.01
60			

(Kuster and Thiel, Z. anorg. 1899, 21, 116.)

+4H<sub>2</sub>O.Solubility in H<sub>2</sub>O at t°.

t°	% FeK <sub>3</sub> (SO <sub>4</sub> ) <sub>3</sub>	t°	% FeK <sub>3</sub> (SO <sub>4</sub> ) <sub>3</sub>
0 5	22 94	80	40 46
17.2	26.79	90	43 82
40.1	32 41	95	44.11
60	35.68		..

(Küster and Thiel.)

+6H<sub>2</sub>O. 100 pts. H<sub>2</sub>O dissolve at t°:

0°	10°	14.5°	16°	25°
19.6	24.5	29.1	30.9	36.5 pts. anhydrous salt,
35°	40°	55°	65°	70°
41	45	56	59.3	64.2 pts. anhydrous salt.

(Tobler, A. 95. 193.)

Solubility in H<sub>2</sub>O at t°.

t°	% FeK <sub>3</sub> (SO <sub>4</sub> ) <sub>3</sub>	t°	% FeK <sub>3</sub> (SO <sub>4</sub> ) <sub>3</sub>
0 5	18.36	60	42 93
17.2	25 16	80	45 29
40.1	33.72		..

(Küster and Thiel.)

Iron (ferric) potassium sulphate, basic, 4Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, 7SO<sub>3</sub>+9H<sub>2</sub>O=4(Fe<sub>2</sub>O<sub>3</sub>, 2H<sub>2</sub>O, SO<sub>3</sub>), K<sub>2</sub>SO<sub>4</sub>+7H<sub>2</sub>O.

Insol. in boiling H<sub>2</sub>O. Sl. sol. in HCl+aq. more readily in aqua regia. (Rammelsberg.) 3Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, 4SO<sub>3</sub>+6H<sub>2</sub>O=K(FeO)<sub>3</sub>(SO<sub>4</sub>)<sub>2</sub>+3H<sub>2</sub>O. Min. *Jarosite*.

Fe<sub>2</sub>O<sub>3</sub>, H<sub>2</sub>O, 3SO<sub>3</sub>, 2K<sub>2</sub>SO<sub>4</sub>+5H<sub>2</sub>O. Sol. in 6 pts. cold H<sub>2</sub>O. Solution soon decomposes. (Maus, Pogg. 11. 78.)

Sol. in 12.5 pts. H<sub>2</sub>O at 10°. (Anthon, Report. 76. 361.)

Formula is given as 3Fe<sub>2</sub>O<sub>3</sub>, 5K<sub>2</sub>O, 12SO<sub>3</sub>+18H<sub>2</sub>O by Marignac.

3Fe<sub>2</sub>O<sub>3</sub>, 6SO<sub>3</sub>, 2K<sub>2</sub>SO<sub>4</sub>+22H<sub>2</sub>O. Sol. when moist in H<sub>2</sub>O. Solution soon decomposes. Insol. in alcohol. (Soubeiran, A. ch. 44. 329.)

3Fe<sub>2</sub>O<sub>3</sub>, 7SO<sub>3</sub>, 5K<sub>2</sub>SO<sub>4</sub>+12H<sub>2</sub>O, and +17H<sub>2</sub>O. (Scheerer, Pogg. 87. 81.)

2Fe<sub>2</sub>O<sub>3</sub>, 5SO<sub>3</sub>, 3K<sub>2</sub>SO<sub>4</sub>+9H<sub>2</sub>O. (S.)

3Fe<sub>2</sub>O<sub>3</sub>, 8SO<sub>3</sub>, 4K<sub>2</sub>SO<sub>4</sub>+20H<sub>2</sub>O and 24H<sub>2</sub>O. (S.)

Iron (ferric) potassium sulphate, K<sub>2</sub>SO<sub>4</sub>, 2Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Insol. in H<sub>2</sub>O, but is gradually decomp. thereby. (Grimm and Ramdohr, A. 98. 127.)

+2H<sub>2</sub>O. Nearly insol. in H<sub>2</sub>O. (Weinland, Z. anorg. 1913, 84. 364.)

K<sub>2</sub>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+24H<sub>2</sub>O. *Iron alum*.

Sol. in 5 pts. H<sub>2</sub>O at 12.5°. (Anthon.)

Aqueous solution is decomp. by heating.

Insol. in alcohol.

Sp. gr. of aqueous solution. According to

G=Gerlach, at 16° (Z. anal. 28. 496); F=Franz, at 17.5° (J. pr. (2) 5. 288), containing:

5 10 15% K<sub>2</sub>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+24H<sub>2</sub>O,

F 1.0268 1.0466 1.0672

G 1.025 1.0507 1.0773

20 25 30% K<sub>2</sub>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+24H<sub>2</sub>O,

F 1.0894 1.1136 1.1422

G 1.1050 1.1340 1.1645

35 % K<sub>2</sub>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+24H<sub>2</sub>O.

G 1.1967.

Melts in crystal H<sub>2</sub>O at 28°. (Locke, Am. Ch. J. 1901, 26. 183.)

Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3K<sub>2</sub>SO<sub>4</sub>. Insol. in H<sub>2</sub>O, but slowly decomp. thereby. (Etard, C. R. 84. 1089.)

Iron (ferric) potassium sulphate sulphite.

See Sulphite sulphate, ferric potassium.

Iron (ferrous) potassium zinc sulphate, FeSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O.

Iron (ferrous) rubidium sulphate, FeSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O (Tutton, Chem. Soc. 63. 337.)

1 l H<sub>2</sub>O dissolves 242 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

Iron (ferric) rubidium sulphate, Rb<sub>2</sub>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+24H<sub>2</sub>O.

Solubility in H<sub>2</sub>O.

Temp.	G per litre	Gram mols. of anhydrous salt per litre
25	97 4	0 294
30	202 4	0 617
35	Basic salt formed	..

(Locke, Am. Ch. J. 1901, 26. 180.)

Iron (ferrous) sodium sulphate, FeSO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>+4H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac, Ann. Min. (5) 9. 25.)

Solubility of FeNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in 100 g H<sub>2</sub>O at t°

t°	Grams FeSO <sub>4</sub>	Grams Na <sub>2</sub> SO <sub>4</sub>
21.8	24 34	22.51
24.92	23 62	22 04
34 95	23 91	21 83
40	24 01	22 62

(Koppel, Z. phys. Ch. 1905, 52. 406.)

Solubility of  $\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	grams $\text{FeSO}_4$	grams $\text{Na}_2\text{SO}_4$	$t^\circ$	grams $\text{FeSO}_4$	grams $\text{Na}_2\text{SO}_4$
18.8	26.63	20.28	31°	33.99	14.41
23	28.82	18.40	35°	35.66	13.85
27	30.95	16.68	40°	39.98	11.92

(Koppel.)

Solubility of  $\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	grams $\text{FeSO}_4$	grams $\text{Na}_2\text{SO}_4$	$t^\circ$	grams $\text{FeSO}_4$	grams $\text{Na}_2\text{SO}_4$
18.8	27.23	22.16	28°	11.28	35.94
23	20.31	26.48	31°	6.95	44.75

(Koppel.)

Solubility of  $\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$  (anhydrous) in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	grams $\text{FeSO}_4$	grams $\text{Na}_2\text{SO}_4$
35	6.16	46.58
40	6.27	46.99

(Koppel.)

See also under  $\text{FeSO}_4$

Iron (ferric) sodium sulphate, basic,  $2\text{Na}_2\text{O} \cdot \text{Fe}_2\text{O}_3 \cdot 4\text{SO}_3 + 7\text{H}_2\text{O}$ .

Only sl. sol. in  $\text{H}_2\text{O}$  with decomp. (Skrabal, Z. anorg. 1904, 38, 319.)  
+  $8\text{H}_2\text{O}$ . Min *Ursubst.* Insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ .

$3\text{Na}_2\text{O} \cdot \text{Fe}_2\text{O}_3 \cdot 6\text{SO}_3 + 6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. (Skrabal.)

$4\text{Fe}_2\text{O}_3 \cdot \text{Na}_2\text{O} \cdot 5\text{SO}_3 + 9\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , difficultly sol. in  $\text{HCl} + \text{Aq}$ . (Scheerer, Pogg. 45, 190.)

Iron (ferric) sodium sulphate,  $[\text{Fe}(\text{SO}_4)_2]\text{Na}_2 + 3\text{H}_2\text{O}$ .

Ppt. Nearly insol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1913, 84, 365.)

Iron (ferrous) thallium sulphate,  $\text{FeSO}_4 \cdot \text{Tl}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Easily decomp. by solution in  $\text{H}_2\text{O}$ . (Willm, A. ch. (4) 5, 56.)

Iron (ferric) thallium sulphate,  $\text{Tl}_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

Not efflorescent. Very easily sol. in  $\text{H}_2\text{O}$ , 361.5 g. anhydrous, or 646 g. hydrated salt are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ , or 0.799 mol. of the anhydrous salt is sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . Melts in crystal  $\text{H}_2\text{O}$  at  $37^\circ$ . (Locke, Am. Ch. J. 1901, 26, 175.)

Iron (ferrous) zinc sulphate,  $\text{FeSO}_4 \cdot \text{ZnSO}_4 + 14\text{H}_2\text{O}$ .

$2\text{FeSO}_4 \cdot 2\text{ZnSO}_4 \cdot \text{H}_2\text{SO}_4$ . (Étard, C. R. 87, 602.)

Iron (ferric) zinc sulphate,  $\text{Fe}_2(\text{SO}_4)_3 \cdot \text{ZnSO}_4 + 24\text{H}_2\text{O}$ .

(Bastick.)

Iron (ferrous) sulphate nitric oxide,  $\text{FeSO}_4 \cdot \text{NO}$ .

The solubility of  $\text{NO}$  in  $\text{FeSO}_4 + \text{Aq}$  is diminished by the presence of  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , phosphoric acid and by the presence of certain salts. (Manchot, A. 1910, 372, 157.)

$\text{Fe}(\text{NO})\text{SO}_4 \cdot \text{FeSO}_4 + 13\text{H}_2\text{O}$ . Decomp. in the air. Sol. in water. (Manchot.)

Lanthanum sulphate, basic,  $2\text{La}_2\text{O}_3 \cdot 3\text{SO}_3 + 3\text{H}_2\text{O}$ .

Precipitate. (Frerichs and Smith.)

Formula is  $3\text{La}_2\text{O}_3 \cdot \text{SO}_3 + x\text{H}_2\text{O}$ . (Cleve, B. 11, 910.)

Lanthanum sulphate,  $\text{La}_2(\text{SO}_4)_3$ .

Anhydrous. Much less sol. in warm than in cold  $\text{H}_2\text{O}$ . 1 pt. is sol. in less than 6 pts  $\text{H}_2\text{O}$ , if added in small portions thereto at  $2-3^\circ$ , and the temperature not allowed to rise to  $13^\circ$ ; but if heated to  $30^\circ$ ,  $\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$  separates out until the solution is solid. (Mosander.)

100 pts.  $\text{H}_2\text{O}$  dissolve 2.208 pts.  $\text{La}_2(\text{SO}_4)_3$  at  $16.5^\circ$ , 2.130 pts. at  $18^\circ$ ; 1.641 pts. at  $34^\circ$ . See also under  $+9\text{H}_2\text{O}$ .

The solubility of  $\text{La}_2(\text{SO}_4)_3$  in  $\text{H}_2\text{O}$  is diminished by the presence of  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_4$ . (Barre, C. R. 1910, 161, 871.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $18^\circ$ .

Pts. per 100 pts. $\text{H}_2\text{O}$		Solid phase
$(\text{NH}_4)_2\text{SO}_4$	$\text{La}_2(\text{SO}_4)_3$	
0.00	2.130	$\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$
4.011	0.393	$\text{La}_2(\text{SO}_4)_3, (\text{NH}_4)_2\text{SO}_4 + 2\text{H}_2\text{O}$
8.727	0.279	"
18.241	0.253	"
27.887	0.476	"
36.112	0.277	"
47.486	0.137	$2\text{La}_2(\text{SO}_4)_3, 5(\text{NH}_4)_2\text{SO}_4$
53.823	0.067	$\text{La}_2(\text{SO}_4)_3, 5(\text{NH}_4)_2\text{SO}_4$
65.286	0.0117	"
73.782	0.0033	"

(Barre.)

Solubility in  $\text{K}_2\text{SO}_4 + \text{Aq}$  at  $16.5^\circ$

Pts. per 100 pts. $\text{H}_2\text{O}$		Solid phase
$\text{K}_2\text{SO}_4$	$\text{La}_2(\text{SO}_4)_3$	
0.00	2.198	$\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$
0.247	0.727	$\text{La}_2(\text{SO}_4)_3, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$
0.496	0.269	"
0.846	0.185	"
1.029	0.054	$\text{La}_2(\text{SO}_4)_3, 5\text{K}_2\text{SO}_4$
1.516	0.022	"

(Barre.)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $18^\circ$ .

Pts per 100 pts $\text{H}_2\text{O}$		Solid phase
$\text{Na}_2\text{SO}_4$	$\text{La}_2(\text{SO}_4)_3$	
0 00	2 130	$\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$
0 395	0 997	$\text{La}_2(\text{SO}_4)_3, \text{Na}_2\text{SO}_4$
0 689	0 353	"
0 774	0 299	"
1 136	0 129	"
2 480	0 044	"
3 802	0 019	"
5 548	0 016	"

(Barre)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 830.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

+  $9\text{H}_2\text{O}$ . Sol. in 42.5 pts.  $\text{H}_2\text{O}$ , calculated as anhydrous salt, at  $23^\circ$ , and 115 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Mosander.)

Solubility in  $\text{H}_2\text{O}$ .

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{La}_2(\text{SO}_4)_3$  at  $t^\circ$ .

$t^\circ$	Pts $\text{La}_2(\text{SO}_4)_3$
0	3.02
14	2.60
30	1.90
50	1.49
75	0.94
100	0.68

(Muthmann and Rohg, B. 1898, 31, 1723.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Normality $\text{H}_2\text{SO}_4$	In 100 g. of the liquid are dissolved		Solid phase
	g. oxide	g sulphate	
0	1.43	2.483	$\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$
0.505	1 69	2 934	"
1 10	1.796	3 118	"
2 16	1 818	3.156	"
3 39	1.42	2.465	"
4 321	1 11	1.927	"
6 685	0 5309	0 9217	"
9 68	0 2659	0 4617	"
12 60	0 2136	0 3709	"
15 15	0.177	0 3073	"

(Wuth, Z anorg 1912, 76, 189)

Lanthanum hydrogen sulphate,  $\text{La}(\text{SO}_4\text{H})_3$ . (Brauner, Z. anorg. 1904, 38, 330.)

Lanthanum potassium sulphate,  $\text{La}_2(\text{SO}_4)_3, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

$\text{La}_2(\text{SO}_4)_3, 5\text{K}_2\text{SO}_4$ . (Barre, C. R. 1910, 151, 872.)

$\text{La}_2(\text{SO}_4)_3, 3\text{K}_2\text{SO}_4$ . Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ . (Cleve.)

$\text{La}_2(\text{SO}_4)_3, 4\text{K}_2\text{SO}_4$ . As above. (Cleve.)

$2\text{La}_2(\text{SO}_4)_3, 9\text{K}_2\text{SO}_4$ . As above. (Cleve.)

## Lanthanum rubidium sulphate,

$\text{La}_2(\text{SO}_4)_3, \text{Rb}_2\text{SO}_4$ .

(Baskerville, J. Am. Chem. Soc. 1904, 26, 67.)

+  $2\text{H}_2\text{O}$ . (Baskerville.)

$3\text{La}_2(\text{SO}_4)_3, 2\text{Rb}_2\text{SO}_4$ . (Baskerville.)

Lanthanum sodium sulphate,  $\text{La}_2(\text{SO}_4)_3, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.) (Barre, C. R. 1910, 151, 872.)

Lead sulphate, basic,  $2\text{PbO}, \text{SO}_3$ .

Not completely insol. in  $\text{H}_2\text{O}$ . Decomp. by acids, even dil.  $\text{HCl}, \text{H}_2\text{O}_2 + \text{Aq}$ , with formation of  $\text{PbSO}_4$ . (Barford, 1889.)

0.060 millimole calc. as  $\text{Pb}$  is sol. in 1 l.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner, C. C. 1907, II, 1056.)

$5\text{PbO}, 3\text{SO}_3$ . (Frankland, Proc Roy Soc 46, 364.)

$\text{Pb}_3\text{O}_4, 2\text{SO}_3$ . (Frankland.)

$3\text{PbO}, \text{PbSO}_4 + \text{H}_2\text{O}$ . Ppt. (Strömholm, Z. anorg. 1904, 38, 442.)

$\text{Pb}_2(\text{SO}_4)(\text{OH})_2$ . 0.106 millimole calc. as  $\text{Pb}$  is sol. in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner, C. C. 1907, II, 1056.)

Lead sulphate,  $\text{PbSO}_4$ .

Sol. in 22,816 pts.  $\text{H}_2\text{O}$  at  $11^\circ$ . (Fresenius, A. 59, 125.)

Sol. in 31,569 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Rodwell, C. N. 11, 50.)

Sol. in 13,000 pts.  $\text{H}_2\text{O}$ . (Kremers, Pogg. 85, 247.)

Calculated from electrical conductivity of  $\text{PbSO}_4 + \text{Aq}$ , 1 l.  $\text{H}_2\text{O}$  dissolves 46 mg.  $\text{PbSO}_4$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12, 241.)

\*  $4.23 \times 10^{-3}$  gr. are dissolved in 1 liter of sat. solution at  $20^\circ$ ;  $4.41 \times 10^{-3}$  at  $25^\circ$ . (Böttger, Z. phys. Ch. 1903, 46, 604.)

1 l.  $\text{H}_2\text{O}$  dissolves 41 mg.  $\text{PbSO}_4$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50, 356.)

0.126 millimole  $\text{Pb}$  is sol. in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner C. C. 1907, II, 1056.)

40 mg. are dissolved in 1 l. of sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64, 168.)

0.0824 g.  $\text{PbSO}_4$  is sol. in 1000 cc.  $\text{H}_2\text{O}$  at  $18^\circ$  and also at  $100^\circ$ . The fact that  $\text{PbSO}_4$  dissolves in  $\text{H}_2\text{O}$  is ascribed to hydrolysis, and in support of this it is shown that the solubility of hydrated oxide of lead,  $\text{PbO}, \text{H}_2\text{O}$ , in dil.  $\text{H}_2\text{SO}_4$  is the same as the solubility of  $\text{PbSO}_4$  in  $\text{H}_2\text{O}$ . (Schnal, C. R. 1909, 148, 1395.)

1 l.  $\text{H}_2\text{O}$  dissolves 26 mg. at  $18^\circ$ ; 30 mg. at  $25^\circ$ ; 38 mg. at  $37^\circ$ . (Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, 34, 447.)

Solubility in  $H_2O$  at  $t^\circ$ .  
(Millimols per l)

$t^\circ$	$PbSO_4$
18	0 126
25	0 144
37	0 183

(Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, 34. 446.)

Sol. in hot conc.  $HCl + Aq.$  (Fresenius.)

Solubility of  $PbSO_4$  in  $HCl + Aq$

Sp. gr. of $HCl + Aq$	% $HCl$ in $HCl + Aq$	Pts $HCl + Aq$ for 1 pt. $PbSO_4$
1 0519	10 602	681 89
1 0800	16 310	281 73
1.1070	22.010	105 65
1 1359	27 525	47 30
1 1570	31 602	35 03

(Rodwell, Chem. Soc. 15. 59.)

Solubility of  $PbSO_4$  in  $HCl + Aq$  at  $t^\circ$ .  
(Millimols. per l)

$t^\circ$	0.1N	0.2N	0.3N	0.4N
18	0 126	1 72	2 67	3 63
25	0 144	2 07	3 14	4 29
37	0 183	2 63	4 06	5 43

(Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, 34. 446.)

Above measurements in  $HCl + Aq$  show solubility directly proportional to the hydrogen ions (Beck and Stegmüller.)

Sol. in  $HNO_3 + Aq.$  and more sol. in hot or conc. than in cold or dil.  $HNO_3 + Aq.$

Sol. in 172 pts.  $HNO_3 + Aq$  of 1 144 sp. gr. at  $12.5^\circ$ . (Bischof.)

Pptd. from  $HNO_3$  solution by dil.  $H_2SO_4 + Aq$  and not by  $H_2O$ . (Bischof, 1827.)

Solubility of  $PbSO_4$  in  $HNO_3 + Aq$

Sp. gr. of $HNO_3 + Aq$	% $HNO_3$ in $HNO_3 + Aq$	Pts $HNO_3 + Aq$ for 1 pt. $PbSO_4$
1 079	11 55	303 10
1.123	17.50	173 75
1.250	34.00	127 48
1 420	60 00	10282 78

(Rodwell, Chem. Soc. 15. 59.)

Solubility in  $HNO_3$  at  $18^\circ$ .  
(Millimols per l)

$HNO_3$	$PbSO_4$
0.1N	0.506
0.2N	0.844
0.3N	1.13
0.4N	1.44

(Beck and Stegmüller)

Sol. in 36,504 pts. dil.  $H_2SO_4 + Aq.$  (Fresenius.) See also under solubility in alcohol. Sl. sol. in conc.  $H_2SO_4$ , from which it is partially pptd. by  $H_2O$  or completely by alcohol (Fresenius.)

100 pts conc.  $H_2SO_4$  dissolve 6 pts.  $PbSO_4$ . (Schultz, Pogg. 133. 137.)

Conc.  $H_2SO_4$  dissolves 0 005 pt.  $PbSO_4$ . (Ure)

100 pts  $H_2SO_4$  dissolve 0 13 pt.  $PbSO_4$ , and 100 pts fuming  $H_2SO_4$  dissolve 4.19 pts. (Struve, Z anal 9. 31.)

More sol in commercial  $H_2SO_4$  than in the more conc. acid. (Hayes)

100 pts  $H_2SO_4 + Aq$  of 1 841 sp. gr. dissolve 0 039 pts  $PbSO_4$ ; of 1.793 sp. gr. dissolve 0.011 pt  $PbSO_4$ ; of 1.540 sp. gr. dissolve 0 003 pt  $PbSO_4$ .

Presence of  $SO_2$  does not increase the solubility;  $HNO_3$  increases the solubility somewhat, i. e., 100 pts  $H_2SO_4 + Aq$  of 1.841 sp. gr. with 5 pts  $HNO_3$  of 1.352 sp. gr. dissolve 0 044 pt  $PbSO_4$ ; 100 pts  $H_2SO_4$  of 1.749 sp. gr. with 5 pts  $HNO_3$  of 1.352 sp. gr. dissolve 0.014 pt  $PbSO_4$ ; 100 pts  $H_2SO_4$  of 1.512 sp. gr. with 5 pts  $HNO_3$  of 1.352 sp. gr. dissolve only a trace

Nitrous oxides do not increase the action. (Kolb, Dingl. 209. 268.)

Solubility in dil.  $H_2SO_4 + Aq$  at  $18^\circ$ .  
(G. per l.)

$H_2SO_4$	$PbSO_4$	$H_2SO_4$	$PbSO_4$
0	0.0382	0 0245	0 0194
0.0049	0.0333	0 0490	0 0130
0 0098	0.0306	0 4904	0.0052

(Plessner, Arb. K. Gesund. Amt. 1907, 26. 384.)

A trace of  $H_2SO_4$  has a considerable effect in reducing the solubility of  $PbSO_4$  in  $H_2O$ . (Sehnal, C. R. 1909, 148. 1395.)

Solubility in dil.  $H_2SO_4 + Aq$  at  $20^\circ$ .  
(G. per l.)

$H_2SO_4$	$PbSO_4$	$H_2SO_4$	$PbSO_4$
0	0.082	0 0980	0.013
0 0098	0.051	0 4900	0 006
0 0196	0 025	0 9800	0

(Sehnal.)

Pptd. from solution in  $H_2SO_4$  by  $HCl$ . (Bolley, A. 91. 113.)

Not more insol. in dil.  $HC_2H_3O_2 + Aq$  than in  $H_2O$ . (Bischof.)

Solubility in other acids is prevented by great excess of  $H_2SO_4$ . (Wackenroder)

Sol. in warm  $NH_4OH + Aq$ , separating on cooling. Completely sol in warm  $KOH$  or  $NaOH + Aq$ .

Decomp. by boiling with  $K_2CO_3$ ,  $Na_2CO_3$ , and  $(NH_4)_2CO_3 + Aq$ .

Sol in  $NH_4$  salts + Aq, but reprecip. by  $H_2SO_4 + Aq$ . (Fresenius, A. 59, 125)

The best solvents of the  $NH_4$  salts are the nitrate, citrate, and tartrate; the two latter should be strongly alkaline with  $NH_4OH + Aq$  (Wackenroder)

Sol. in  $NH_4Cl + Aq$  at 12.5–25°.

Sl. decomp. by  $NaCl + Aq$  (Bley)

1 l. sat.  $NaCl + Aq$  dissolves 0.66 g  $PbSO_4$ . (Bequerel.)

Sol. in 100 pts. cold conc.  $NaCl + Aq$ , and  $PbCl_2$  is deposited after a few hours (Field)

Solubility of  $PbSO_4$  in  $NaCl + Aq$  at 18°.  
(Millimols per l)

NaCl	$PbSO_4$
0.1N	0.546
0.2N	0.904
0.3N	1.28
0.4N	1.68

(Beck and Stegmüller, Arb. h. Gesund. Amt 1910, 84, 446)

Sol in  $Fe_2Cl_6 + Aq$ . (Fresenius, Z. anal. 18, 419)

Sol in  $Na_2S_2O_3 + Aq$  (Lowe)

Sol in  $(NH_4)_2SO_4 + Aq$ . (Rose)

Solubility of  $PbSO_4 + PbSO_4$ ,  $K_2SO_4$  in  $H_2O$

°	$K_2SO_4$		Solid phase
	g in 100 cc of solution	Mol in 100 cc of solution	
0	0.195	0.0112	$K_2SO_4$ , $PbSO_4 + PbSO_4$
22	0.396	0.0227	" "

(Brønsted, Z. phys. Ch. 1911, 77, 316.)

Sol in 47 pts  $NH_4C_2H_3O_2 + Aq$  1.036 sp. gr., and 969 pts  $NH_4NO_3 + Aq$  (1.269 sp. gr.) ; from the solution in  $NH_4C_2H_3O_2$  it is pptd by  $H_2SO_4$  or  $K_2SO_4$ ; from solution in  $NH_4NO_3$  by  $K_2SO_4$ , but not by  $H_2SO_4$ . (Busch.)

Sol. in acetates of  $NH_4$ , Na, K, Ca, Al, and Mg. (Mercer.)

Solubility in  $NH_4C_2H_3O_2 + Aq$  Excess of  $PbSO_4$  was boiled with solution of  $NH_4C_2H_3O_2 + Aq$  of varying conc

G. $NH_4C_2H_3O_2$ in 100 cc	g $PbSO_4$ contained in 5 cc solution		
	Hot	Cooled	Cooled 24 hrs
28	0.356		
30	0.418		0.224
32	0.494	0.451	0.242
35	0.513	0.452	
37	0.529		0.238
40	0.539		0.293
45	0.555	0.488	

(Dunnington and Long, Am. Ch. J. 1899, 22, 218.)

Solubility in ammonium acetate + Aq at 25°.

$NH_4C_2H_3O_2$ Millimol. per l	Solubility of $PbSO_4$	
	Millimols per l	g. per l
0.0	0.134	0.041
103.5	2.10	0.636
207.1	4.55	1.38
414.1	10.10	3.06

(Noyes and Whitcomb, J. Am. Chem. Soc. 1905, 27, 756.)

Solubility in  $KC_2H_3O_2 + Aq$  at 25°.

Solid phase,  $PbSO_4 + PbK_2(SO_4)_2$ .

Composition of the solutions

$KC_2H_3O_2$	$Pb(C_2H_3O_2)_2$	$KC_2H_3O_2$	$Pb(C_2H_3O_2)_2$
4.33	2.54	26.58	9.83
9.03	3.55	28.82	11.40
17.81	5.43	28.93	19.41
22.07	5.95		

(Fox, Chem. Soc. 1909, 95, 887.)

100 pts  $H_2O$  containing a drop of  $HCl + H_2O_2$  and 2.05 pts  $NaC_2H_3O_2$  dissolve 0.054 pt  $PbSO_4$ , containing 8.2 pts  $NaC_2H_3O_2$  dissolve 0.900 pt.  $PbSO_4$ ; containing 41.0 pts  $NaC_2H_3O_2$  dissolve 11.200 pts  $PbSO_4$ . (Dibbitts, Z. anal. 1874, 13, 139)

Solubility in  $NaC_2H_3O_2 + Aq$  at 25°.

Composition of the solutions

% Na acetate	% Pb acetate	% $Na_2SO_4$	% $H_2O$
6.69	0.78	0.34	92.19
11.76	2.73	1.26	84.25
16.90	5.70	2.49	74.91
19.92	8.24	3.60	68.24
21.51	10.75	4.68	63.10
6.95	0.81	0.35	91.90

The proportion of sulphate in solution in each case corresponded with the amount of Pb present, but was calculated to sodium sulphate, since  $Na_2SO_4 + 10H_2O$  cryst. from the solutions on cooling. The solid phase in these solutions was  $PbSO_4$ .

(Fox, Chem. Soc. 1909, 95, 887.)

Sol. in  $Mn(C_2H_3O_2)_2$ ,  $Zn(C_2H_3O_2)_2$ ,  $Ni(C_2H_3O_2)_2$ , and  $Cu(C_2H_3O_2)_2$ , but not in  $Hg(C_2H_3O_2)_2$  or  $Ag(C_2H_3O_2)_2$

Solubility in  $KC_2H_3O_2 + Aq$  is not less than that in  $NaC_2H_3O_2 + Aq$ . (Dibbitts, Z. anal. 13, 137)

Insol in  $Pb(C_2H_3O_2)_2 + Aq$  (Smith.)

Sol. in basic lead acetate + Aq, but not in neutral  $Pb(C_2H_3O_2)_2 + Aq$ . (Stammer, Z. anal. 23, 67)

12.2 pts  $Ca(C_2H_3O_2)_2$  in very dil. solution dissolve 1 pt  $PbSO_4$ . (Stadel, Z. anal. 2, 180)

Sol in  $Al(C_2H_3O_2)_3 + Aq$  (Lennsen)

Very easily and abundantly sol in  $\text{NH}_4$  tartrate + Aq. (Wöhler, A 34. 235)

Even when native, easily sol. in  $\text{NH}_4$  citrate + Aq. (Smith.) •

Insol in alcohol (18%) and  $\text{H}_2\text{SO}_4$  when  $\text{NH}_4$  acetate, K tartrate, or  $\text{NH}_4$  succinate are present. Insol in alcohol (18%) and  $\text{H}_2\text{SO}_4$  or  $(\text{NH}_4)_2\text{SO}_4$  when Na acetate, Na or  $\text{NH}_4$  oxalate are present. Sol. in  $\text{NH}_4$  dicitrate and K tricitrate in presence of  $\text{H}_2\text{SO}_4$ , in  $\text{NH}_4$  succinate and  $\text{NH}_4$  acetate in presence of  $(\text{NH}_4)_2\text{SO}_4$ ; and in  $\text{NH}_4$  citrate in presence of  $\text{H}_2\text{SO}_4$  or  $(\text{NH}_4)_2\text{SO}_4$  (Storer, C. N. 21. 17)

Alcohol (59%) alone, or with ethylsulphuric acid or sugar, does not dissolve Pb by 3 months action. (Storer)

Insol. in acetone. (Naumann, B. 1904, 37. 4329), methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate (Naumann, B. 1910, 43. 314.)

Min. Anglesite Sol in cold citric acid + Aq. (Bolton, C. N. 37. 14)

Lead hydrogen sulphate,  $\text{PbSO}_4 \cdot \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$ .

Decomp by  $\text{H}_2\text{O}$ .

Lead pyrosulphate,  $\text{Pb S}_2\text{O}_7$

Decomp. by  $\text{H}_2\text{O}$ . (Schultz.)

Lead potassium sulphate,  $\text{PbSO}_4 \cdot \text{K}_2\text{SO}_4$ .

When  $\text{PbSO}_4$  is added to potassium acetate + Aq at  $25^\circ$  a double salt,  $\text{PbK}_2(\text{SO}_4)_2$  is formed. This salt is insol. in the solution which contains only potassium acetate and lead acetate. (Fox, Chem. Soc 1909, 95. 882.)

Decomp. by  $\text{H}_2\text{O}$ . Stable only in solutions of  $\text{K}_2\text{SO}_4$  containing at least 0.56%  $\text{K}_2\text{SO}_4$  at  $7^\circ$ ; 0.62% at  $17^\circ$ ; 1.09% at  $50^\circ$ ; 1.37% at  $75^\circ$ ; 1.69% at  $100^\circ$ . (Barre, C R 1909, 149. 294)

Lead sulphate chloride,  $\text{PbSO}_4 \cdot 2\text{PbCl}_2 + \text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$  or  $\text{NaCl}$  + Aq (Becquerel, C. R 20. 1523)

Lead sulphate fluoride,  $\text{PbSO}_4 \cdot 2\text{PbF}_2$ .

Not decomp by  $\text{H}_2\text{SO}_4$ . (Lonyet, C. R 24. 434)

Lithium sulphate,  $\text{Li}_2\text{SO}_4$ .

More sol. in cold than in hot  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 34.6 pts  $\text{Li}_2\text{SO}_4$  at  $18^\circ$  (Wittstein.)

100 pts.  $\text{H}_2\text{O}$  dissolve pts  $\text{Li}_2\text{SO}_4$  at  $t^\circ$

$t^\circ$	Pts. $\text{Li}_2\text{SO}_4$	$t^\circ$	Pts. $\text{Li}_2\text{SO}_4$	$t^\circ$	Pts. $\text{Li}_2\text{SO}_4$
0	35.34	45	32.38	100	29.24
20	34.36	65	30.3		

(Kremers, Pogg. 95. 468)

Sat.  $\text{Li}_2\text{SO}_4$  + Aq contains at:

$-20^\circ$   $-16^\circ$   $-15^\circ$   $-12^\circ$   
18.4 22.5 22.6 24.4 %  $\text{Li}_2\text{SO}_4$ .

$-4^\circ$   $+15^\circ$   $+90^\circ$   
25.7 25.3 23.9 %  $\text{Li}_2\text{SO}_4$ .  
(Étard, A. ch. 1894, (7) 2. 547.)

Sat. solution boils at  $105^\circ$ . (Kremers.)

Sp. gr. of  $\text{Li}_2\text{SO}_4$  + Aq at  $19.5^\circ$  containing:

6.5 7.4 12.5 15.3 %  $\text{Li}_2\text{SO}_4$ ,  
1.05 1.06 1.098 1.118

22.6 24.4 29.4 %  $\text{Li}_2\text{SO}_4$ .  
1.167 1.178 1.208

(Kremers, Pogg. 114. 47.)

Sp. gr. of  $\text{Li}_2\text{SO}_4$  + Aq at  $15^\circ$  containing 5%  
 $\text{Li}_2\text{SO}_4 = 1.0430$ , 10%  $\text{Li}_2\text{SO}_4 = 1.0877$ .  
(Kohlrausch, W. Ann 1879. 1)

Sp. gr. of  $\text{Li}_2\text{SO}_4$  + Aq at  $25^\circ$ .

Concentration of $\text{Li}_2\text{SO}_4$ + Aq	Sp. gr.
1—normal	1.0453
$\frac{1}{2}$ —"	1.0234
$\frac{1}{4}$ —"	1.0115
$\frac{1}{8}$ —"	1.0057

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Sp. gr. of  $\text{Li}_2\text{SO}_4$  + Aq.

$\frac{1}{2}$ $\text{Li}_2\text{SO}_4$ g in 1000 g of solution	Sp. gr. $16^\circ/16^\circ$
0	1.000000
2.9198	1.002589
16.0461	1.014093

(Dijken, Z. phys. Ch. 1897, 24. 109)

Sp. gr. of  $\text{Li}_2\text{SO}_4$  + Aq at  $20^\circ$ .

Normality of $\text{Li}_2\text{SO}_4$ + Aq	% $\text{Li}_2\text{SO}_4$	Sp. gr.
2.60	23.48	1.2330
1.96	18.53	1.1650
1.708	16.41	1.1449
1.320	13.01	1.1133
0.747	7.71	1.0678

(Forchheimer, Z. phys. Ch 1900, 34. 24)

Insol. in  $\text{SO}_3$ . (Weber, B 17. 2497.)

10 cm. of sat.  $\text{Li}_2\text{SO}_4$  in absolute  $\text{H}_2\text{SO}_4$  contain approx 2.719 g.  $\text{Li}_2\text{SO}_4$ . (Bergius, Z. phys. Ch 1910, 72. 355.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt $\text{H}_2\text{SO}_4$	% by wt $\text{Li}_2\text{SO}_4$	
5.05	22.74	$\text{Li}_2\text{SO}_4, \text{H}_2\text{O}$
12.23	20.45	
15.37	19.11	
16.60	19.10	
32.70	13.37	
36.90	11.90	
42.98	10.57	
48.00	10.20	
52.72	11.44	
54.54	12.92	
55.08	13.69	$\text{Li}_2\text{SO}_4$
56.30	13.87	
61.46	17.10	$\text{Li}_2\text{SO}_4, \text{H}_2\text{SO}_4$
61.82	17.00	
62.14	17.97	
62.49	18.89	
65.70	16.55	
69.40	13.75	
77.30	11.31	
78.23	11.64	
81.20	13.28	
81.70	13.85	
82.30	15.50	
83.43	15.65	

(Van Dorp, Z. phys. Ch. 1910, **73**, 289.)

Solution in  $\text{H}_2\text{SO}_4$  contains 17.2%  $\text{Li}_2\text{SO}_4$  at  $30^\circ$  (Van Dorp, Z. phys. Ch. 1913, **86**, 112)

Solubility of  $\text{Li}_2\text{SO}_4 + \text{Th}(\text{SO}_4)_2$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

Solid phase,  $\text{Th}(\text{SO}_4)_2$ .  
G in 100 g.  $\text{H}_2\text{O}$

$\text{Li}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$	$\text{Li}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$
0.0	1.722	11.13	11.05
2.57	4.13	13.18	12.54
4.93	6.20	16.12	14.52
6.98	7.95	20.49	16.92
9.23	9.68	16.92	18.87

(Barre, Bull. Soc. 1912, (4) **11**, 647.)

Easily sol (Kastner), sl. sol (Berzelius) in alcohol

Solubility of  $\text{Li}_2\text{SO}_4$  in alcohol + Aq at  $30^\circ$ .Solid phase  $\text{Li}_2\text{SO}_4, \text{H}_2\text{O}$ .

G per 100 g sat. solution			
$\text{C}_2\text{H}_5\text{OH}$	$\text{Li}_2\text{SO}_4$	$\text{C}_2\text{H}_5\text{OH}$	$\text{Li}_2\text{SO}_4$
0	25.1	47.28	3.04
11.75	16.16	55.59	1.22
21.19	11.52	69.39	0.4
29.40	8.17	80.74	0
33.31	6.66	94.11	0

(Schreinemakers and van Dorp, Chem. Weekbl. 1906, **3**, 557.)

Insol. in methyl acetate (Naumann, B. 1909, **42**, 3790), ethyl acetate (Naumann, B. 1904, **37**, 3801); acetone (Eidmann, C. C. 1893, II 1014, Naumann, B. 1904, **37**, 4329).  
+  $\text{H}_2\text{O}$  Very sl. efflorescent. (Rammelsberg.)

Aq. solution contains 25.1%  $\text{Li}_2\text{SO}_4$  at  $30^\circ$ . (Schreinemakers, C. C. 1910, I, 1801); 24.3 g. at  $50^\circ$ . (Schreinemakers and Cocheret, Chem. Weekbl. 1905, **2**, 771.)

Lithium hydrogen sulphate,  $\text{LiHSO}_4$ .

Decomp by  $\text{H}_2\text{O}$   
Cryst. from  $\text{H}_2\text{SO}_4$ . (Gmelin.)  
 $\text{Li}_2\text{H}_2(\text{SO}_4)_2$ . Cryst. from  $\text{H}_2\text{SO}_4$ . (Schultz, Pogg. 133, 137.)  
 $\text{Li}_2\text{SO}_4, 7\text{H}_2\text{SO}_4$ . (Bergius, Z. phys. Ch. 1910, **72**, 355.)

Lithium potassium sulphate,  $\text{Li}_2\text{SO}_4, \text{K}_2\text{SO}_4$ .

This is the only compd of  $\text{Li}_2\text{SO}_4$  and  $\text{K}_2\text{SO}_4$  which exists below  $100^\circ$ . (Spielrein, C. R. 1913, **157**, 48.)

$\text{K}_2\text{Li}_2(\text{SO}_4)_2$ . (Knobloch.) Has the formula  $\text{K}_2\text{Li}_2(\text{SO}_4)_2 + 8\text{H}_2\text{O}$ , according to Rammelsberg.

Lithium sodium sulphate,  $\text{Na}_2\text{Li}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ 

$\text{Na}_2\text{Li}_2(\text{SO}_4)_2 + 9\text{H}_2\text{O}$ .  
 $\text{Na}_2\text{Li}_2(\text{SO}_4)_2 + 5\text{H}_2\text{O}$ . (Rammelsberg.)  
Do not exist. (Trost)  
 $\text{Li}_2\text{SO}_4, \text{Na}_2\text{SO}_4 + 5.5\text{H}_2\text{O}$ . Exists from  $0^\circ$ – $16^\circ$ .  
+  $3\text{H}_2\text{O}$ . Exists from  $32^\circ$ – $100^\circ$ .  
 $\text{Li}_2\text{SO}_4, 3\text{Na}_2\text{SO}_4 + 12\text{H}_2\text{O}$ . Exists from  $16^\circ$ – $24^\circ$ .  
 $4\text{Li}_2\text{SO}_4, \text{Na}_2\text{SO}_4 + 5\text{H}_2\text{O}$ . Exists from  $24^\circ$ – $32^\circ$ .

(Spielrein, C. R. 1913, **157**, 47.)Lithium thallic sulphate,  $\text{Li}_3\text{Th}(\text{SO}_4)_3 + 3\text{H}_2\text{O}$ .

(Meyer and Goldschmidt, C. C. 1903, I, 495.)

**Lithium titanium sulphate,**

Less hygroscopic than K compound.  
(Mazzuchelli and Pontanelli, C. C. 1909, II. 420.)

**Lithium uranyl sulphate,  $\text{Li}_2\text{SO}_4 \cdot \text{UO}_2\text{SO}_4 + 4\text{H}_2\text{O}.$** 

(de Coninck, Chem. Soc 1905, 88. (2) 530.)

**Magnesium sulphate basic,**

Sl. sol. in cold or hot  $\text{H}_2\text{O}$

Sol. in  $\text{HCl} + \text{Aq}$  (Thugutt, Z. anorg 1892, 2. 150)

**Magnesium sulphate,  $\text{MgSO}_4.$** 

*Anhydrous.* Very slowly sol. in  $\text{H}_2\text{O}$ , sol in hot conc.  $\text{H}_2\text{SO}_4$ , less in  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$

$+ \text{H}_2\text{O}$ . Min *Kieserite* Easily sol. in warm, but slowly dissolved by cold  $\text{H}_2\text{O}$ .

100 g. sat. solution at  $83^\circ$  contain 40.2 g.  $\text{MgSO}_4$ . (Genger, Dissert 1904.)

$+ 6\text{H}_2\text{O}$ , and  $+ 7\text{H}_2\text{O}$ . The latter exists in two modifications; (a) hexagonal, and (b) the ordinary or rhombic salt.

$\text{MgSO}_4 + \text{Aq}$ , which on cooling or keeping in closed vessels has deposited  $\text{MgSO}_4 + 6\text{H}_2\text{O}$ , always contains for 100 pts  $\text{H}_2\text{O}$  at.

$0^\circ$	$10^\circ$	$20^\circ$
40.75	42.23	43.87 pts. $\text{MgSO}_4$ .

If only hexagonal  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  has been deposited, then the mother liquor contains for 100 pts  $\text{H}_2\text{O}$  at:

$0^\circ$	$10^\circ$	$20^\circ$
34.67	38.71	42.84 pts. $\text{MgSO}_4$ .

Solutions prepared from rhombic  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  contain for 100 pts  $\text{H}_2\text{O}$  at:

$0^\circ$	$10^\circ$	$20^\circ$
26.0	30.9	35.6 pts. $\text{MgSO}_4$ . (Löwel.)

These results may be given in tabular form as follows.

Temp.	A sat aqueous solution of $\text{MgSO}_4 + 7\text{H}_2\text{O}$ (b) contains for 100 pts $\text{H}_2\text{O}$	
	Anhydrous $\text{MgSO}_4$	$7\text{H}_2\text{O}$ (b) salt
$0^\circ$	26.0	73.31
$10^\circ$	30.9	93.75
$20^\circ$	35.6	116.54

Temp	A sat aqueous solution of $\text{MgSO}_4 + 7\text{H}_2\text{O}$ (a) contains for 100 pts $\text{H}_2\text{O}$	
	Anhydrous $\text{MgSO}_4$	$7\text{H}_2\text{O}$ (a) salt
$0^\circ$	34.67	111.74
$10^\circ$	38.71	133.67
$20^\circ$	42.84	159.61

Temp	A sat aqueous solution of $\text{MgSO}_4 + 6\text{H}_2\text{O}$ contains for 100 pts $\text{H}_2\text{O}$		
	Anhydrous $\text{MgSO}_4$	$6\text{H}_2\text{O}$ salt	$7\text{H}_2\text{O}$ salt
$0^\circ$	40.75	122.22	146.02
$10^\circ$	42.32	129.44	155.53
$20^\circ$	43.87	137.72	167.97

It is seen from table that at the same temp. the  $6\text{H}_2\text{O}$  salt is more sol than the  $7\text{H}_2\text{O}$  (b) salt, and the latter is more sol than  $7\text{H}_2\text{O}$  (a) salt; that the solubility of the  $7\text{H}_2\text{O}$  (b) salt increases rapidly from  $0^\circ$  to  $20^\circ$ ; that the  $6\text{H}_2\text{O}$  salt is not much more sol. at  $20^\circ$  than at  $0^\circ$ , and at  $20^\circ$  the  $7\text{H}_2\text{O}$  (b) salt is nearly as sol as the  $6\text{H}_2\text{O}$  salt (Löwel, A. ch. (3) 43. 405)

100 pts  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts.  $\text{MgSO}_4$ . G L—according to Gay Lussac (A. ch. (2) 11 311), T—according to Tobler (A. 95. 198)

$t^\circ$	G L	T	$t^\circ$	G L	T
0	25.8	24.7	50	49.7	
10	30.5		55		52.8
20	35.0		60	55.9	
25		37.1	70	60.1	
30	39.8		80	65.1	
40	45.2		90	70.3	

100 pts  $\text{H}_2\text{O}$  at  $105.5^\circ$  dissolve 135.2 pts.  $\text{MgSO}_4$ . (Griffiths)

$\text{MgSO}_4 + \text{Aq}$  sat at  $17.5^\circ$  has sp. gr. = 1.2932, and contains 55.57 %  $\text{MgSO}_4 + 7\text{H}_2\text{O}$ , or 100 pts  $\text{H}_2\text{O}$  dissolve 125.00 pts.  $\text{MgSO}_4 + 7\text{H}_2\text{O}$ , or 60 pts.  $\text{MgSO}_4$  at  $17.5^\circ$  (Karsten)

100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 53.8 pts., and 125 pts at ord temp. (Otto-Graham)

Sol in 2 pts cold, and 0.5 pt boiling  $\text{H}_2\text{O}$  (Fourcroy.)

The aqueous solution contains for 100 pts.  $\text{H}_2\text{O}$  92.217 pts.  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  at  $15^\circ$  (Michel and Kraft.)

1 pt  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  is sol in 0.933 pt  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach), in 0.82 pt  $\text{H}_2\text{O}$  at  $23^\circ$  (Schiff)

100 pts  $\text{H}_2\text{O}$  dissolve 28.087 pts.  $\text{MgSO}_4$  at  $0^\circ$ . (Pfaff, A. 99 224)

100 pts  $\text{H}_2\text{O}$  dissolve pts.  $\text{MgSO}_4$  at  $t^\circ$ .

$t^\circ$	Pts $\text{MgSO}_4$
0	26.37
17.9	33.28
24.1	35.98

(Dracon, J. B. 1886. 62.)

100 pts.  $\text{MgSO}_4 + \text{Aq}$  sat at  $18-20^\circ$  contain 25.67-26.38 pts.  $\text{MgSO}_4$ . (v. Hauer, J. pr. 98. 137.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ , using  $MgSO_4 + 7H_2O$

$t^\circ$	Pts $MgSO_4$	$t^\circ$	Pts $MgSO_4$	$t^\circ$	Pts $MgSO_4$
0	26.9	37	44.2	74	61.4
1	27.4	38	44.7	75	61.9
2	27.9	39	45.2	76	62.3
3	28.3	40	45.6	77	62.8
4	28.8	41	46.1	78	63.2
5	29.3	42	46.5	79	63.7
6	29.7	43	47.0	80	64.2
7	30.2	44	47.5	81	64.6
8	30.6	45	48.0	82	65.1
9	31.1	46	48.4	83	65.6
10	31.5	47	48.9	84	66.0
11	32.0	48	49.3	85	66.5
12	32.4	49	49.8	86	67.0
13	32.9	50	50.3	87	67.5
14	33.4	51	50.7	88	68.0
15	33.8	52	51.2	89	68.4
16	34.3	53	51.7	90	68.9
17	34.7	54	52.2	91	69.4
18	35.2	55	52.7	92	69.9
19	35.7	56	53.2	93	70.4
20	36.2	57	53.6	94	70.9
21	36.7	58	54.1	95	71.4
22	37.1	59	54.5	96	71.9
23	37.6	60	55.0	97	72.4
24	38.0	61	55.5	98	72.8
25	38.5	62	55.9	99	73.3
26	39.0	63	56.4	100	73.8
27	39.5	64	56.8	101	74.3
28	39.9	65	57.3	102	74.8
29	40.4	66	57.7	103	75.2
30	40.9	67	58.2	104	75.7
31	41.4	68	58.6	105	76.2
32	41.8	69	59.1	106	76.7
33	42.3	70	59.6	107	77.2
34	42.8	71	60.0	108	77.7
35	43.3	72	60.5	108.4	77.9
36	43.7	73	61.0		

(Mulder, calculated from his own and other observations, Scheik Verhandel 1864. 52).

100 pts  $H_2O$  dissolve 72.4 pts.  $MgSO_4 + 7H_2O$  at  $0^\circ$ , 178 pts. at  $40^\circ$ , and 212.6 pts. at  $49^\circ$  (Tilden, Chem. Soc. 46, 409.)

Supersat.  $MgSO_4 + Aq$  is brought to crystallization by addition of crystal of  $MgSO_4 + 7H_2O$ , or an isomorphous substance as  $ZnSO_4 + 7H_2O$ ,  $NiSO_4 + 7H_2O$ ,  $FeSO_4 + 7H_2O$ , or  $CoSO_4 + 7H_2O$  (Thomson, Chem. Soc. 35. 199.)

Sat.  $MgSO_4 + Aq$  contains at:

$2^\circ$   $7^\circ$   $23^\circ$   $67^\circ$   $81^\circ$   
20.9 22.5 26.0 35.6 38.6%  $MgSO_4$ ,

$94^\circ$   $130^\circ$   $145^\circ$   $164^\circ$   $188^\circ$   
41.5 45.3 38.0 29.3 20.4%  $MgSO_4$ .

Readily forms supersat. solutions.

(Etard, A. ch. 1894, (7) 2. 551.)

M.-pt. of  $MgSO_4 + 7H_2O$  is  $70^\circ$ . (Tilden, Chem. Soc. 46. 409.)

$MgSO_4 + Aq$  with sp. gr. 1.30 contains 44.4%  $MgSO_4$ , sp. gr. 1.42, 39%, sp. gr. 1.30, 30%  $MgSO_4$  (Dalton)

Sp. gr. of  $MgSO_4 + Aq$  sat. at  $15^\circ = 1.275$  (Michel and Kraft), at  $8^\circ = 1.267$  (Anthon); at  $18.75^\circ = 1.293$  (Karsten.)

Sp. gr. of  $MgSO_4 + Aq$  at  $15^\circ$ .

% $MgSO_4$	Sp. gr.	% $MgSO_4$	Sp. gr.
5	1.054	30	1.326
10	1.108	35	1.384
15	1.161	40	1.446
20	1.215	45	1.511
25	1.269	50	1.580

(Calculated from Anthon by Schiff, A. 107. 303.)

Sp. gr. of  $MgSO_4 + Aq$  at  $23^\circ$

% $MgSO_4 + 7H_2O$	Sp. gr.	% $MgSO_4 + 7H_2O$	Sp. gr.
1	1.0048	28	1.1426
2	1.0096	29	1.1481
3	1.0144	30	1.1536
4	1.0193	31	1.1592
5	1.0242	32	1.1648
6	1.0290	33	1.1704
7	1.0339	34	1.1760
8	1.0387	35	1.1817
9	1.0437	36	1.1875
10	1.0487	37	1.1933
11	1.0537	38	1.1991
12	1.0587	39	1.2049
13	1.0637	40	1.2108
14	1.0688	41	1.2168
15	1.0739	42	1.2228
16	1.0790	43	1.2288
17	1.0842	44	1.2349
18	1.0894	45	1.2410
19	1.0945	46	1.2472
20	1.0997	47	1.2534
21	1.1050	48	1.2596
22	1.1103	49	1.2659
23	1.1156	50	1.2722
24	1.1209	51	1.2786
25	1.1261	52	1.2850
26	1.1316	53	1.2915
27	1.1371	54	1.2980

(Schiff, A. 113. 185.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $12^\circ$ .

% $\text{MgSO}_4 + 7\text{H}_2\text{O}$	Sp. gr.	% $\text{MgSO}_4 + 7\text{H}_2\text{O}$	Sp. gr.
1	1.0046	21	1.1071
2	1.0096	22	1.1125
3	1.0146	23	1.1179
4	1.0196	24	1.1234
5	1.0246	25	1.1289
6	1.0296	26	1.1344
7	1.0346	27	1.1399
8	1.0396	28	1.1454
9	1.0446	29	1.1510
10	1.0497	30	1.1566
11	1.0548	31	1.1622
12	1.0599	32	1.1679
13	1.0650	33	1.1736
14	1.0702	34	1.1793
15	1.0754	35	1.1850
16	1.0807	36	1.1908
17	1.0859	37	1.1965
18	1.0911	38	1.2023
19	1.0964	39	1.2082
20	1.1018	40	1.2140

(Oudemans, Z. anal. 7. 419.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $15^\circ$ .

% $\text{MgSO}_4$	Sp. gr.	% $\text{MgSO}_4$	Sp. gr.
1	1.01031	14	1.15083
2	1.02002	15	1.16222
3	1.03092	16	1.17420
4	1.04123	17	1.18618
5	1.05154	18	1.19816
6	1.06229	19	1.21014
7	1.07304	20	1.22212
8	1.08379	21	1.23465
9	1.09454	22	1.24718
10	1.10529	23	1.25972
11	1.11608	24	1.27225
12	1.12806	25	1.28478
13	1.13945	25.248	1.28802

(Gerlach, Z. anal. 8. 287.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $23.5^\circ$ . a=no. of  $\frac{1}{2}$  mols. in grms. dissolved in 1000 g.  $\text{H}_2\text{O}$ ; b=sp. gr. if a is  $\text{MgSO}_4 + 7\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol. wt.=123; c=sp. gr. if a is  $\text{MgSO}_4$ ,  $\frac{1}{2}$  mol. wt.=60.

a	b	c	a	b	c
1	1.056	1.059	5	1.203	1.260
2	1.103	1.114	6	1.229	..
3	1.141	1.166	7	1.252	..
4	1.174	1.214	8	1.273	..

(Favre and Valson, C. R. 79. 968.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $15^\circ$ .

% $\text{MgSO}_4$	Sp. gr.	% $\text{MgSO}_4$	Sp. gr.
5	1.0510	20	1.2200
10	1.1052	25	1.2861
15	1.1602		

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $0^\circ$ . S=pts.  $\text{MgSO}_4$  in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
13.800	1.1586	7.4046	1.0826
11.7458	1.1329	5.0447	1.0557
9.6218	1.1072	2.5907	1.0284

(Charpy, A. ch. (6) 29. 26.)

Sat.  $\text{MgSO}_4 + \text{Aq}$  boils at  $105^\circ$  (Griffiths),  $108.4^\circ$  (Mulder).

Crust forms at  $103.5^\circ$  (solution containing 48.4 pts.  $\text{MgSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ ), highest temp. observed,  $105^\circ$  (Gerlach, Z. anal. 26. 426.)

B-pt of  $\text{MgSO}_4 + \text{Aq}$  containing pts.  $\text{MgSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ .

B. pt.	Pts. $\text{MgSO}_4$	B. pt.	Pts. $\text{MgSO}_4$	B. pt.	Pts. $\text{MgSO}_4$
100.5°	8.8	102.5°	34.7	104.5°	51.3
101.0	16.7	103.0	39.5	105	54.6
101.5	23.5	103.5	43.8	108	75(?)
102.0	29.5	104.0	47.7		

(Gerlach, Z. anal. 26. 432.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $9.5^\circ$ .

Mnss of salt per unit mass of solution	Density of solution (g. per cc)
0.00191	1.00170
0.00380	1.00348
0.00569	1.00526
0.00758	1.00705
0.01132	1.01060

(McGregor, C. N. 1887, 55.6.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{MgSO}_4 + \text{Aq}$	Sp. gr.
1—normal	1.0584
$\frac{1}{2}$ —"	1.0297
$\frac{1}{3}$ —"	1.0152
$\frac{1}{4}$ —"	1.0076

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{MgSO}_4 + \text{Aq}$  containing 11.0222%  $\text{MgSO}_4$ , 1.11471, containing 8.343%  $\text{MgSO}_4$ , 1.08558. (Schönrock, Z. phys. Ch. 1893, 11. 782.)

Sp. gr of $\text{MgSO}_4 + \text{Aq.}$		
G.-equivalents $\text{MgSO}_4$ per liter	$t^\circ$	Sp gr $t^\circ/t^\circ$
0.002548	17.989	1.0001625
0.005093	18.020	1.000324
0.01015	17.995	1.000639
0.02023	17.980	1.001274
0.05023	18.047	1.003117
0.09950	18.033	1.006122
0.19773	18.014	1.012035
0.29459	17.997	1.017806
0.48671	17.994	1.029101
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0.5022	17.90	1.03000
5.0220	17.95	1.26970
<hr/>		
0.002616	14.096	1.0001672
0.005230	14.109	1.0003111
0.01042	14.088	1.000659
0.02077	14.092	1.001306
0.12482	14.199	1.007682
0.24567	14.092	1.014980

(Kohlrausch, W. Ann. 1894, 53. 27.)

Sp. gr. of $\text{MgSO}_4 + \text{Aq.}$	
$\frac{1}{2} \text{MgSO}_4$ g. in 1000 g. of solution	Sp gr $16^\circ/16^\circ$
0	1.000000
0.5368	1.000570
1.0917	1.001157
"	1.001141
2.1076	1.002234
4.1367	1.004372
9.0608	1.009523
18.0846	1.018954
37.1342	1.038983
52.1382	1.054867

(Dyken, Z. phys. Ch. 1897, 24. 108.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $18.2^\circ$ , when p = per cent strength of the solution, d = observed density; and w = volume conc. in grams per cc.  $\left(\frac{pd}{100} = w.\right)$

p	d	w
26.25	1.2903	1.3374
25.91	1.2860	1.3319
24.53	1.2693	1.3101
21.60	1.2330	1.2650
18.41	1.1950	1.2187
13.79	1.1423	1.1562
12.63	1.1291	1.1413
11.29	1.1147	1.1246
8.08	1.0803	1.0859
2.01	1.0204	1.0191

(Barnes, J. phys. Chem. 1898, 2. 542.)

Sp. gr. of $\text{MgSO}_4 + \text{Aq}$ at $20^\circ$ .		
Normality of $\text{MgSO}_4 + \text{Aq}$	% $\text{MgSO}_4$	Sp gr
2.73	25.46	1.2879
1.86	18.61	1.2019
0.934	10.14	1.1049
<hr/>		
(Forchheimer, Z. phys. Ch. 1900, 34. 24.)		
Sp gr. of dil. $\text{MgSO}_4 + \text{Aq}$ at $20.004^\circ$ .		
Conc. = g. equiv. per l. at $20.004^\circ$ .		
Sp gr. compared with $\text{H}_2\text{O}$ at $20.004^\circ = 1$ .		
<hr/>		
Conc	Sp. gr	
0.0000	1.000,000,0	
0.0001	1.000,006,4	
0.0002	1.000,012,9	
0.0003	1.000,019,4	
0.0004	1.000,025,9	
0.0005	1.000,032,4	
0.0010	1.000,064,8	
0.0020	1.000,129,4	
0.0050	1.000,322,4	
0.0100	1.000,642,1	

(Lamb and Lee, J. Am. Chem. Soc 1913, 35. 1684.)

More sol in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Richter)

In sat.  $\text{HCl} + \text{Aq}$ , anhydrous  $\text{MgSO}_4$  is scarcely sol.;  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  dissolves, but is precipitated by a current of  $\text{HCl}$  gas. (Hensgen, B. 10. 259.)

Marguerite (C R 43. 50) denies the precipitation.

For solubility in  $\text{H}_2\text{SO}_4$ , see  $\text{MgH}_2(\text{SO}_4)_2$ . Completely pptd from  $\text{MgSO}_4 + \text{Aq}$  by conc.  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  (Persoz.)

Somewhat sol in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  with separation of a double sulphate.

Rapidly sol in  $\text{KCl} + \text{Aq}$  with separation of  $\text{K}_2\text{SO}_4$ .

Sol. in sat.  $\text{NaCl} + \text{Aq}$  without pptn. of the latter.

Easily sol. in sat.  $\text{KNO}_3 + \text{Aq}$  without causing any pptn.

Sol in sat.  $\text{NaNO}_3 + \text{Aq}$ . (Karsten)

Rapidly sol in sat.  $\text{CuSO}_4 + \text{Aq}$ ; when saturation is reached, a double salt separates out. (Karsten.)

100 pts sat.  $\text{MgSO}_4 + \text{NiSO}_4 + \text{Aq}$  at  $18-20^\circ$  contain 30.93 pts. of the two salts; 100 pts. sat.  $\text{MgSO}_4 + \text{ZnSO}_4 + \text{Aq}$  at  $18-20^\circ$  contain 35.45 pts., 100 pts. sat.  $\text{MgSO}_4 + \text{NiSO}_4 + \text{ZnSO}_4 + \text{Aq}$  at  $18-20^\circ$  contain 35.62 pts. (v. Hauer, J. pr. 98. 137.)

100 pts  $\text{H}_2\text{O}$  dissolve 14.1 pts.  $\text{MgSO}_4$  and 9.8 pts  $\text{K}_2\text{SO}_4$ , if sat.  $\text{MgSO}_4 + \text{Aq}$  is sat. with  $\text{K}_2\text{SO}_4$ , 32.4 pts  $\text{MgSO}_4$  and 8.2 pts.  $\text{K}_2\text{SO}_4$ , if sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$  is sat. with  $\text{MgSO}_4$ , all at  $15^\circ$ . (Mulder, J. B. 1866.)

100 pts  $\text{H}_2\text{O}$  dissolve 25.95 pts.  $\text{MgSO}_4$  and 5.21 pts  $\text{Na}_2\text{SO}_4$  at  $0^\circ$ . (Diacon, J. B. 1866. 62)

100 pts.  $H_2O$  dissolve 15.306 pts.  $MgSO_4$  and 13.086 pts.  $Na_2SO_4$  at  $0^\circ$ . (Pfaff, A 99. 224.)

See also under  $MgNa_2(SO_4)_2 + 4H_2O$

Solubility of mixtures of  $MgSO_4$  and  $MgNa_2(SO_4)_2 + 4H_2O$  at  $t^\circ$ .

$t^\circ$	$\kappa$ per 100 g $H_2O$	
	$Na_2SO_4$	$MgSO_4$
22	23 3	31 4
24 5	27 2	24 2
30	36 1	19 1
35	33 9	18 4

(Roozeboom, 1888, Z. phys. Ch. 2. 518.)

See also under  $MgNa_2(SO_4)_2 + 4H_2O$ .

Slowly sol in sat  $ZnSO_4 + Aq$  without pptn until saturation, when a double salt separates out.

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1895, 20. 828.)

100 pts. dil. alcohol containing at  $15^\circ$ :

10 20 40 % alcohol  
contain 39.3 21.3 1.62%  $MgSO_4 + 7H_2O$ .  
(Schiff, A. 118. 365.)

At higher temp. the solubility increases proportional to the temp (Gerardin, A. ch. (4) 5. 145.)

100 pts absolute methyl alcohol dissolve 1.18 pts.  $MgSO_4$  at  $18^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

100 pts absolute methyl alcohol dissolve 41 pts.  $MgSO_4 + 7H_2O$  at  $17^\circ$ ; 100 pts absolute methyl alcohol dissolve 29 pts.  $MgSO_4 + 7H_2O$  at  $3-4^\circ$ , 100 pts. 93% methyl alcohol dissolve 9.7 pts  $MgSO_4 + 7H_2O$  at  $17^\circ$ ; 100 pts. 50% methyl alcohol dissolve 4.1 pts.  $MgSO_4 + 7H_2O$  at  $3-4^\circ$  (de Bruyn, R. t. c. 11. 112.)

100 pts. absolute ethyl alcohol dissolve 1 3 pts  $MgSO_4 + 7H_2O$  at  $3^\circ$  (de Bruyn)

Insol. in  $CS_2$  (Arcetowski, Z. anorg. 1894, 6. 257)

Insol. in methyl acetate (Naumann, B 1909, 42. 3790.), ethyl acetate (Naumann, B 1910, 43. 314.); acetone (Naumann, B 1904, 37. 4320)

100 g. 95% formic acid dissolve 0.34 g.  $MgSO_4$  at  $19^\circ$ . (Aschan, Ch. Ztg. 1913, 37. 1117.)

100 g. sat solution of  $MgSO_4$  and sugar in  $H_2O$  contains 46.52 g. sugar + 14.0 g.  $MgSO_4$ , or 100 g.  $H_2O$  dissolve 119.6 g. sugar + 36.0 g.  $MgSO_4$ . (Kohler, Z. Ver. Zuckerind, 1897, 47. 447.)

**Magnesium hydrogen sulphate,  $MgH_2(SO_4)_2$ .**

Decomp. by  $H_2O$ . Sol. in  $H_2SO_4$ . Insol. in methyl acetate (Naumann, B 1909, 42. 3790.)

$MgH_2(SO_4)_2$ . Boiling  $H_2SO_4$  dissolves about 2%  $MgSO_4$ , from which this compound crystallises. (Schultz, Pogg 133. 437.)

**Magnesium pyrosulphate,  $MgS_2O_7$ .**

Decomp. by  $H_2O$ .

**Magnesium manganous sulphate,  $MgSO_4$ ,  $2MnSO_4 + 15H_2O$ .**

Min. *Fauserite*.

**Magnesium manganous zinc sulphate,  $MgSO_4$ ,  $MnSO_4$ ,  $ZnSO_4 + 21H_2O$**

Sol. in  $H_2O$  (Vohl, A. 99. 124.)

**Magnesium nickel sulphate,  $MgSO_4$ ,  $3NiSO_4 + 28H_2O$ .**

Sol in  $H_2O$ . (Schuff)

**Magnesium nickel potassium sulphate,  $MgSO_4$ ,  $NiSO_4$ ,  $2K_2SO_4 + 12H_2O$ .**

Sol in  $H_2O$ . (Vohl, A. 94. 57.)

**Magnesium potassium sulphate,  $MgK_2(SO_4)_2 + 6H_2O$**

100 pts  $H_2O$  dissolve 22.7 pts. anhydrous salt at  $16.5^\circ$ . (Mulder)

100 pts.  $H_2O$  dissolve at:

$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$	$35^\circ$
14 1	19 6	25.0	30 4	33 3

pts. anhydrous salt,

$45^\circ$	$55^\circ$	$60^\circ$	$65^\circ$	$75^\circ$
40 5	47 0	50 2	53 0	59 8

pts. anhydrous salt.

(Tobler, A. 95. 193.)

100 g.  $H_2O$  dissolve 30.52 g.  $MgK_2(SO_4)_2 + 6H_2O$  at  $15^\circ$ . (Lothian, Pharm. J. 1909, 82. 292.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	Sat. solution contains		Mols $K_2SO_4$ mole $MgSO_4$ in the solution	100 pts. $H_2O$ dissolve	
	% $K_2SO_4$	% $MgSO_4$		$K_2SO_4$	$MgSO_4$
10	9 4	9 8	1 1.52	11.63	12 13
20	10 9	10 8	1 1.43	13 92	13 79
30	12 4	11 8	1 1 38	16 36	15 56
40	13.8	13 1	1 1 37	18 88	17 92
50	14 7	14 8	1 1 46	20 85	20 99
60	15 2	16 3	1 1 55	22 19	23 79
70	15 6	16 8	1 1 52	23 07	24.85
80	16.0	17.1	1 1 56	23 91	25.56
80	16 6	18 1	1 1.58	25 42	27 72
90	17 2	18 2	1 1 54	26 62	28 17

(Precht, B. 1882, 15. 1668.)

Sp. gr. of aqueous solution at 15° containing

2 4 6 8% hydrous salt,  
1 0129 1 0261 1 0394 1 053

10 12 14 16% hydrous salt,  
1 0668 1.0808 1 095 1 1094

18 20 22% hydrous salt.  
1 124 1.1388 1 1539

(Schiff, A. 113. 183, calculated by Gerlach,  
Z. anal. 8. 287.)

Sp. gr. of  $\text{MgK}_2(\text{SO}_4)_2 + \text{Aq}$  at 18°.

G-equiv. of salt per l.	Sp. gr.
1 0010	1 0633
0 8345	1.0531
0.6688	1 0427
0 3744	1 0243
0 0998	1.0040
0 02004	1.0015
0 01004	1.0004

These results lead the author to conclude that in dil. solutions the double salt is decomposed into its constituents. (McKay, Elektrochem. Zeit. 1899, 6. 115.)

Min. *Picromerite*  
+4H<sub>2</sub>O. (van der Heide, B. 26. 414)  
2MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> Min. *Langbeinite*  
Deliquescent Absorbs 56.26% H<sub>2</sub>O from air to form K<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>+6H<sub>2</sub>O (Mallet, Chem. Soc. 1900, 77. 220)  
4MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>+5H<sub>2</sub>O (van't Hoff and Kassatkin, B. A. B. 1889. 951.)

**Magnesium potassium zinc sulphate, MgSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O (Vohl, A. 94. 57.)

**Magnesium potassium chloride, MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, MgCl<sub>2</sub>+6H<sub>2</sub>O.**

Min. *Kainite*.

**Magnesium rubidium sulphate, MgSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O (Tutton, Chem. Soc. 63. 337.)  
1 l H<sub>2</sub>O dissolves 202 g anhydrous salt at 25°. (Loeke, Am. Ch. J. 1902, 27. 459)  
2MgSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub> Deliquescent (Mallet, Chem. Soc. 1900, 77. 223)

**Magnesium sodium sulphate, MgSO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>+4H<sub>2</sub>O.**

Min. *Blödit*, *Simonyite*  
Blödit is efflorescent, Simonyite, deliquescent.  
+5H<sub>2</sub>O. Min. *Léowitz*  
+6H<sub>2</sub>O. Decomps on air. Sol in 3 pts. cold H<sub>2</sub>O.

Na<sub>2</sub>Mg(SO<sub>4</sub>)<sub>2</sub> Min. *Vanthoffite*. (van't Hoff, B. A. B. 1902. 414.)

MgNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O. Min. *Astrakante*.

100 mols. H<sub>2</sub>O hold mols. salt in solution, at t°.

t°	MgSO <sub>4</sub>	Na <sub>2</sub> SO <sub>4</sub>
22	4 70	2 95
24.5	3 68	3 45
30	3 60	3 60
35	3 69	3 69
47	3 60	3 60

(Roozeboom, R. t. c. 1887, 6. 333.)

Solubility of mixtures of  $\text{MgNa}_2(\text{SO}_4)_2 + 4\text{H}_2\text{O}$  and  $\text{Na}_2\text{SO}_4$  at t°

t°	g per 100 g H <sub>2</sub> O	
	Na <sub>2</sub> SO <sub>4</sub>	MgSO <sub>4</sub>
18 5	43 0	45 5
22	35 2	48.9
24 5	32 5	50 3
30	25 9	55 0
35	23 5	59 4

(Roozeboom, Z. phys. Ch. 1888, 2. 518)

See also under MgSO<sub>4</sub>.

**Magnesium thallos sulphate, MgSO<sub>4</sub>, Th<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O, but decomp by repeated recrystallisations. (Werther)

**Magnesium uranyl sulphate,**

MgSO<sub>4</sub>, (UO<sub>2</sub>)SO<sub>4</sub>+5H<sub>2</sub>O

(de Coninck, Chem. Soc. 1905, 88. (2) 530.)

**Magnesium zinc sulphate, MgSO<sub>4</sub>, ZnSO<sub>4</sub>+14H<sub>2</sub>O**

Sol. in H<sub>2</sub>O (Pierre, A. ch. (3) 16. 244)  
+10H<sub>2</sub>O (Pierre)

3ZnSO<sub>4</sub>, 5MgSO<sub>4</sub>+56H<sub>2</sub>O (Schiff.)

There are only two compounds, 2(MgSO<sub>4</sub>, 7H<sub>2</sub>O), ZnSO<sub>4</sub>, 7H<sub>2</sub>O and MgSO<sub>4</sub>, 7H<sub>2</sub>O, ZnSO<sub>4</sub>, 7H<sub>2</sub>O (Hollmann, Z. phys. Ch. 1901, 37. 212, and 1902, 40. 577.)

**Magnesium sulphate potassium chloride,**

MgSO<sub>4</sub>, KCl+3H<sub>2</sub>O or MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, MgCl<sub>2</sub>+6H<sub>2</sub>O

Min. *Kainite*

100 pts. H<sub>2</sub>O dissolve 79.56 pts at 18°.  
(Krause, Arch. Pharm. (3) 6. 326.)

Not sol in a mixture of abs alcohol and ether, which dissolves out MgCl<sub>2</sub> (Lehmann, J. B. 1867. 416.)

Alcohol dissolves out MgCl<sub>2</sub>, also little H<sub>2</sub>O. Much H<sub>2</sub>O dissolves completely. (Zincken, Miner. Jahrb. 1855. 310)

**Magnesium sulphate potassium chromate,**

2MgSO<sub>4</sub>, K<sub>2</sub>CrO<sub>4</sub>+9H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Etard, C. R. 85. 443)

Manganous sulphate, basic,  $3\text{MnO} \cdot 2\text{SO}_3 + 3\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$ , but slowly decomp thereby (Gorceu, C R 94, 1425.)

Manganous sulphate,  $\text{MnSO}_4$ .

Anhydrous.

Absorbs  $\text{H}_2\text{O}$  from the air to form  $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$   
1 pt.  $\text{MnSO}_4$  is sol in pts  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$
6 25	1 77	18 75	1 067	75	1 494
10	1 631	37 5	1 457	101 25	2 631

Or—

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{MnSO}_4$  at  $t^\circ$

$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$
6 25	56 40	18 75	60 06	75	66 95
10	61 29	37 5	65 63	101 25	49 33

(Brandes, Pogg 20 575)

Sol in 2.5 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$ , at  $62.5^\circ$  it is difficult to dissolve 1 pt.  $\text{MnSO}_4$  in 3 pts  $\text{H}_2\text{O}$ , but the sat solution at  $62.5^\circ$  does not become cloudy on heating to  $100^\circ$ . (Jahn)

100 pts  $\text{MnSO}_4$  + Aq sat at  $11-14^\circ$  contain 37.5 pts.  $\text{MnSO}_4$ . (v Hauer, J. pr. 103, 114)  
Sat.  $\text{MnSO}_4$  + Aq contains at.

$-8^\circ$   $-5^\circ$   $+5^\circ$   $18^\circ$   $22^\circ$   
30 0 31.0 34.1 38 3 33.2%  $\text{MnSO}_4$ ,  
 $23^\circ$   $32^\circ$   $45^\circ$   $52^\circ$   $70^\circ$   
39.1 41.7 44 2 36 4 41 1%  $\text{MnSO}_4$ ,  
 $83^\circ$   $110^\circ$   $115^\circ$   $123^\circ$   $130^\circ$   $140^\circ$   
36 3 18 4 21 5 16.7 13 6 9.4%  $\text{MnSO}_4$ .

(Étard, A. ch. 1894, (7) 2. 553.)

Solubility in  $\text{H}_2\text{O}$  increases from  $0-55^\circ$ , and decreases from  $55-145^\circ$ . The increasing solubility is that of  $\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$ , and  $\text{MnSO}_4 + 2\text{H}_2\text{O}$  separates out at  $35^\circ$ , and is completely insol at  $145^\circ$ . (Étard)

If solubility  $S = \text{pts}$  anhydrous  $\text{MnSO}_4$  in 100 pts. solution,  $S = 30.0 + 0.2828t$  from  $-8^\circ$  to  $57^\circ$ ;  $S = 48.0 - 0.4585t$  from  $57^\circ$  to  $150^\circ$ .

Practically insol in  $\text{H}_2\text{O}$  at  $180^\circ$  (Étard, C. R. 106, 208)

Solubility varies according to the hydrate used. Above results of Étard show the solubility of  $\text{MnSO}_4 \cdot 7\text{H}_2\text{O}$  at  $0^\circ$ , and  $\text{MnSO}_4 + 3\text{H}_2\text{O}$  at  $57^\circ$ . Anhydrous  $\text{MnSO}_4$  is stable only above  $117^\circ$  (Linebarger)

100 pts.  $\text{H}_2\text{O}$  dissolve pts anhydrous  $\text{MnSO}_4$  at  $t^\circ$

$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$
120	67.18	141	41.18	155	26 49
132	63.16	146	38.83	170	16 15

(Linebarger, Am. Ch. J 15, 225.)

+  $\text{H}_2\text{O}$ . Stable only between  $57^\circ$  and  $117^\circ$ .

100 pts  $\text{H}_2\text{O}$  dissolve pts.  $\text{MnSO}_4$  from  $\text{MnSO}_4 + \text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$
48	87.98	78	79 13	115	69 78
53	86.10	90	75 63	117	68 81
65	84.33	100	71 27		
72	82.73	106	70 14		

(Linebarger.)

Min Szmkite.

Solubility of  $\text{MnSO}_4 + \text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts. $\text{MnSO}_4$ per 100 pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{MnSO}_4$ per 100 pts. $\text{H}_2\text{O}$
41.5	61 06	75	49 45
50 1	58 01	84 8	44 87
67 1	51 37	95	38.71
		99 6	34.27

Av. of varying results.

(Cottrell, J. phys Ch 1900, 4. 652.)

Linebarger's determinations are inaccurate. (Cottrell)

+  $2\text{H}_2\text{O}$ . Stable between  $40^\circ$  and  $57^\circ$

100 pts.  $\text{H}_2\text{O}$  dissolve pts  $\text{MnSO}_4$  from  $\text{MnSO}_4 + 2\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$
35	68 88	42	77 63	50	83.16
40	75 31	45	80 07	55	86 27

(Linebarger)

+  $3\text{H}_2\text{O}$ . Stable between  $30^\circ$  and  $40^\circ$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts  $\text{MnSO}_4$  from  $\text{MnSO}_4 + 3\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$
5	54 68	25	66 85	68	71 89
12	60.56	30	67 38	53	72 81
16	63 41	35	68 31	57	73 17
19	65.12	40	70 63		

(Linebarger)

+  $4\text{H}_2\text{O}$ . Sl. efflorescent. Less sol. in boiling than in cold  $\text{H}_2\text{O}$ .

100 pts  $\text{H}_2\text{O}$  at  $4.4^\circ$  dissolve 31 pts.  $\text{MnSO}_4$  +  $4\text{H}_2\text{O}$  (Jahn)

100 pts H <sub>2</sub> O at t° dissolve pts MnSO <sub>4</sub> + 4H <sub>2</sub> O			
t°	Pts. MnSO <sub>4</sub> + 4H <sub>2</sub> O	t°	Pts. MnSO <sub>4</sub> + 4H <sub>2</sub> O
0 25	113 22	37 5	149
10	123	75	144
18 75	122	101 25	93

(Brandes, Pogg. 20. 375.)

Solubility of MnSO<sub>4</sub> in 100 pts. H<sub>2</sub>O at t°, using MnSO<sub>4</sub> + 4H<sub>2</sub>O

t°	Pts. MnSO <sub>4</sub>	t°	Pts. MnSO <sub>4</sub>	t°	Pts. MnSO <sub>4</sub>
0	55 4	35	71 9	70	61.5
1	55.9	36	72 2	71	61.5
2	56.5	37	72 4	72	61 5
3	57 1	38	72 7	73	61.5
4	57.7	39	72 9	74	61.5
5	58.2	40	73 1	75	61 5
6	58 8	41	73 3	76	61 5
7	59 4	42	73 5	77	61 5
8	60 0	43	73 7	78	61 5
9	60 5	44	73.9	79	61 5
10	61 1	45	74 0	80	61 5
11	61 7	46	74 2	81	61 5
12	62 2	47	74 4	82	61 5
13	62 7	48	74.6	83	61 5
14	63 3	49	74 7	84	61 4
15	63 8	50	74 8	85	61 3
16	64 3	51	74 9	86	61 2
17	64 8	52	75 1	87	61.0
18	65.3	53	75 2	88	60 8
19	65 8	54	75.3	89	60 6
20	66 3	55	74.7	90	60 3
21	66 7	56	74.0	91	60 0
22	67 2	57	72 9	92	59 6
23	67 6	58	71 5	93	59 2
24	68 1	59	69 5	94	58.6
25	68 5	60	65 9	95	57 9
26	68 9			96	57 2
27	69 3	63.5	61 3	97	56 3
28	69.7	64	61 5	98	55.4
29	70 0	65	61.5	99	54.8
30	70 4	66	61.5	100	52 9
31	70 7	67	61.5	101	51 2
32	71 0	68	61 5	102	49 3
33	71 3	69	61 5	102.5	47 4
34	71 6				

(Mulder, Scheik. Verhandel. 1864. 137.)

100 pts. H<sub>2</sub>O dissolve pts. MnSO<sub>4</sub> from MnSO<sub>4</sub> + 4H<sub>2</sub>O at t°.

t°	Pts. MnSO <sub>4</sub>	t°	Pts. MnSO <sub>4</sub>	t°	Pts. MnSO <sub>4</sub>
2 2	57 88	25	72 23	48	84.33
7.3	61 78	30	74 67	52	86.16
11	64 01	35 5	78 81	56	88 19
15	67 12	40	79 63		
20	69 93	45	83 06		

(Lanebarger.)

Stable in aqueous solution between 25° and 31° (Schieber, M 1898, 19. 281.)

Solubility of MnSO<sub>4</sub> + 4H<sub>2</sub>O in H<sub>2</sub>O at t°.

t°	Pts. MnSO <sub>4</sub> per 100 pts H <sub>2</sub> O	t°	Pts. MnSO <sub>4</sub> per 100 pts H <sub>2</sub> O
16 0	63 97	35 0	67 87
17 7	64 16	35 5	68 09
18 5	64 19	39 9	68.81
25 0	65.32	49 9	72 48
30 0	66.43	50 0	72 62
32 2	66 83		

(Cottrell, J. phys. Ch. 1900, 4. 651.)

Lanebarger's determinations are inaccurate. (Cottrell.)

Solubility in H<sub>2</sub>O at t°.

t°	g. MnSO <sub>4</sub> for 100 g. H <sub>2</sub> O
30 15	66.38
35	68 22

(Richards and Fraprie, Am. Ch. J. 1901, 26. 77.)

+5H<sub>2</sub>O Sol. in 1 pt. H<sub>2</sub>O at 18.75° (Jahn, A. 28. 110.)

Stable from 8° to 18°.

100 pts H<sub>2</sub>O dissolve pts MnSO<sub>4</sub> from MnSO<sub>4</sub> + 5H<sub>2</sub>O at t°

t°	Pts. MnSO <sub>4</sub>	t°	Pts. MnSO <sub>4</sub>	t°	Pts. MnSO <sub>4</sub>
0	58 05	20	75.16	40	84.63
2 5	62 41	25	78 63	42	85 27
4	64 22	30	79 16	45	86 16
7	66 83	32	80 38	47 7	86 95
10	68 05	34	82 04	53	88 89
15	72.33	37	83 91	54	89 08

(Lanebarger.)

Stable in aqueous solution between 15° and 20°. (Schieber, M 1898, 19. 281.)

Solubility of MnSO<sub>4</sub> + 5H<sub>2</sub>O at t°.

t°	Pts. MnSO <sub>4</sub> per 100 pts H <sub>2</sub> O	t°	Pts. MnSO <sub>4</sub> per 100 pts H <sub>2</sub> O
5	58.06	16	61 59
9	59 23	25	64 78
12	60 19	30	67 76
12 3	60 16	31 1	67 92
15	61 08	35 5	71 61

(Cottrell, J. phys. Ch. 1900, 4. 651.)

Lanebarger's determinations are inaccurate (Cottrell.)

Solubility in  $H_2O$  at  $25^\circ = 65.09$  g.  $MnSO_4$  for 100 g  $H_2O$ . (Richards and Fraprie, Am. Ch. J 1901, 26. 77.)

+ $6H_2O$ . Stable from  $-5^\circ$  to  $+8^\circ$

100 pts.  $H_2O$  dissolve pts.  $MnSO_4$  from  $MnSO_4 + 6H_2O$  at  $t^\circ$ .

$t^\circ$	Pts $MnSO_4$	$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts $MnSO_4$
-4	55.87	9	70.88	30	76.24
0	64.21	15	72.45	34	77.02
3	66.87	20	74.35	35	77.23
5	67.49	25	75.38	38	74.81

(Linebarger)

+ $7H_2O$ . Efflorescent

Sol. in less than 0.5 pt  $H_2O$  at  $18.75^\circ$  (Jahn.)

Stable between  $-10^\circ$  and  $-5^\circ$

100 pts  $H_2O$  dissolve pts  $MnSO_4$  from  $MnSO_4 + 7H_2O$  at  $t^\circ$

$t^\circ$	Pts $MnSO_4$	$t^\circ$	Pts $MnSO_4$	$t^\circ$	Pts $MnSO_4$
-10	50.11	0	53.61	10	59.91
-8	50.93	5	54.83	15	64.34
-5	51.53	7	56.62		

(Linebarger.)

Stable in aqueous solution below  $0^\circ$  (Schueber, M 1898, 19. 281)

Solubility of  $MnSO_4 + 7H_2O$  in  $H_2O$  at  $t^\circ$

$t^\circ$	Pts $MnSO_4$ per 100 pts $H_2O$	$t^\circ$	Pts $MnSO_4$ per 100 pts $H_2O$
-10	47.96	9	59.33
0	56.23	12	61.78
5	56.38	14.3	63.93

(Cottrell, l c)

M-pt. of  $MnSO_4 + 7H_2O$  is  $54^\circ$  (Tilden, Chem Soc. 45. 409.)

Sp. gr. of  $MnSO_4 + Aq$  at  $15^\circ$ .

% $MnSO_4 + 4H_2O$	Sp. gr	% $MnSO_4 + 4H_2O$	Sp. gr
1	1.006	29	1.208
2	1.013	30	1.2160
3	1.020	31	1.224
4	1.025	32	1.231
5	1.0320	33	1.244
6	1.038	34	1.250
7	1.044	35	1.2579
8	1.050	36	1.268
9	1.056	37	1.276
10	1.0650	38	1.285
11	1.072	39	1.295
12	1.079	40	1.3038
13	1.085	41	1.313
14	1.093	42	1.322
15	1.1001	43	1.331
16	1.106	44	1.340
17	1.114	45	1.3495
18	1.121	46	1.360
19	1.129	47	1.370
20	1.1363	48	1.380
21	1.144	49	1.389
22	1.150	50	1.3986
23	1.160	51	1.410
24	1.166	52	1.420
25	1.1751	53	1.430
26	1.183	54	1.440
27	1.190	55	1.4514
28	1.200		

(Gerlach, Z anal 8. 288.)

Sp. gr. of  $MnSO_4 + Aq$  at  $23^\circ$ . a=no. of  $\frac{1}{2}$  mols. in grms. dissolved in 1000 g  $H_2O$ ; b=sp. gr if a is  $MnSO_4 + 5H_2O$ ,  $\frac{1}{2}$  mol wt.=120.5; c=sp. gr. if a is  $MnSO_4$ ,  $\frac{1}{2}$  mol wt.=75.5

a	b	c	a	b	c
1	1.068	1.071	6	1.306	3.576
2	1.128	1.139	7	1.341	1.429
3	1.181	1.202	8	1.371	...
4	1.227	1.262	9	1.399	...
5	1.269	1.320	10	1.426	...

(Favie and Valson, C. R. 79. 968)

Above table recalculated by Gerlach (Z anal. 28. 475)

% $MnSO_4 + 5H_2O$	Sp. gr.	% $MnSO_4 + 5H_2O$	Sp. gr.
10	1.0630	40	1.2900
20	1.1325	50	1.3800
30	1.2070		

Sp. gr. of  $\text{MnSO}_4 + \text{Aq}$  at  $15^\circ$ . a = %; b = sp. gr. if a is  $\text{MnSO}_4$ , c = sp. gr. if a is  $\text{MnSO}_4 + 4\text{H}_2\text{O}$ ; d = sp. gr. if a is  $\text{MnSO}_4 + 5\text{H}_2\text{O}$ ; e = sp. gr. if a is  $\text{MnSO}_4 + 7\text{H}_2\text{O}$

a	b	c	d	e
5	1.0500	1.0340	1.0310	1.0270
10	1.1035	1.0690	1.0630	1.0545
15	1.1005	1.1065	1.0965	1.0830
20	1.2215	1.1435	1.1315	1.1130
25	1.2870	1.1835	1.1685	1.1440
30	1.3575	1.2255	1.2070	1.1765
35		1.2695	1.2470	1.2105
40		1.3155	1.2885	1.2455
45		1.3640	1.3315	1.2815
50			1.3760	1.3185
55				1.3565

(Gerlach, Z. anal. 28. 475.)

Sp. gr. of  $\text{MnSO}_4 + \text{Aq}$  at  $0^\circ$ . S = pts.  $\text{MnSO}_4$  in 100 pts. solution

S	Sp. gr.	S	Sp. gr.
16.7450	1.1834	8.8295	1.0928
14.0462	1.1519	6.0172	1.0622
11.5804	1.1239	3.0865	1.0315

(Charpy, A. ch. (6) 29. 26)

Sp. gr. of  $\text{MnSO}_4 + \text{Aq}$  at room temp. containing:

11.45 18.8 22.08 %  $\text{MnSO}_4$ .  
1.1469 1.2513 1.3082

(Wagner, W. Ann. 1883, 18. 271.)

Sp. gr. of  $\text{MnSO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{MnSO}_4 + \text{Aq}$	Sp. gr.
1—normal	1.0728
$1/2$ —"	1.0365
$1/4$ —"	1.0179
$1/8$ —"	1.0087
$1/16$ —"	1.0041

(Wagner, Z. phys. Ch. 1890, 5. 39.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{MnSO}_4 + \text{Aq}$  containing 30.819%  $\text{MnSO}_4 = 1.36267$  (Schönrock, Z. phys. Ch. 1893, 11, 781.)

Sat.  $\text{MnSO}_4 + \text{Aq}$  boils at  $102.4^\circ$ ; crust forms at  $101.6^\circ$ , and solution contains 48.7 pts  $\text{MnSO}_4$  to 100 pts  $\text{H}_2\text{O}$ .

B-pt. of  $\text{MnSO}_4 + \text{Aq}$  containing pts.  $\text{MnSO}_4$  to 100 pts  $\text{H}_2\text{O}$ .

B-pt.	Pts $\text{MnSO}_4$	B-pt.	Pts $\text{MnSO}_4$
100 $5^\circ$	17 1	102 $0^\circ$	58 9
101 0	32 1	102 4	68 4
101 5	45 2		..

(Gerlach, Z. anal. 26. 434.)

Sol. in about 20 pts. boiling  $\text{H}_2\text{SO}_4$ , and more sol. in boiling  $\text{H}_2\text{SO}_4 + \text{Aq}$  of 1:6 sp. gr. (Schultz, Pogg. 133. 137.)

Completely pptd. from solution by  $\text{HCl} + \text{H}_2\text{O}_2$ . (Forssz)

For solubility in  $(\text{NH}_4)_2\text{SO}_4$ , see under  $(\text{NH}_4)_2\text{SO}_4$ .

$\text{MnSO}_4 + \text{Aq}$  sat. at  $10^\circ$ , then sat. with  $\text{K}_2\text{SO}_4$  at same temp. contains for 100 pts.  $\text{H}_2\text{O}$  16.7 pts  $\text{MnSO}_4$  and 44.3 pts  $\text{K}_2\text{SO}_4$  (Mulder)

Solubility of  $\text{MnSO}_4 + \text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at  $35^\circ$ .

g per 100 g sat. solution		
$\text{MnSO}_4$	$\text{Na}_2\text{SO}_4$	Solid phase
39.45	0	$\text{MnSO}_4, \text{H}_2\text{O}$
33.92	5.23	"
33.06	7.97	$\text{MnSO}_4, \text{H}_2\text{O} + 9\text{MnSO}_4, 10\text{Na}_2\text{SO}_4$
32.92	7.42	"
31.05	9.20	$9\text{MnSO}_4, 10\text{Na}_2\text{SO}_4$
27.67	10.76	"
22.14	14.28	"
14.58	20.01	"
13.96	21.91	"
12.19	22.49	$9\text{MnSO}_4, 10\text{Na}_2\text{SO}_4 + \text{MnSO}_4, 3\text{Na}_2\text{SO}_4$
10.45	23.41	$\text{MnSO}_4, 3\text{Na}_2\text{SO}_4$
7.43	26.53	"
5.69	29.31	"
5.11	30.52	$\text{MnSO}_4, 3\text{Na}_2\text{SO}_4 + \text{Na}_2\text{SO}_4$
2.96	31.33	$\text{Na}_2\text{SO}_4$
0	33	"

(Schreinemakers and Provijn, Proc. Ak. Wet. Amsterdam, 1913, 15. 326.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Anhydrous  $\text{MnSO}_4$  is insol. in absolute alcohol

1000 pts. alcohol of 0.872 sp. gr. dissolve 63 pts.  $\text{MnSO}_4$ .

Sol. in 50 pts. of 50% alcohol. Insol. in absolute alcohol (Brandes, Pogg. 20. 556.)

100 pts. solution saturated at  $15^\circ$  in dil. alcohol containing:

0 10 50 60 % alcohol, contain 56.25 51.4 2.0 0.66 pts.  $\text{MnSO}_4 + 5\text{H}_2\text{O}$ .

(Schiff, A. 118. 385.)

When  $\text{MnSO}_4 + 7\text{H}_2\text{O}$  is boiled with absolute alcohol none is dissolved, but  $\text{MnSO}_4 + 3\text{H}_2\text{O}$  is formed.

When  $\text{MnSO}_4 + 7\text{H}_2\text{O}$  is dissolved in 15–50% alcohol, the liquid separates into two layers, the lower containing less (12–14%) alcohol and more (47–49%) salt; the upper containing

more (50-55%) alcohol and less (1.3-2.2%) salt. If the alcohol has the above strength (15-50%) the separation takes place at ordinary temp., but with 13-14% or 60% or more alcohol, warming is necessary to effect the separation. (Schiff, A. 118. 363.)

Solubility of  $\text{MnSO}_4 + \text{H}_2\text{O}$  in alcohol + Aq at  $t^\circ$ .

Composition of two layers sat. with the solid salt at  $t^\circ$ .

$t^\circ$	Alcohol layer		Water layer	
	% alcohol	% $\text{MnSO}_4$	% alcohol	% $\text{MnSO}_4$
30	45.20	2.49	8.69	30.15
31	43.90	2.74	8.47	30.10
35	41.71	3.44	9.24	28.61
37	38.26	4.84	11.03	26.47
41	34.01	5.86	11.93	24.97
42	32.37	6.89	13.57	23.09
43	31.42	8.51	14.33	22.01

(Schreinemakers and Deuss, Z. phys. Ch. 1912, 79. 559.)

Composition of alcohol solutions sat. with  $\text{MnSO}_4 + \text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{H}_2\text{O}$	% alcohol	% $\text{MnSO}_4$
50	63.74	0	36.26
	65.21	6.67	28.12
	65.23	16.02	18.75
	64.83	22.63	12.54
	59.41	36.47	4.12
35	61.4	0	38.6
	62.13	5.50	32.37
	62.06	6.46	31.48
	62.01	7.48	30.51
	*62.15	9.24	28.61
	*54.85	41.71	3.44
	50.69	47.73	1.58
	50.16	48.27	1.57
30	61.4	0	38.6
	61.43	2.26	36.31
	61.25	5.09	33.66
	60.78	5.96	*33.26
	*61.16	8.69	30.15
	*52.31	45.20	2.49
	44.83	54.19	0.08
	30.95	68.97	0.08
	9.19	90.80	0.01

\*The solutions also sat. with respect to one another.

(Schreinemakers and Deuss.)

Composition of the solutions sat. with respect to one another.

$t^\circ$	water layer		alcohol layer	
	% alcohol	% $\text{MnSO}_4$	% alcohol	% $\text{MnSO}_4$
50	†5.68	34.95	†53.64	0.97
	†7.69	30.99	†45.83	2.19
	†8.70	29.20	†41.93	3.11
	†11.85	24.84	†35.15	5.95
35	†8.38	29.52	†42.38	3.07
	*9.24	28.61	*41.71	3.44
	10.75	26.33	36.89	5.19
	15.09	21.85	30.06	9.03
30	†7.60	32.40	†50.97	1.74
	*8.69	30.15	*45.20	2.49
	10.46	27.58	40.71	3.93
	11.86	25.75	37.54	5.20
	16.18	20.86	29.89	9.64

(Schreinemakers and Deuss.)

†Metastable solutions.

\*Solutions also sat. with respect to  $\text{MnSO}_4 + \text{H}_2\text{O}$ .

Solubility of  $\text{MnSO}_4 + 4\text{H}_2\text{O}$  in alcohol + Aq.

g. $\text{H}_2\text{O}$	g. alcohol	$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$
55.86	30.03	14.11
52.25	43.59	4.16
49.41	47.66	2.94
45.34	53.00	1.66
42.56	56.24	1.20

(Lanebarger, Am. Ch. J. 1892, 14. 380.)

Solubility of  $\text{MnSO}_4 + 5\text{H}_2\text{O}$  in alcohol + Aq.

Composition of the solution sat. with  $\text{MnSO}_4 + 5\text{H}_2\text{O}$ .

$t^\circ$	alcohol layer		water layer	
	% alcohol	% $\text{MnSO}_4$	% alcohol	% $\text{MnSO}_4$
10	37.06	5.44	13.78	25.25
15	44.56	2.79	9.25	29.79
17.6	47.11	2.22	8.53	30.88
21	53.55	1.10	6.10	35.05
25	53.09	1.23	6.81	33.72

Composition of solution sat. with solid substance at  $25^\circ$ .

% $\text{H}_2\text{O}$	% alcohol	% $\text{MnSO}_4$	Solid phase
60.7	0	39.3	$\text{MnSO}_4 + 5\text{H}_2\text{O}$
*59.47	6.81	33.72	"
*45.68	53.09	1.23	"
42.05	57.39	0.56	"
23.30	76.70	0.0	$\text{MnSO}_4 + \text{H}_2\text{O}$

\*The two liquids are sat. with respect to one another.

Composition of the two solutions sat. with respect to one another at 25°.

Water layer		Alcohol layer	
% alcohol	% MnSO <sub>4</sub>	% alcohol	% MnSO <sub>4</sub>
*3 81	*33 72	*53 09	1 23
8 48	31 51	49 76	1 53
15 02	22 61	32 75	8 01

\*Also sat with MnSO<sub>4</sub>, 5H<sub>2</sub>O.

(Schreinemakers and Deuss.)

Insol. in absolute ether between 5° and 7°, and no crystal H<sub>2</sub>O is removed thereby. Insol. in boiling oil of turpentine, but 1 mol. crystal H<sub>2</sub>O is removed from MnSO<sub>4</sub>+4H<sub>2</sub>O (Brandes, Pogg. 20, 568)

Insol. in benzonitrile (Naumann, B 1914, 47, 1370.), ethyl acetate. Naumann, B. 1910, 43, 314.; acetone. (Naumann, B. 1904, 37, 4329, Erdmann, C.C. 1899, II. 1014.)

100 g. sat. solution in glycol contain 0.5 g. MnSO<sub>4</sub> (de Coninck, Bull. Ac. roy. Belg. 1905, 359)

MnSO<sub>4</sub>+7H<sub>2</sub>O occurs as the min *Mallardite*.

**Manganomanganic sulphate**, MnO, MnO<sub>2</sub>, 4SO<sub>3</sub>+9H<sub>2</sub>O.

Deliquescent. Decomp. by H<sub>2</sub>O. Sol. in little dil. H<sub>2</sub>SO<sub>4</sub>+Aq (Fremy, C. R. 82, 475)

**Manganic sulphate**, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Extremely deliquescent. Sol. in H<sub>2</sub>O with evolution of heat, and decomposition into a basic sulphate. Behaves similarly with dilute acids. Sol. in traces in cold conc. H<sub>2</sub>SO<sub>4</sub>. Insol. in cold conc. HNO<sub>3</sub>+Aq. Sol. in conc. HCl+Aq. Decomp. by absolute alcohol. (Carius, A. 98, 53)

**Manganyl sulphate**, MnO<sub>2</sub>, SO<sub>3</sub>.

Sol. in H<sub>2</sub>SO<sub>4</sub> but solution decomp. if below 40–60° Baumé. Solubility in 40° Baumé acid = 15%; 55°, 4–5%. Solution can be heated to 60–80° without decomp. (Bad. Anilin u. Sodafabrik, C. C. 1905, II. 1398.)

**Manganous hydrogen sulphate**.

MnSO<sub>4</sub> is sol. in 20 pts. boiling conc. H<sub>2</sub>SO<sub>4</sub>, more sol. in boiling H<sub>2</sub>SO<sub>4</sub>+Aq of 1.6 sp. gr (Schultz.)

MnH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, and +H<sub>2</sub>O. Sol. in H<sub>2</sub>O with decomp. (Schultz.)

MnH<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>. Sol. in H<sub>2</sub>O with decomp. (Schultz.)

**Manganic hydrogen sulphate**, Mn<sub>2</sub>H<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+8H<sub>2</sub>O.

Deliquescent. Decomp. by H<sub>2</sub>O. Sol. in dil. H<sub>2</sub>SO<sub>4</sub>+Aq. (Francke, J. pr. (2) 36, 251.)

**Manganous hydrazine sulphate**, MnH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.

1 pt. is sol. in 60 pts. H<sub>2</sub>O at 18°  
Stable in the air at 100°. (Curtius, J. pr. 1894, (2) 50, 331)

**Manganous nickel potassium sulphate**, MnSO<sub>4</sub>, NiSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>+12H<sub>2</sub>O Sol. in H<sub>2</sub>O (Vohl, A. 94, 57.)

**Manganous potassium sulphate**, K<sub>2</sub>SO<sub>4</sub>, MnSO<sub>4</sub>+2H<sub>2</sub>O.

+1H<sub>2</sub>O. Efflorescent. (Pierre, A. ch. (3) 16, 239.)

2MnSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> (Mallet, C. N. 1899, 80, 301)

**Manganic potassium sulphate**, K<sub>2</sub>Mn<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O.

Decomp. by dissolving in H<sub>2</sub>O. (Mitscherlich.)

**Manganomanganic potassium sulphate**, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, 5K<sub>2</sub>SO<sub>4</sub>=3Mn(SO<sub>4</sub>)<sub>2</sub>, 2MnSO<sub>4</sub>, 5K<sub>2</sub>SO<sub>4</sub>.

Decomp. by much H<sub>2</sub>O. Sol. in dil. or conc. H<sub>2</sub>SO<sub>4</sub>. Insol. in alcohol or ether. (Francke, J. pr. (2) 36, 166)

**Manganous potassium zinc sulphate**, MnSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O  
Sol. in H<sub>2</sub>O. (Vohl)

**Manganous rubidium sulphate**, MnSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O (Tutton, Chem. Soc. 63, 337.)  
1 l. H<sub>2</sub>O dissolves 357 g. anhydrous salt at 25° (Locke, Am. Ch. J. 1902, 27, 459)

+2H<sub>2</sub>O (Wyruboff, Bull. Soc. Min. 1891, 14, 242.)

2MnSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub>. (Wyruboff.)

**Manganic rubidium sulphate**, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, Rb<sub>2</sub>SO<sub>4</sub>+24H<sub>2</sub>O.

Deliquescent. (Christensen, Z. anorg. 1901, 27, 333)

**Manganous sodium sulphate**, MnSO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>, +2H<sub>2</sub>O. Deliquescent in moist air. (Geiger.)

+4H<sub>2</sub>O. Sol. in 12 pts. boiling H<sub>2</sub>O. (Geiger.)

**Manganous sulphate ammonia**, MnSO<sub>4</sub>, 4NH<sub>3</sub>, Decomp. by H<sub>2</sub>O. (Rose, Pogg. 20, 148.)

**Manganous sulphate cupric oxide**, MnSO<sub>4</sub>, 2CuO+3H<sub>2</sub>O.

(Mailhe, A. ch. 1902, (7) 27, 392.)  
MnSO<sub>4</sub>, 3CuO+2H<sub>2</sub>O (Recoura, C. R. 1901, 132, 1415.)

MnSO<sub>4</sub>, 24CuO+2H<sub>2</sub>O (Recoura.)

**Manganous sulphate hydrazine,  $\text{MnSO}_4 \cdot 2\text{N}_2\text{H}_4$ .**

Very unstable

Somewhat sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z. anorg. 1908, 60, 285.)

**Manganous sulphate hydroxylamine,  $\text{MnSO}_4 \cdot \text{NH}_2\text{OH} + 2\text{H}_2\text{O}$ .**

Insol in  $\text{H}_2\text{O}$ . (Feldt, B 1894, 27, 405)

**Mercurous sulphate, basic,  $2\text{Hg}_2\text{O} \cdot \text{SO}_3 + \text{H}_2\text{O}$ .**

Sol in 25,000 pts.  $\text{H}_2\text{O}$  at  $20^\circ$  (Gouy, C. R. 1900, 130, 1401.)

**Mercurous sulphate,  $\text{Hg}_2\text{SO}_4$ .**

Sol in 500 pts. cold, and 300 pts. hot  $\text{H}_2\text{O}$  (Wackeueroder, A. 41, 319.)

Solubility in  $\text{H}_2\text{O}$  at  $18^\circ = 7.8 \times 10^{-4}$  g. mol. per liter (Wilsmore, Z. phys. Ch 1900, 35, 305.)

1 l.  $\text{H}_2\text{O}$  dissolves  $11.71 \times 10^{-4}$  g.-mol.  $\text{Hg}_2\text{SO}_4$  at  $25^\circ$  (Drucker, Z. anorg. 1901, 28, 362.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	In 100 pts. of the solution	
	$\text{Hg}_2\text{SO}_4$	$\text{H}_2\text{SO}_4$
16.5	0.055	0.008
33	0.060	0.018
50	0.065	0.037
75	0.074	0.063
91	0.084	0.071
100	0.092	0.071

(Barre, A. ch. 1911, (8) 24, 203.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ$  is 20% greater than at  $18^\circ$  and  $= 11.71 \times 10^{-4}$  g. mol. per l. By addition of increasing amts. of  $\text{H}_2\text{SO}_4$  the solubility is somewhat, but not regularly, decreased,  $\text{K}_2\text{SO}_4$  lowers solubility less than  $\text{H}_2\text{SO}_4$ . (Drucker, Z. anorg. 1901, 28, 362.)

Easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$ , from which solution it is separated by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Wackeueroder, A. 41, 319.)

Abundantly sol. in hot, less sol. in cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Berzelius.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

$\text{H}_2\text{SO}_4$ normality	g.-mol. $\text{Hg}_2\text{SO}_4$ per litre
0.0400	$8.31 \times 10^{-4}$
0.1000	$8.78 \times 10^{-4}$
0.2000	$8.04 \times 10^{-4}$

(Drucker, Z. anorg. 1901, 28, 362.)

Partially decomp. by hot  $\text{NH}_4$  salts +  $\text{Aq}$  (Miahle, A. ch. (3) 5, 179.)

5 times more sol. in sat.  $\text{CdSO}_4 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Hulett, Phys. Rev. 1907, 25, 16.)

Sat.  $\text{ZnSO}_4$  or  $\text{CaSO}_4 + \text{Aq}$  attack much less

than pure  $\text{H}_2\text{O}$ , yet the solubility of  $\text{Hg}_2\text{SO}_4$  in these solutions is greater, i. e., 0.8 g. in 1 l.  $\text{ZnSO}_4 + \text{Aq}$  and 1.1 g. in 1 l.  $\text{CdSO}_4 + \text{Aq}$  at  $20^\circ$ . (Gouy, C. R. 1900, 130, 1402.)

Solubility in  $0.2\text{N } \text{K}_2\text{SO}_4 + \text{Aq} = 9.05 \times 10^{-4}$  g. mol. per l. at  $25^\circ$  (Drucker, Z. anorg. 1901, 28, 362.)

Solubility of  $\text{Hg}_2\text{SO}_4$  in  $\text{K}_2\text{SO}_4 + \text{Aq}$ .

$t^\circ$	g. per 100 g. sat. solution		
	$\text{K}_2\text{SO}_4$	$\text{Hg}_2\text{SO}_4$	free $\text{H}_2\text{SO}_4$
15	2.90	0.0475	0.0080
	5.70	0.0703	0.0093
	8.22	0.0912	0.0098
	8.77	0.0994	
	9.44	0.1080	0.0110
33	2.94	0.0677	0.0250
	5.68	0.1015	0.0350
	8.30	0.1364	0.0441
	10.70	0.1724	0.0438
	11.90	0.1902	0.0420
75	3.10	0.1344	0.1681
	5.75	0.2120	0.2135
	8.50	0.2951	0.2514
	13.20	0.4610	0.2503
	17.30	0.6440	0.2225

(Barre, A. ch. 1911, (8) 24, 202.)

About 3 times as sol. in sat.  $\text{ZnSO}_4 + \text{Aq}$  as in distilled  $\text{H}_2\text{O}$ . (Wright, Phil. Mag (5) 1885, 19, 29.)

**Mercuric sulphate, basic,  $2\text{HgO} \cdot \text{SO}_3$ .**

(Mailhe, A. ch. 1902, (7) 27, 394.)

$3\text{HgO} \cdot \text{SO}_3$  (Meneval *in situ*)

Sol in 2000 pts. cold and 600 pts. boiling  $\text{H}_2\text{O}$ . (Fourcroy, A. ch. 10, 307.)

Sol in 43,478 pts.  $\text{H}_2\text{O}$  at  $16^\circ$  when pptd. cold, and in 32,258 pts. at  $16^\circ$  when pptd. at  $100^\circ$ . (Cameron, Z. anal. 19, 144.)

Sl. sol. in warm dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Rose.)

Solubility in  $\text{H}_2\text{O}$  is increased by addition of  $\text{H}_2\text{SO}_4$  up to an acid content of 4.3 mol  $\text{SO}_3$  to 93.7 mols.  $\text{H}_2\text{O}$ . (Hoitsema, Z. phys. Ch. 1895, 17, 665.)

Sol. in warm conc.  $\text{HCl}$  or  $\text{HBr} + \text{Aq}$ . (Ditte)

Sol. in alkali chlorides +  $\text{Aq}$  (Miahle)

Sol. in dil.  $\text{HNO}_3$  or in  $\text{HCl} + \text{Aq}$ . More easily sol. in the warm acids. (Ray, Chem. Soc. 1897, 71, 1099.)

$3\text{HgO} \cdot 2\text{SO}_3 + 2\text{H}_2\text{O}$ . (Hoitsema, Z. phys. Ch. 1895, 17, 659.)

$4\text{HgO} \cdot 3\text{SO}_3$ . (Hopkins, Sil. Am. J. 18, 364.)

**Mercuric sulphate,  $\text{HgSO}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  into  $3\text{HgO} \cdot \text{SO}_3$ , and a sol. acid salt. Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Decomp. by all acids. (Berzelius.)

Sol in warm conc HCl or HBr + Aq; very al. sol in boiling conc. HCl + Aq (Ditte, A. ch. (5) 17, 121.)

Very sl. sol in hot conc HF (Ditte, A. ch. 1879, (5) 17, 125.)

Sol in HCN + Aq (Mohr.)

Sol. with decomp. in NaCl + Aq (Miahle.)

Insol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20, 829.)

Insol. in conc. alcohol.

Insol. in acetone (Naumann, B. 1904, 37, 4329.), methyl acetate. (Naumann, B. 1909, 42, 3790.); ethyl acetate. (Naumann, B. 1910, 43, 314.)

Insol. in benzonitrile (Naumann, B. 1914, 47, 1370.)

Insol. in pyridine. (Schroeder, Dissert. 1901.)

+  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Eisfeldt, Pharm Centr 1863, 812.)

**Mercuriomercuric sulphate**,  $\text{Hg}_2\text{O}$ ,  $2\text{HgO}$ ,  $\text{SO}_2$ .

Insol. in cold  $\text{H}_2\text{O}$ ; not decomp. by boiling  $\text{H}_2\text{O}$ . Decomp. by HCl + Aq. (Brooke, Pogg 66, 63.)

$\text{Hg}_2\text{SO}_4$ ,  $\text{HgSO}_4$  (Baskerville, J. Am. Chem. Soc. 1897, 19, 875.)

**Mercuric hydrogen sulphate**,  $\text{HgH}_2(\text{SO}_4)_2$ .

(Braham, C. N. 42, 163.)

**Mercuric potassium sulphate**,  $3\text{HgSO}_4$ ,

$\text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Hirzel, J. B. 1850, 332.)

**Mercuric sulphate chloride ammonium chloride**,  $2\text{HgSO}_4$ ,  $\text{HgCl}_2$ ,  $2\text{NH}_4\text{Cl}$ .

Decomp. with  $\text{H}_2\text{O}$ . Ether dissolves out  $\text{HgCl}_2$ . (Kosmann, A. ch. (3) 27, 238.)

**Mercuric sulphate cyanide**,  $\text{HgSO}_4$ ,  $\text{Hg}(\text{CN})_2$ ,

+  $5\text{H}_2\text{O}$ .

Decomp. by conc. or warm acids. (Rupp, Arch Pharm. 1912, 250, 280.)

**Mercuric sulphate hydrazine**,  $\text{HgSO}_4$ ,  $\text{N}_2\text{H}_4$ .

Ppt. (Hofmann and Marburg, A. 1899, 306, 216.)

**Mercuric sulphate hydrobromide**,  $\text{HgSO}_4$ ,

$2\text{HBr}$ .

Sol. in  $\text{H}_2\text{O}$  without separation of basic sulphate. (Ditte, A. ch. (5) 17, 122.)

$3\text{HgO}$ ,  $\text{SO}_2$ ,  $6\text{HBr}$  Sol. in  $\text{H}_2\text{O}$ . (Ditte.)

**Mercuric sulphate hydrochloride**,  $\text{HgSO}_4$ ,

HCl.

Not attacked by HCl. Sl. sol in  $\text{HNO}_3$ . (Baskerville, J. Am. Chem. Soc. 1901, 23, 895.)

$\text{HgSO}_4$ ,  $2\text{HCl}$ . Sol. in  $\text{H}_2\text{O}$  without separation of a basic salt.

Very sol in warm  $\text{H}_2\text{SO}_4$ , solidifying on cooling if very conc., or crystallising if dil. (Ditte.)

Very deliquescent.

Very sol in  $\text{H}_2\text{O}$  (Baskerville, J. Am. Chem. Soc. 1901, 23, 895.)

+  $\text{H}_2\text{O}$ . (Baskerville, J. Am. Chem. Soc. 1901, 23, 895.)

$3\text{HgO}$ ,  $\text{SO}_2$ ,  $6\text{HCl}$  Sol in  $\text{H}_2\text{O}$ . (Ditte.)

**Mercuric sulphate hydroxylamine**,  $\text{HgSO}_4$ ,

$2\text{NH}_2\text{OH} + \text{H}_2\text{O}$ .

Decomp. by cold  $\text{H}_2\text{O}$ . (Adams, Am. Ch. J. 1902, 28, 209.)

**Mercuric sulphate iodate iodide**,  $6(3\text{HgO}$ ,

$2\text{SO}_2)$ ,  $6\text{HgI}_2$ ,  $\text{Hg}(\text{IO}_3)_2$ .

Decomp. by  $\text{H}_2\text{O}$  and acids. (Bruckner, M. 1907, 28, 961.)

**Mercuric sulphate iodide, basic**,  $3\text{HgO}$ ,  $2\text{SO}_2$ ,

$\text{HgI}_2$ .

$3(3\text{HgO}$ ,  $2\text{SO}_2)$ ,  $2\text{HgI}_2 + 10\text{H}_2\text{O}$ .

$2(3\text{HgO}$ ,  $2\text{SO}_2)$ ,  $\text{HgI}_2 + 10\text{H}_2\text{O}$  Very sol.

in hot conc  $\text{HNO}_3$ .

$3\text{HgO}$ ,  $2\text{SO}_2$ ,  $\text{HgSO}_4$ ,  $\text{HgI}_2 + 10\text{H}_2\text{O}$ .

(Ditte, C. R. 1905, 140, 1167.)

**Mercuric sulphate iodide**,  $\text{HgSO}_4$ ,  $\text{HgI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol or ether.

(Ruegel, J. B. pr. Pharm. 11, 393.)

$3\text{HgSO}_4$ ,  $\text{HgI}_2$ . Decomp. by cold or hot  $\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{SO}_4$  + Aq (Ditte, C. R. 1905, 140, 1165.)

$4\text{HgSO}_4$ ,  $\text{HgI}_2 + 15\text{H}_2\text{O}$ , and +  $18\text{H}_2\text{O}$  Decomp. by cold or hot  $\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{SO}_4$ . (Ditte.)

**Mercuric sulphate phosphide**.

See Dimercuriphosphonium mercuric sulphate.

**Mercuric sulphate sulphide, basic**,  $2\text{HgO}$ ,

$\text{SO}_2$ ,  $\text{HgS}$ .

Somewhat sol. in HCl,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ .

(Jacobson, Pogg. 1846, 68, 412.)

$4\text{HgO}$ ,  $3\text{SO}_2$ ,  $2\text{HgS} + 4\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{SO}_4$ . (Estrup, Z. anorg. 1909, 62, 189.)

**Mercuric sulphate sulphide**,  $2\text{HgSO}_4$ ,  $\text{HgS}$ .

Sl. sol in hot HCl,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3$  + Aq.

Easily sol. in hot aqua regia. (Jacobson, Pogg. 68, 410.)

$2\text{HgSO}_4$ ,  $\text{HgS}$ . (Palm, C. C. 1863, 122.)

$\text{HgSO}_4$ ,  $2\text{HgS}$ . (Barfoed, J. B. 1864, 282.)

Sol. in aqua regia. (Denigès, Bull. Soc. 1915, (4) 17, 355.)

$\text{HgSO}_4$ ,  $3\text{HgS}$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol in aqua regia, decomp. by  $\text{HNO}_3$  into—

$3\text{HgSO}_4$ ,  $\text{HgS}$ . Insol. in all acids except aqua regia (Spring, A. 199, 116.)

**Molybdenum sesquisulphate (?)**.

Basic Insol. in  $\text{H}_2\text{O}$ .

Neutral Decomp. by  $\text{H}_2\text{O}$  into acid and basic salts.

Acid Sol in  $\text{H}_2\text{O}$ . (Berzelius.)

**Molybdenum disulphate (?)**Sol. in  $H_2O$ .**Molybdenum sulphate,  $Mo_2O_3 \cdot 2SO_3$ .**

Very slowly sol. in cold, more quickly sol. in hot  $H_2O$ . (Bailhache, C. R. 1901, 132, 476.)  
 $7MoO_3 \cdot 2MoO_3 \cdot 7SO_3 + Aq$  (Péchar, C. R. 1901, 132, 630.)

**Molybdic sulphate,  $MoO_3 \cdot SO_3$ .**Deliquescent. Sol. in  $H_2O$ . (Schultz-Sellack, B. 4, 14.)

$MoO_3 \cdot 3SO_3 + 2H_2O$ . Deliquescent. Partially sol. in  $H_2O$  (Anderson, Berz. J. B. 22, 161.)

Does not exist (Schultz-Sellack.)

**Molybdenum sulphate ammonia,** $5NH_3 \cdot MoO_3SO_3 \cdot 7MoO_3 + 8H_2O$ . $3NH_3 \cdot MoO_3SO_3 \cdot 7MoO_3 + 10H_2O$ 

Both very sol. in water but less sol. in  $H_2O$  containing ammonium salts (Péchar, C. R. 1901, 132, 630.)

**Neodymium sulphate, basic,  $Nd_2O_3 \cdot SO_3$ .**Insol. in  $H_2O$ .

Nearly insol. in dil. acids. (Wöhler, B. 1913, 46, 1730.)

Insol. in  $H_2O$  (Matignon, C. R. 1902, 134, 658.)**Neodymium sulphate,  $Nd_2(SO_4)_3 + 8H_2O$ .**Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .

$t^\circ$	pts. $Nd_2(SO_4)_3$
0	9.50
16	7.05
30	5.04
50	3.72
80	2.70
100	2.21

(Muthmann and Rohg, B. 1898, 31, 1728.)

**Neodymium hydrogen sulphate,  $Nd(SO_4H)_3$ .**

(Brauner, Z. anorg. 1904, 38, 331.)

**Neodymium potassium sulphate.**

Cryst. modification more sol. in cold than in hot  $H_2O$ . (Boudouard, C. R. 1898, 126, 901.)

**Nickel sulphate, basic.**Very sl. sol. in  $H_2O$ . (Berzelius.) $6NiO \cdot 5SO_3 + 4H_2O$ . (Athanasesco, C. R. 103, 271.) $7NiO \cdot 7H_2O \cdot SO_3 + 3H_2O$ . Nearly insol. in  $H_2O$ . (Habermann, M. 5, 432.) $5NiO \cdot SO_3 \cdot 5NiO \cdot 2SO_3$ ; and  $5NiO \cdot 3SO_3$ . (Pickering, Chem. Soc. 1907, 91, 1985.) $6NiO \cdot SO_3$ . (Strömholm, C. C. 1906, 1, 1222.)**Nickel sulphate,  $NiSO_4$ .**100 pts.  $H_2O$  dissolve pts.  $NiSO_4$  at  $t^\circ$ 

20°	16°	20°	23°	31°
30.4	37.4	39.7	41	45.3 pts $NiSO_4$

41°	50°	53°	60°	70°
49.1	52	54.4	57.2	61.9 pts $NiSO_4$

(Tobler, A. 95, 193.)

100 pts. of sat. solution contain: at 11-14°, 28.84; at 18-20°, 30.77 pts anhydrous salt. (v. Hauer, W. A. B. 63, 2, 221.)

100 pts.  $H_2O$  at 112.5° dissolve 185.71 pts  $NiSO_4$ . (Griffiths.) $NiSO_4 \cdot 7H_2O$  is sol. in 3 pts.  $H_2O$  at 12.5° (Tupputi.)100 pts.  $H_2O$  at 15.5° dissolve 75.8 pts  $NiSO_4 + 7H_2O$ Sat.  $NiSO_4 + Aq$  contains at:

—3° +2° 5° 11° 17° 54°

21.7 22.7 23.1 25.2 26.6 33.6%  $NiSO_4$ .

68° 74° 92° 97° 110° 117° 119°

38.2 38.7 42.4 44.2 46.5 48.8 49.4%  $NiSO_4$ .

(Étard, A. ch. 1894, (7) 2, 552.)

See also below under hydrated salts.

Sp. gr. of  $NiSO_4 + Aq$  containing g.  $NiSO_4 + 7H_2O$  in 1000 g.  $H_2O$  at 23.5°

140.5 g. (= 1/2 mol.)	281	421.5	562
1.073	1.136	1.190	1.238

602.5 843 983.5 1124

1.280 1.317 1.349 1.378

Containing  $NiSO_4$  (anhydrous):

77.5 g. (= 1/2 mol.) 155 232.5 310 387.5 465

1.079 1.153 1.224 1.292 1.358 1.421

(Gerlach, Z. anal. 28, 468.)

Sp. gr. of  $NiSO_4 + Aq$  at 0°. S = pts  $NiSO_4$  in 100 pts solution;  $S_1$  = mols.  $NiSO_4$  in 100 mols solution

S	$S_1$	Sp. gr.
4.2930	0.581	1.0522
3.9591	0.476	1.0431
3.2845	0.392	1.0357
2.5043	0.297	1.0271
1.6131	0.189	1.0173
0.8327	0.097	1.0089

(Charpy, A. ch. (6) 29, 26.)

Sp. gr. of  $NiSO_4 + Aq$  at room temp. containing:

10.62	18.19	25.35% $NiSO_4$
1.0925	1.1977	1.3137

(Wagner, W. Ann. 1883, 18, 272.)

Sp. gr. of  $NiSO_4 + Aq$  at 25°.

Concentration of $NiSO_4 + Aq$	Sp. gr.
1-normal	1.0773
1/2 " "	1.0391
1/3 " "	1.0198
1/4 " "	1.0017

(Wagner, Z. phys. Ch. 1890, 5, 39.)

For solubility of  $\text{NiSO}_4 \cdot \text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$ , see under  $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$  and  $\text{NiNa}_2(\text{SO}_4)_2$ .  
100 pts sat.  $\text{NiSO}_4 \cdot \text{ZnSO}_4 + \text{Aq}$  at 18–20° contain 35.45 pts. of the two salts (v. Hauer).  
Insol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20, 828.)

$\text{HC}_2\text{H}_3\text{O}_2$  precipitates it completely from aqueous solution. (Persoz.)

100 pts. absolute methyl alcohol dissolve 0.5 pt.  $\text{NiSO}_4$  at 18°. (de Bruyn, Z. phys. Ch. 10, 783.)

Solubility of  $\text{NiSO}_4 \cdot 3\text{CH}_3\text{O} + 3\text{H}_2\text{O}$  in methyl alcohol at 14°

P = % anhydrous  $\text{NiSO}_4$  in the sat. solutions

Alcohol % by wt	P	In 1000 mol of the solution		
		Mol $\text{NiSO}_4$	Mol $\text{CH}_3\text{O}$	Mol $\text{H}_2\text{O}$
100	3.72	7.75	969	23.2
97.5	0.77	1.65	950	48.5
95	0.455	0.96	908	91
92.5	0.50	1.0	871	128
90	0.70	1.6	830	168
89	1.01	2.0	814	184
88	1.25	2.4	800	198
87	1.48	2.9	781	216
86	1.73	3.2	767	230
85	1.93	3.6	755	241

(de Bruyn, R. t. c. 1903, 22, 418.)

This salt is more sol. in ethyl alcohol than in methyl alcohol.

See also under hydrated salts

For solubility of  $\text{NiSO}_4$  in ethyl alcohol, see under hydrated salts.

100 g. sat. solution in glycol contain 9.7 g.  $\text{NiSO}_4$  at ord. temp. (de Coninck, Bull. Ac. Roy. Belg. 1906, 359.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate, (Naumann, B. 1904, 37, 3602.)

Very sl. sol. in acetone. (Krug and McElroy.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014).

+ $\text{H}_2\text{O}$ . Very sl. sol. in abs. methyl alcohol. After standing in contact with it for 8–9 months, the solution contains 1.34%  $\text{NiSO}_4$ . (de Bruyn, R. t. c. 1903, 22, 414.)

+ $2\text{H}_2\text{O}$ . Cryst. from sat.  $\text{NiSO}_4 + \text{Aq}$  at 131°. (Steele and Johnson.)

+ $4\text{H}_2\text{O}$ . Solubility in methyl alcohol +  $\text{Aq}$  at 10°. Time = 24 hrs. P = % anhydrous salt in the sat. solutions.

Alcohol of 100% 80% 50% 20% water  
P 7.38 0.66 1.43 14.8 25.1

(de Bruyn, R. t. c. 1903, 22, 414.)

+ $6\text{H}_2\text{O}$ . Two modifications.  $\alpha$ -blue, tetragonal;  $\beta$ -green, monoclinic.

Solubility of  $\alpha$ - $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°.

Salt used	t°	% $\text{NiSO}_4$ in 100 g $\text{H}_2\text{O}$	Salt remaining
$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (blue)	32.3	43.57	$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (blue)
"	33.0	43.35	"
"	34.0	43.84	"
"	35.6	43.79	"
$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$	44.7	48.05	"
$\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$	44.7	47.97	"
$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (blue)	50.0	50.15	"
"	51.0	50.66	"
"	52.0	52.34	"
"	53.0	52.34	"

(Steele and Johnson.)

Solubility of  $\beta$ - $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°.

Salt used	t°	% $\text{NiSO}_4$ per 100 g $\text{H}_2\text{O}$	Salt remaining
$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (blue)	54.5	52.50	$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (green)
$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (blue)	57.0	53.40	"
$\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$	57.0	54.84	"
$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (blue)	60.0	54.84	"
$\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$	69.0	55.35	"
$\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$	70.0	56.44	"
$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (blue)	73.0	60.72	"
$\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$ (blue)	80.0	63.17	"
$\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$	89.0	67.90	"
$\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$	99.0	70.71	"

(Steele and Johnson, Chem. Soc. 1904, 85, 118.)

Tr. point from  $\alpha$ - to  $\beta$ -salt = 53.3°. (Steele and Johnson.)

100 pts. absolute methyl alcohol dissolve 31.6 pts.  $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$  at 17°; 100 pts. 93.5% methyl alcohol dissolve 7.8 pts.  $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$  at 18°; 100 pts. 50% methyl alcohol dissolve 1.9 pts.  $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$  at 18°. (de Bruyn, Z. phys. Ch. 10, 786.)

$\alpha$ -Salt. Solubility in methyl alcohol +  $\text{Aq}$  at 14°. Time = 5 to 6 hrs.

Alcohol % by wt.	% $\text{NiSO}_4$	In 1000 mol of the solution		
		Mol. $\text{NiSO}_4$	Mol. $\text{CH}_3\text{O}$	Mol. $\text{H}_2\text{O}$
100	12.4	26	794	180
97.5	10.6	22.3	808	170
95	6.5	14	817	169
92.5	3.06	5.9	838	156
90	1.18	2.3	821	177
85	0.315	0.57	757	242
80	0.25	0.4	688	312
60	0.46	0.8	453	546
40	2.43	3.5	265	732
20	14.7	21	105	874
0 (water)	26.0	39	0	961

(de Bruyn, R. t. c. 1903, 22, 412.)

$\beta$ -salt. Solubility in methyl alcohol + Aq at 14°. Time = 24 hrs

Alcohol % by wt.	% NiSO <sub>4</sub>	In 1000 mol of the solution		
		Mol NiSO <sub>4</sub>	Mol. CH <sub>3</sub> OH	Mol. H <sub>2</sub> O
100	15.7	33.8	763	203
97.5	12.4	26	781	193
95	10.0	20.3	784	196
92.5	5.61	11.1	800	189
90	2.35	4.5	810	185
89	1.79			
88	1.29			
87	0.97			
86	0.735			
85	0.61	1.3	755	244
80	0.415	0.7	682	317
60	0.75	1.3	453	546
40	3.11	4.0	264	732
20	14.1	21.0	105	874
0 (water)	27.2	40.0	0	960

(de Bruyn)

+7H<sub>2</sub>O  
Solubility in 100 pts. H<sub>2</sub>O at t°, using  
NiSO<sub>4</sub> + 7H<sub>2</sub>O.

t°	Pts NiSO <sub>4</sub>	t°	Pts NiSO <sub>4</sub>	t°	Pts NiSO <sub>4</sub>
0	29.3	33	45.5	66	63.6
1	29.7	34	46.0	67	64.1
2	30.1	35	46.5	68	64.7
3	30.5	36	47.0	69	65.3
4	31.0	37	47.5	70	65.9
5	31.5	38	48.0	71	66.5
6	32.0	39	48.5	72	67.0
7	32.5	40	49.0	73	67.6
8	33.0	41	49.5	74	68.2
9	33.5	42	50.1	75	68.8
10	34.0	43	50.6	76	69.3
11	34.5	44	51.2	77	69.9
12	35.0	45	51.7	78	70.5
13	35.5	46	52.3	79	71.1
14	36.0	47	52.8	80	71.7
15	36.5	48	53.4	81	72.3
16	37.0	49	53.9	82	72.9
17	37.5	50	54.5	83	73.5
18	38.0	51	55.0	84	74.1
19	38.5	52	55.6	85	74.6
20	39.0	53	56.1	86	75.2
21	39.5	54	56.7	87	75.8
22	40.0	55	57.3	88	76.4
23	40.5	56	57.9	89	77.0
24	41.0	57	58.4	90	77.6
25	41.5	58	59.0	91	78.2
26	42.0	59	59.6	92	78.8
27	42.5	60	60.2	93	79.4
28	43.0	61	60.7	94	80.1
29	43.5	62	61.3	95	80.7
30	44.0	63	61.9	96	81.3
31	44.5	64	62.4	97	81.9
32	45.0	65	63.0	98	82.5

Solubility in 100 pts. H<sub>2</sub>O at t° — Continued

t°	Pts NiSO <sub>4</sub>	t°	Pts NiSO <sub>4</sub>	t°	Pts NiSO <sub>4</sub>
99	83.1	103	85.6	107	88.1
100	83.7	104	86.2	108	88.7
101	84.3	105	86.8	108.4	88.7
102	84.9	106	87.5		

(Mulder, calculated from his own and Tohler's determinations, Scheik. Verhandel. 1864, 70.)

Solubility in H<sub>2</sub>O at t°.

Salt used	t°	g NiSO <sub>4</sub> in 100 g H <sub>2</sub> O	Salt remaining
NiSO <sub>4</sub> + 7H <sub>2</sub> O	-5	25.74	NiSO <sub>4</sub> + 7H <sub>2</sub> O
"	0	27.22	"
"	9	31.55	"
"	15	34.19	"
"	22.6	37.90	"
"	22.8	38.88	"
"	30.0	42.46	"
NiSO <sub>4</sub> + 6H <sub>2</sub> O	30.0	42.47	"
NiSO <sub>4</sub> + 7H <sub>2</sub> O	32.3	44.02	"
"	33.0	45.74	"
"	34.0	45.5	"

(Steele and Johnson, Chem. Soc. 1904, 85, 116.)

M-pt. of NiSO<sub>4</sub> + 7H<sub>2</sub>O = 98–100°. (Tilden, Chem. Soc. 45, 409.)

Tr. point from a-6H<sub>2</sub>O salt to 7H<sub>2</sub>O salt = 31.5°. (Steele and Johnson.)

Exists also in an unstable, more soluble modification. (Fedorow, C. C. 1903, II, 95.)

Solubility of NiSO<sub>4</sub> · 7H<sub>2</sub>O + Na<sub>2</sub>SO<sub>4</sub> · 10H<sub>2</sub>O in 100 g H<sub>2</sub>O at t°.

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
0	22.46	10.09
5	25.28	15.245
10	28.26	20.64

(Koppel, Z. phys. Ch. 1905, 52, 401.)

See also under NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>.

100 pts. absolute methyl alcohol dissolve 46 pts. NiSO<sub>4</sub> + 7H<sub>2</sub>O at 17°; 100 pts. absolute methyl alcohol dissolve 24.7 pts. NiSO<sub>4</sub> + 7H<sub>2</sub>O at 4°; 100 pts. 93.5% methyl alcohol dissolve 10.1 pts. NiSO<sub>4</sub> + 7H<sub>2</sub>O at 4°, 100 pts. 50% methyl alcohol dissolve 2 pts. NiSO<sub>4</sub> + 7H<sub>2</sub>O at 4°. (de Bruyn, Z. phys. Ch. 10, 786.)

Solubility in methyl alcohol + Aq at 14°  
Time, 5 to 6 hrs

Alcohol % by wt.	% NiSO <sub>4</sub>	In 1000 mol of solution		
		Mol NiSO <sub>4</sub>	Mol CH <sub>3</sub> O	Mol H <sub>2</sub> O
100	16 8	35 7	714	250
97 5	13 9	29	734	237
95	11 6	23 6	742	234 5
92 5	8 12	16 2	760	224
90	5 78	11 2	758	231
85	1 52	3	744	253
84	1 08			
83	0 985			
82	0 83			
81	0 665			
80	0 553	1 2	687	312
60	0 805	1 3	453	546
45	1 73			
40	2 78	4	264	732
35	4 55			
30	6 33			
20	13 7	20	105	875
0 (water)	26 4	39 5	0	960.5

(de Bruyn, B. t. c. 1903, 22, 411)

100 g. absolute ethyl alcohol dissolves 1.3 g. NiSO<sub>4</sub> + 7H<sub>2</sub>O at 4°, and 2.2 g. at 17°. (de Bruyn, Z. phys. Ch. 10, 788)  
Min. *Morenoensis*

**Nickel hydrazine sulphate**, NiH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.

1 pt. is sol in 275.5 pts. H<sub>2</sub>O at 18°. Sol in hot H<sub>2</sub>O. Sol in HNO<sub>3</sub> with decomp.; insol. in HCl. Sol. in NH<sub>4</sub>OH + Aq. (Curcius, J. pr. 1894, (2) 50, 331.)

**Nickel potassium sulphate**, NiSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> + 6H<sub>2</sub>O.

Sol. in 8-9 pts. H<sub>2</sub>O (Tuppen.)

100 pts. H<sub>2</sub>O dissolve at:

0° 10° 14° 20° 30°  
5.3 8.9 10.5 13.8 18.6 pts. anhydrous salt,

36° 40° 55° 60° 75°

20.4 27.7 32.4 35.4 45.6 pts. anhydrous salt.

(Tobler, A. 95, 193.)

Saturated solution contains at:

20° 40° 60° 80°

8.7 12.3 17.6 22.0% anhydrous salt.

(v. Hauer, J. pr. 74, 433.)

1 l. H<sub>2</sub>O dissolves 68.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27, 459.)

**Nickel potassium zinc sulphate**, NiSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub> + 12H<sub>2</sub>O.

Sol in H<sub>2</sub>O. (Vohl, A. 94, 51.)

**Nickel rubidium sulphate**, NiSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub> + 6H<sub>2</sub>O.

Sol in H<sub>2</sub>O. (Tutton, Chem. Soc. 63, 337)  
1 l. H<sub>2</sub>O dissolves 90.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27, 459.)

**Nickel sodium sulphate**, NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O.

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> · 4H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
20	29 31	26 87
25	27 33	25 33
30	24 64	22 58
35	23 66	21 67
40	21 88	20 65

(Koppel, Z. phys. Ch. 1905, 52, 401.)

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> · 4H<sub>2</sub>O + NiSO<sub>4</sub>, 7H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams NiSO <sub>4</sub>	grams NiSO <sub>4</sub>	t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
18 5	30 70	25 805	30	34 98	19 825
20	31 59	25 355	35	36 01	16 435
25	33 11	23 07	40	37 935	14 295

(Koppel.)

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> · 4H<sub>2</sub>O + Na<sub>2</sub>SO<sub>4</sub>, 10H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
18 5	26 14	29 455
20	24 07	31 365
25	18 81	37 13
30	9 87	44 25

(Koppel.)

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> · 4H<sub>2</sub>O + Na<sub>2</sub>SO<sub>4</sub> (anhydrous) in 100 g. H<sub>2</sub>O at t°.

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
35	7 13	49 595
40	7 245	49 03

(Koppel.)

**Nickel thallium sulphate**, NiSO<sub>4</sub>, Tl<sub>2</sub>SO<sub>4</sub> + 6H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O. Can be recryst. from little H<sub>2</sub>O without decomp. (Werther, J. pr. 92, 132.)

1 l. H<sub>2</sub>O dissolves 46.1 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27, 459.)

**Nickel zinc sulphate**, NiSO<sub>4</sub>, ZnSO<sub>4</sub> + 13H<sub>2</sub>O.

Sol. in 3-4 pts. cold H<sub>2</sub>O. Insol. in alcohol. (Tuppen, 1811.)

Completely sol. in NH<sub>4</sub>OH + Aq.  
2NiSO<sub>4</sub>, 2ZnSO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>. (Étard, C. R. 87, 602.)

**Nickel sulphate ammonia,  $\text{NiSO}_4 \cdot 6\text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$  with separation of hydroxide (Rose, Pogg. 20. 151.)

$\text{NiSO}_4 \cdot 5\text{NH}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent.

(André, C. R. 106. 936.)

$\text{NiSO}_4 \cdot 4\text{NH}_3 + 2\text{H}_2\text{O}$  Easily sol. in  $\text{H}_2\text{O}$ . Can be recrystallized out of little  $\text{H}_2\text{O}$ . Insol. even in dil. alcohol. (Erdmann.)

**Nickel sulphate cupric oxide,  $\text{NiSO}_4 \cdot 2\text{CuO} + 6\text{H}_2\text{O}$ .**

(Mailhe, Bull. Soc. 1902, (3) 27. 172.)

$2\text{NiSO}_4 \cdot 3\text{CuO} + 10\text{H}_2\text{O}$ , and  $+12\text{H}_2\text{O}$

(Mailhe.)

$5\text{NiSO}_4 \cdot 16\text{CuO} + x\text{H}_2\text{O}$  (Recoura, C. R. 1901, 132. 1415.)

$\text{NiSO}_4 \cdot 20\text{CuO} + x\text{H}_2\text{O}$  (Recoura.)

**Nickel sulphate, hydrazine,  $\text{NiSO}_4 \cdot 3\text{N}_2\text{H}_4$ .**

Ppt. (Curtius, J. pr. 1894, (2) 50. 343.)

**Nickel sulphate hydroxylamine,  $\text{NiSO}_4 \cdot 6\text{NH}_2\text{OH}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Uhlenhut, A. 1899, 307. 334.)

**Nitrosyl sulphate,  $\text{H}(\text{NO})\text{SO}_4$ .**

See Nitrosulphonic acid.

**Osmious sulphate.**

Easily sol. in  $\text{H}_2\text{O}$  and alcohol.

**Osmic sulphate.**

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Palladous sulphate, basic,  $\text{PdSO}_4 \cdot 7\text{PdO} + 6\text{H}_2\text{O}$ , and  $10\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Kane.)

**Palladous sulphate,  $\text{PdSO}_4 + 2\text{H}_2\text{O}$ .**

Deliquescent in moist air; very sol. in  $\text{H}_2\text{O}$ , but decomp. by much  $\text{H}_2\text{O}$ , with separation of a basic salt. (Kane.)

**Phosphoryl sulphate,  $(\text{PO})_2(\text{SO}_4)_2$  (?).**

Possible composition of Weber's (B. 20. 86)  $\text{P}_2\text{O}_5 \cdot 3\text{SO}_3$  (?).

$3\text{P}_2\text{O}_5 \cdot 2\text{SO}_3$ . Immediately decomp. by  $\text{H}_2\text{O}$ . (Adie, C. N. 1891, 63. 102.)

**Platinic sulphate,  $\text{Pt}(\text{SO}_4)_2$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, or ether; also in  $\text{H}_3\text{PO}_4$ ,  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ . (Berzelius.)

$\text{H}_2\text{PtO}_4 \cdot 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Blondel, A. ch. 1905, (8) 6. 109.)

$\text{PtO}_3 \cdot 8\text{H}_2\text{O} + 4\text{H}_2\text{O}$ . Ppt. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_4$ .

$\text{PtSO}_4(\text{OH})_2 \cdot 4\text{Pt}(\text{OH})_4 + 3\text{H}_2\text{O}$ . Ppt (Prost, Bull. Soc. (2) 46. 156.)

$\text{Pt}_2\text{SO}_{10} + 16\text{H}_2\text{O}$ . As above. (Prost.)

**Platinum hydroxylamine sulphate,  $\text{Pt}(\text{NH}_2\text{OH})_2\text{SO}_4$ .**

Only sl. sol. in  $\text{H}_2\text{O}$ , sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Uhlenhut, A. 1900, 311. 123.)

**Platinic potassium sulphate, basic.**

Insol. in boiling  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in boiling  $\text{HCl} + \text{Aq}$ . Sl. decomp. by aqua regia (B. Davy.)

$\text{Pt}_{10}(\text{SO}_4)_2\text{O}_{19} \cdot 3\text{K}_2\text{SO}_4 + 34\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  (Prost, Bull. Soc. (2) 46. 156.)

$\text{Pt}_{18}(\text{SO}_4)_3\text{O}_{23} \cdot 5\text{K}_2\text{SO}_4 + 34\text{H}_2\text{O}$ . As above. (Prost.)

**Platinum rubidium sulphate,  $\text{Pt}_4\text{Rb}_6(\text{SO}_4)_4 + 17\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Prost, Bull. Soc. (2) 46. 156.)

**Platinum sulphate sulphocarbamide,  $\text{PtSO}_4 \cdot 4\text{CS}(\text{NH}_2)_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$  without decomp. (Kurnakow. J. pr. 1894, (2) 50. 489.)

**Potassium sulphate,  $\text{K}_2\text{SO}_4$ .**

Not hygroscopic in the ordinary sense of the word. 100 pts  $\text{K}_2\text{SO}_4$  over  $\text{H}_2\text{O}$  at  $14-20^\circ$  absorb 58 pts  $\text{H}_2\text{O}$  in 22 days, and finally deliquesce completely (Mulder.)

12 pts  $\text{K}_2\text{SO}_4$  mixed with 100 pts.  $\text{H}_2\text{O}$  lower the temp.  $3.3^\circ$  (Rüdorff, B. 2. 68.)

100 pts  $\text{H}_2\text{O}$  dissolve with absorption of heat at  $0^\circ$ .

8.36 pts.  $\text{K}_2\text{SO}_4$ . (Gay-Lussac.)

8.46 " (Mulder.)

8.5 " (Gerardin.)

7.31 " (Möller, Pogg. 117. 386.)

7.3-7.9 " (Nordenskiöld, Pogg. 136. 314.)

100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 8.36 pts.  $\text{K}_2\text{SO}_4$ , at  $12.72^\circ$ , 10.57 pts., at  $49.08^\circ$ , 16.91 pts., at  $63.90^\circ$ , 19.29 pts., at  $101.50^\circ$ , 26.33 pts. (Gay Lussac, A. ch. (2) 11. 311.)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{K}_2\text{SO}_4$	$t^\circ$	Pts. $\text{K}_2\text{SO}_4$
0	7.8	47.0	16.0
15.65	10.3	70.2	20.3
28.1	12.8	98.0	23.9

(Nordenskiöld, Pogg. 136. 341.)

100 pts. sat.  $\text{K}_2\text{SO}_4$  at  $101.7^\circ$  contain 17.5 pts.  $\text{K}_2\text{SO}_4$ , or 100 pts  $\text{H}_2\text{O}$  at  $101.25^\circ$  dissolve 21.212 pts.  $\text{K}_2\text{SO}_4$ . (Griffiths.)

100 pts  $\text{H}_2\text{O}$  at  $102.8^\circ$  dissolves 29 pts.  $\text{K}_2\text{SO}_4$  (Penny); at  $15^\circ$ , 7.3-8.23 pts. (Ure's Diet.), at  $100^\circ$ , 20 pts (Ure's Diet.); at  $100^\circ$ , 24.2 pts. (Weasel)

Sol. in 9.081 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach); in 16 pts. at  $15^\circ$ , and 5 pts. at  $100^\circ$  (Bergmann); in 18 pts. cold, and 5 pts. boiling  $\text{H}_2\text{O}$  (Fourcroy); in 15 pts. cold, and 5 pts. boiling  $\text{H}_2\text{O}$  (Reid); in 12 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , and 4 pts. boiling  $\text{H}_2\text{O}$  (M. R. and P.), in 12 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl.)

$\text{K}_2\text{SO}_4$  sat. at  $16^\circ$  has sp. gr. = 1.0774, and contains 10.055 pts  $\text{K}_2\text{SO}_4$  in 100 pts  $\text{H}_2\text{O}$  (Michel and Krafft, A. ch. (3) 41. 478.)

100 pts.  $\text{H}_2\text{O}$  dissolve 9.26 pts.  $\text{K}_2\text{SO}_4$  at  $15.6^\circ$ , and sat. solution has sp. gr. = 1.177. (Page and Keightley, Chem. Soc. (2) 10. 566.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. K <sub>2</sub> SO <sub>4</sub>	t°	Pts. K <sub>2</sub> SO <sub>4</sub>	t°	Pts. K <sub>2</sub> SO <sub>4</sub>
0	8.5	35	13.1	70	19.8
1	8.6	36	13.3	71	20.0
2	8.7	37	13.4	72	20.2
3	8.8	38	13.6	73	20.4
4	9.0	39	13.8	74	20.6
5	9.1	40	14.0	75	20.8
6	9.2	41	14.2	76	21.0
7	9.3	42	14.3	77	21.2
8	9.4	43	14.5	78	21.4
9	9.5	44	14.7	79	21.6
10	9.7	45	14.9	80	21.8
11	9.8	46	15.1	81	22.0
12	9.9	47	15.3	82	22.2
13	10.0	48	15.5	83	22.4
14	10.2	49	15.6	84	22.6
15	10.3	50	15.8	85	22.8
16	10.4	51	16.0	86	23.0
17	10.5	52	16.2	87	23.2
18	10.7	53	16.4	88	23.4
19	10.8	54	16.6	89	23.6
20	10.9	55	16.8	90	23.9
21	11.1	56	17.0	91	24.1
22	11.2	57	17.2	92	24.3
23	11.3	58	17.4	93	24.5
24	11.5	59	17.6	94	24.7
25	11.6	60	17.8	95	25.0
26	11.7	61	18.0	96	25.2
27	11.9	62	18.2	97	25.5
28	12.0	63	18.4	98	25.7
29	12.2	64	18.6	99	25.9
30	12.3	65	18.8	100	26.2
31	12.5	66	19.0	101	26.4
32	12.6	67	19.2	102	26.6
33	12.8	68	19.4	102.25	26.75
34	13.0	69	19.6		

(Mulder, calculated from his own and other experiments, Scheik Verhandel 1884. 50.)

If solubility S=pts. anhydrous salt in 100 pts. of solution,  $S=7.5+0.1070t$  from 0° to 163°. Solubility from 163° to 220° is constant at 25. (Étard, C R. 106. 208.)

Solubility of K<sub>2</sub>SO<sub>4</sub> in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. K <sub>2</sub> SO <sub>4</sub>	t°	Pts. K <sub>2</sub> SO <sub>4</sub>	t°	Pts. K <sub>2</sub> SO <sub>4</sub>
16	9.76	39	14.21	120	26.5
20	10.30	54	17.39	143	28.8
28	12.59	98	23.91	170	32.9
36	13.28				

(Tilden and Shonstone, Phil Trans. 1884. 23.)

Solubility of K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O. 100 pts H<sub>2</sub>O dissolve at:

4.3°	18.4°	69.9°
8.16	10.8	19.7 pts. K <sub>2</sub> SO <sub>4</sub>

(Andreae, J. pr. (2) 29. 456.)

100 ccm. H<sub>2</sub>O dissolve 12.04 g. K<sub>2</sub>SO<sub>4</sub> at 25°. (Trevor, Z phys Ch. 7. 468.)Sat. K<sub>2</sub>SO<sub>4</sub>+Aq contains at:

21°	23°	60°	98°	130°
10.1	10.3	14.5	19.1	21.1% K <sub>2</sub> SO <sub>4</sub>
130°	152°	175°	195°	220°
21.3	22.8	24.5	23.8	24.6% K <sub>2</sub> SO <sub>4</sub>

(Étard, A. ch. 1894, (7) 2. 549.)

Solubility of K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O at t°.G. K<sub>2</sub>SO<sub>4</sub> per 100 g. H<sub>2</sub>O

t°	K <sub>2</sub> SO <sub>4</sub>	Sp gr	t°	K <sub>2</sub> SO <sub>4</sub>	Sp gr
0	40	7.47	1.0589	58.95	18.01
15	70	10.37	1.0770	74.85	20.64
31	45	13.34	1.0921	89.70	22.80
42.75	15	61	1.1010	101.1°	24.21

\* = b.-pt

(Berkeley, Phil. Trans. Roy. Soc. 1904, 203. A, 189.)

100 g H<sub>2</sub>O dissolve 0.133 gram-equivalent K<sub>2</sub>SO<sub>4</sub> at 25° (Van't Hoff and Meyerhoffer, Z. phys. Ch. 1904, 49. 315.)  
1 l. sat K<sub>2</sub>SO<sub>4</sub>+Aq at 25° contains 0.617 mols. K<sub>2</sub>SO<sub>4</sub>. (Heiz, Z anorg 1911, 73. 274.)

Solubility of K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O at t°.

t°	% K <sub>2</sub> SO <sub>4</sub>
4.78	7.82
30.05	11.43
54.20	14.77
68.90	16.40

(Le Blanc and Schmandt, Z. phys. Ch. 1911, 77. 614.)

100 g. H<sub>2</sub>O dissolve 12.10 g. K<sub>2</sub>SO<sub>4</sub> at 25°. (Amadori, Rend Acc. Linc. 1912, (5) 21. 11. 667.)

Solubility of K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O at various pressures. Figures denote pts. K<sub>2</sub>SO<sub>4</sub> contained in 100 pts. sat. K<sub>2</sub>SO<sub>4</sub>+Aq at t° and A pressure in atmospheres

A	0°	15°	15.5°	16.2°
1	6.81	9.14	9.24	9.35
20	7.14		9.44	9.54
30	7.14			

(Möller, Pogg. 117. 386.)

Sat. K<sub>2</sub>SO<sub>4</sub>+Aq boils at 101.5°, and contains 26.33 pts K<sub>2</sub>SO<sub>4</sub> to 100 pts. H<sub>2</sub>O (Gay-Lussac); at 101.7°, and contains 21.2 pts. K<sub>2</sub>SO<sub>4</sub> to 100 pts. H<sub>2</sub>O (Griffiths); at 102.25°, and contains 26.75 pts K<sub>2</sub>SO<sub>4</sub> to 100 pts. H<sub>2</sub>O (Mulder); boils at 103° (Kramers).

Crust-forms at 101.7°, and solution contains 25.3 pts. K<sub>2</sub>SO<sub>4</sub> to 100 pts. H<sub>2</sub>O; highest

temp. observed, 102.1° (Gerlach, Z. anal. 26. 426.)

B.-pt. of  $K_2SO_4 + Aq$  containing pts.  $K_2SO_4$  to 100 pts  $H_2O$

B.-pt	Pts $K_2SO_4$	B.-pt	Pts. $K_2SO_4$
100 5°	7	102°	30 0
101 0	14 5	102 1	31.6
101 5	22 1		

(Gerlach, Z. anal. 26. 430)

Sp. gr. of  $K_2SO_4$  at 18°

% $K_2SO_4$	Sp. gr.	% $K_2SO_4$	Sp. gr.
2 401	1 0193	9 264	1 0763
4 744	1 0385	10 945	1 0909
6 908	1 0508		

(Kremer, Pugg 95 120)

Sp. gr. and B.-pt. of  $K_2SO_4 + Aq$  at 12.5°

Pts $K_2SO_4$ to 100 pts $H_2O$	Sp. gr.	B.-pt.	Pts $K_2SO_4$ to 100 pts $H_2O$	Sp. gr.	B.-pt.
1	1 0079	100 38°	0	1 0456	101 12°
2	1 0151	100 63°	7	1 0524	101 25°
3	1 0231	100 75°	8	1 0599	101 25°
4	1 0305	100 88°	9	1 0676	101 38°
5	1 0391	101°	10	1 0735	101 5°

(Brandes and Gruner, 1827.)

$K_2SO_4 + Aq$  sat. at 8° has 1.072 sp. gr. (Anthon, A. 24. 211.)

$K_2SO_4 + Aq$  saturated at 12° contains 10.38%  $K_2SO_4$  and has sp. gr. 1.0716 (Struve, Zeit. Ch. (2) 5. 323); saturated at 15° contains 11.01%  $K_2SO_4$  and has sp. gr. 1.0831 (Gerlach); saturated at 18.75° contains 10.74%  $K_2SO_4$  and has sp. gr. 1.0798 (Karsten).

Sp. gr. of  $K_2SO_4 + Aq$  at 15°.

% $K_2SO_4$	Sp. gr.	% $K_2SO_4$	Sp. gr.	% $K_2SO_4$	Sp. gr.
1	1 0082	5	1 0410	8	1.0604
2	1.0163	6	1.0495	9	1.0750
3	1.0245	7	1 0579	9.92	1 0830
4	1.0328				

(Gerlach, Z. anal. 8. 287.)

Sp. gr. of  $K_2SO_4 + Aq$  at 18°.

% $K_2SO_4$	Sp. gr.
5	1 0395
10	1 0815

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $K_2SO_4 + Aq$  at 15°/15° a=pts.  $K_2SO_4$  in 100 pts of the solution, b=pts.  $K_2SO_4$  in 100 pts  $H_2O$ .

a	b	Sp. gr.
1	1 010	1 00808
3	3 093	1 02447
5	5.293	1.04091
7	7.527	1 05776
9	9 890	1 07499
9 92	11 013	1 08305

(Gerlach, Z. anal. 28. 493.)

Sp. gr. of  $K_2SO_4 + Aq$  at 20° containing 0.5 mol.  $K_2SO_4$  to 100 mols.  $H_2O$  = 1.03758; containing 1 mol  $K_2SO_4$  to 100 mols.  $H_2O$  = 1 06744 (Nicol, Phil. Mag. (5) 16. 122)

Sp. gr. of  $K_2SO_4 + Aq$  at 25°

Concentration of $K_2SO_4 + Aq$	Sp. gr.
1-normal	1 0664
$\frac{1}{2}$ " "	1 0388
$\frac{1}{4}$ " "	1.0170
$\frac{1}{8}$ " "	1 0084

(Wagner, Z. phys. Ch. 1890, 5. 37.)

$K_2SO_4 + Aq$  containing 6.7%  $K_2SO_4$  has sp. gr. 20°/20° = 1.0549 (Le Blanc and Rohland, Z. phys. Ch. 1890, 19. 278)

Sp. gr. of  $K_2SO_4 + Aq$  at 20.1°, when p = per cent strength of solution, d = observed density; w = volume conc in gr per cc.  $\left(\frac{pd}{100} = w\right)$

p	d	w
9.83	1.0800	0 10615
8.172	1 0557	0 08708
6 779	1 0539	0.07144
5 021	1.0394	0 05218
3 127	1 0238	0 03202
2 508	1 0186	0 02554
1 448	1.0100	0 01463
1 079	1.0070	0 01087
1 047	1.0066	0 01053
0.455	1 0018	0 00456

(Barnes, J. phys. Chem. 1898, 2. 543.)

Sp. gr. of  $K_2SO_4 + Aq$  at 18°.

$\frac{1}{2}$ $K_2SO_4$ g.-equiv. per l	Sp. gr. at 18°
0 8327	1.0567
0 7975	1.0539
0.6688	1 0456
0 5029	1.0344
0.5016	1 0340
0.2508	1 0173
0 01001	1 0006

(McKay, Elektrochem. Zeit. 1899, 6. 115.)

Sp gr. of sat  $K_2SO_4 + Aq$  at  $t^\circ$ .

$t^\circ$	$\kappa$ $K_2SO_4$ sol in 100 g $H_2O$	Sp gr
0	7.35	1.058
10	9.22	1.069
20	11.11	1.081
30	12.97	1.089
40	14.76	1.097
50	16.50	1.106
60	18.17	1.114
70	19.75	1.121

(Tschernaj, J. Russ. phys. Chem. Soc. 1912, 44, 1565)

Sol in conc acids; not pptd. by glacial  $HCl$ ,  $H_2O_2$ . Insol. in  $KOH + Aq$  of 1.35 sp gr. (Liebig, A. 11, 262.)Solubility of  $K_2SO_4$  in  $H_2SO_4 + Aq$  at  $18^\circ$ .

Mols. per 100 mols solution		Solid phase
$K_2SO_4$	$H_2SO_4$	
1.10	0	$K_2SO_4$
1.59	0.95	"
2.49	2.70	"
2.75	3.17	$K_2SO_4, KHSO_4$
2.75	3.74	"
2.83	5.08	"
2.80	5.79	$K_2SO_4, 3KHSO_4$
2.61	5.61	$K_2SO_4, 6KHSO_4$
2.25	8.19	$K_2SO_4 + KHSO_4$
1.08	7.94	$KHSO_4$
0.77	9.2	"
0.44	22.7	"

(Stortenbecker, R. t. c. 1902, 21, 407.)

Solubility in  $H_2SO_4 + Aq$  at  $0^\circ$ .

1000 g of the solution contain		Solid phase
Mols $H_2SO_4$	Mols $K_2SO_4$	
..	0.393	$K_2SO_4$
0.37	0.53	"
0.75	0.64	"
1.08	0.74	$K_2SO_4 + K_2H(SO_4)_2$
1.13	0.73	$K_2H(SO_4)_2$
1.44	0.71	"
1.66	0.69	"
1.89	0.66	$K_2H(SO_4)_2 + Ka$
1.88	0.69	"
2.15	0.59	$Ka + Kb$
2.12	0.61	"
2.29	0.54	$Kb$
2.30	0.53	$Kb + KHSO_4$
2.33	.	"
2.48	0.43	$KHSO_4$
3.08	0.28	"
4.43	0.12	"
5.27	0.09	"

These results show that at  $0^\circ$  there existbetween  $K_2H(SO_4)_2$  and  $KHSO_4$ , two acid sulphates,  $Ka$  and  $Kb$ .  $Ka$  is probably  $K_2SO_4, 3KHSO_4$  and  $Kb$  is probably  $K_2SO_4, 6KHSO_4$ .

(D'Ans, Z. anorg. 1909, 63, 228.)

3.1 mols.  $K_2SO_4$  are sol. in absolute  $H_2SO_4$  at  $25^\circ$ . (Bergius, Z. phys. Ch. 1910, 73, 353.)Solubility in  $H_2SO_4 + Aq$  at  $25^\circ$ .

Millimols $H_2SO_4$ in 10 cm.	Millimols $K_2SO_4$ in 10 cm.
3.97	6.17
7.97	8.92
14.35	10.82
	14.86

(Heiz, Z. anorg. 1912, 73, 276.)

Solubility in  $H_2SO_4 + Aq$  at  $25^\circ$ .

In 1000 g of the solution		Solid phase
Mols $SO_4$	Mols $K_2SO_4$	
6.42	0.171	$KHSO_4$
6.60	0.190	"
6.91	0.206	$KHSO_4 + KH_2(SO_4)_2, H_2O$
7.26	0.182	"
7.62	0.157	"
7.88	0.167	"
8.00	0.201	"
8.10	0.250	$KH_2(SO_4)_2, H_2O$
8.15	0.352	"
8.16	0.364	$KH_2(SO_4)_2, H_2O + KH_2(SO_4)_2$
8.29	0.341	"
8.33	0.322	"
8.45	0.325	"
8.62	0.346	"
8.67	0.384	$KH_2(SO_4)_2$
8.71	0.412	"
8.82	0.583	$KH_2(SO_4)_2$
8.65	0.890	$KH_2(SO_4)_2 + KHSO_4$
8.63	0.899	$KHSO_4$ (metastable solution)
8.70	0.882	"
8.96	0.501	"
9.80	0.365	"
9.78	0.430	"
9.80	0.665	$KHSO_4$
9.66	0.904	"
9.66	0.937	"

(D'Ans, Z. anorg. 1913, 80, 239.)

Pptd from  $K_2SO_4 + Aq$  by  $NH_4OH + Aq$ . (Sullivan.)

Solubility of  $K_2SO_4$  in  $NH_4OH + Aq$  at  $20^\circ$ .

G $NH_4$ in 100 ccm $H_2O$	G $K_2SO_4$ in 100 ccm. $H_2O$
0	10.804
6.08	4.100
15.37	0.828
24.69	0.140
31.02	0.042

(Girard, Bull. Soc. (2) 43. 522.)

1 l. sat. solution in  $H_2O$  contains 105.7 g.  $K_2SO_4$  at  $20^\circ$ ; in  $NH_4OH + Aq$  (5.2%  $NH_4$ ), 45.2 g. (Konowalow, J. Russ. Phys. Chem. Soc. 1894, 31. 985.)

Solubility of  $K_2SO_4$  in  $KOH + Aq$  at  $25^\circ$ .

In 1000 g of the solution	
Mols $K_2SO_4$	Mols $(KOH)_2$
0.617	0.0
0.433	0.258
0.280	0.433
0.137	1.13
0.035	2.86
0.009	3.42
0.0	4.809

(D'Ans and Schreiner, Z. anorg. 1910, 67. 438.)

Sol. in sat.  $NH_4Cl + Aq$  without pptn. (See  $NH_4Cl$ .)

Sl. sol. in sat.  $KCl + Aq$  without pptn. 100 g. sat  $KCl + Aq$  at  $25^\circ$  dissolve 0.0167 g. equiv.  $K_2SO_4$  at  $25^\circ$  (Van't Hoff and Meyerhoffer Z. phys. Ch. 1904 49. 315.)

Sl. sol. in sat.  $KNO_3 + Aq$  without causing pptn.

1 l. of the solution contains 50.7 g.  $K_2SO_4 + 216.5$  g.  $KNO_3 = 267.2$  g. mixed salts at  $15^\circ$  Sp. gr.  $K_2SO_4 + KNO_3 + Aq = 1.165$ .

1 l. of the solution contains 47.66 g.  $K_2SO_4 + 308.5$  g.  $KNO_3 = 356.2$  g. mixed salts at  $25^\circ$ . Sp. gr.  $(NH_4)_2SO_4 + KNO_3 + Aq = 1.210$ . (Euler, Z. phys. Ch. 1904, 49. 313.)

See also under  $KNO_3$ .

Sol. in sat.  $NaNO_3 + Aq$  without causing pptn. at first, but soon  $KNO_3$  is pptd. (Karsten.) (See  $NaNO_3$ .)

Sol. in  $(NH_4)_2SO_4 + Aq$  with pptn. of  $(NH_4)_2SO_4$ . (Rüdorff, B. 6. 485) (See  $(NH_4)_2SO_4$ .)

More sol. in aqueous solutions of other salts, as  $Na_2SO_4$ ,  $MgSO_4$ ,  $CuSO_4$ , etc., than in pure  $H_2O$ . (Pfaff, A. 99. 227.)

Sol. in sat.  $Na_2SO_4 + Aq$ ,  $MgSO_4 + Aq$ ,  $NaCl + Aq$ . (See  $MgSO_4$  and  $NaCl$ .)

Solubility of  $K_2SO_4$  in  $Na_2SO_4 + Aq$ .

Temp $-34^\circ$		Temp $-60^\circ$	
% $Na_2SO_4$	% $K_2SO_4$	% $Na_2SO_4$	% $K_2SO_4$
0	11.9	0	15.3
7.1	10.7	6.6	13.9
31.4	4.3	27.1	8.2
33.1	0	31.3	0

(Nacken, B. A. B. 1910. 1016.)

100 g.  $H_2O$  sat. with both  $K_2SO_4$  and  $Th_2SO_4$  dissolve.

4.74 g.  $Th_2SO_4 + 10.3$  g.  $K_2SO_4$  at  $15^\circ$ .

11.5 g. " + 16.4 g. " "  $62^\circ$ .

18.52 g. " + 26.2 g. " "  $100^\circ$ .

(Rabe, Z. anorg. 1902, 31. 156.)

Sl. sol. in sat.  $ZnSO_4$  or  $CuSO_4 + Aq$  with separation of double salt.

100 pts.  $H_2O$  dissolve 8.5 + 0.12 pts  $K_2SO_4$ . On addition of a K salt,  $K_2SO_4$  is pptd. The amount of  $K_2SO_4$  remaining in solution plus the amt of K in the salt added is a constant (Blarez, C. R. 112. 939.)

Solubility of  $K_2SO_4 + Th(SO_4)_2$  at  $16^\circ$ .Solid phase,  $Th(SO_4)_2$ 

Pts. per 100 pts $H_2O$		Pts per 100 pts $H_2O$	
$K_2SO_4$	$Th(SO_4)_2$	$K_2SO_4$	$Th(SO_4)_2$
0.000	1.390	1.487	0.870
0.424	1.667	1.633	0.635
1.004	2.193	1.844	0.370
1.152	3.191	2.512	0.128
1.224	2.514	3.092	0.070
1.283	2.222	4.050	0.027
1.348	1.706	4.825	0.008
1.378	1.637	.	.

(Barre, C. R. 1911, 150. 1555.)

Difficultly sol. in 20%  $KC_2H_3O_2 + Aq$ . (Stromeyer)

Solubility in K acetate + Aq at  $25^\circ$ .

Composition of the solutions		
% K acetate	% $K_2SO_4$	% $H_2O$
6.11	6.65	87.24
8.68	5.09	86.23
11.29	3.99	84.72
15.59	2.35	82.06
20.12	1.23	78.65
29.95	0.39	69.66

The solid phase in these solutions is  $K_2SO_4$ .

(Fox, Chem. Soc. 1909, 95. 885.)

100 g. hydroxylamine dissolve 3.5 g.  $K_2SO_4$  at  $17-18^\circ$ . (de Bruyn, Z. phys. Ch. 1892, 10. 782.)

Easily sol. in liquid HF. (Franklin, Z anorg 1905, 46, 2)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am Ch. J. 1898, 20, 829)

Neither dissolved nor attacked by liquid  $\text{NO}_2$ . (Frankland, Chem. Soc 1901, 79, 1361)

Insol. in absolute alcohol.

Insol. in alcohol, the sp gr. of which is 0.905 (Anthon)

Solubility in dil. alcohol increases with the temp

100 pts. alcohol of 0.039 sp. gr. (53% by vol., 45% by weight) dissolve at:

4° 8° 60°  
0.16 0.21 0.92 pts.  $\text{K}_2\text{SO}_4$ .

(Gerardin, A. ch. (4) 5, 147.)

100 pts. of the sat. solution at 15° in alcohol of:

10 20 30 40% by weight,  
contain 3.9 1.40 0.56 0.21 pts.  $\text{K}_2\text{SO}_4$ .

(Schiff, A. 118, 362.)

Solubility in acetic acid + Aq at 25°.

Concentration of the acetic acid Mol/Liter	Solubility of $\text{K}_2\text{SO}_4$ Mol/Liter
0 000	0.6714
0 070	0.6619
0 137	0.6559
0 328	0.6350
0 578	0.6097
1.161	0.5556
2 183	0.4743

(Rothmund and Wilmore, Z. phys. Ch 1902, 40, 620.)

Solubility in phenol + Aq at 25°.

Concentration of the phenol Mol/Liter	Solubility of $\text{K}_2\text{SO}_4$ Mol/Liter
0 000	0.6714
0.016	0.6650
0 021	0.6614
0 032	0.6598
0 040	0.6555
0.047	0.6522
0.064	0.6502
0.076	0.6494
0.127	0.6310
0 152	0.6251
0.236	0.6042
0 252	0.5956
0 308	0.5834
0.409	0.5572
0.464	0.5480
0.486	0.5425
0.495	0.5389
0 498 (saturated)	0.5377

(Rothmund and Wilmore, Z. phys. Ch. 1902, 40, 619.)

100 g. 95% formic acid dissolve 36.5 g.  $\text{K}_2\text{SO}_4$  at 21°. (Aschan, Ch. Ztg. 1913, 37, 1117.)

Solubility in organic substances + Aq at 25°.

Organic substance	Composition of the solutions		
	% organic substance	% $\text{K}_2\text{SO}_4$	% $\text{H}_2\text{O}$
Alcohol	1 35	9 17	89.48
	4.80	6 90	88 30
	7.80	4 96	87 24
	9.70	4.32	85 98
	12.34	3 57	84 09
	14 51	2 71	82 78
	15 26	2 66	82.08
	20.50	1 83	77 67
	26.91	0 97	72.12
	35.97	0 41	63.62
	43 90	0 22	55.88
	69 26	0 016	30.72
Pyridine	4 23	7 95	87.82
	13.90	4 77	81.33
	24 51	2 75	72.74
	34 19	1 47	64.34
	46 29	0 45	53.26
	55 93	0 12	43 95
	75 90	0 006	24.09
Ethylene glycol	3 16	9 67	87.17
	9 89	7 69	82 53
	18 47	5 74	75.79
	32 11	3.57	64 32
	49 03	1.83	49 14
Chloral hydrate	6 44	9 13	84.43
	9 09	8.41	82.50
	12.38	7 79	79 83
	13 20	7.31	79 49
	22 07	5.88	72.05
	33 15	4.54	62 31
	44 40	3 36	52 24
	47 30	2 92	49.78
	62.82	2 00	35.18
	70 28	1 75	27.97
Glycerol	80.36	1 40	18 24
	85.26	1 08	13.66
Glycerol	8 96	8 87	82 17
	13 36	7 69	78 95
	20.34	6 47	73 19
	24.15	5 83	70.02
	33.73	4 44	61.83
	40.40	3 65	55.95
	43.52	3 38	53 10
	50 18	2 69	47 13
	57 22	2.07	40.71
	67 94	1.53	30.53
Mannitol	78 18	0 98	20 84
	98.28	0 73	0 99
Mannitol	3 20	10 32	86.48
	5.82	10 07	84.11
	8 35	9.61	82.04
	11 26	9.19	79.55
	14 30	8.66	77 04
	17 22	8 35	74 43

Solubility in organic substances + Aq at 25°.—  
*Continued.*

Organic substances	Composition of the solutions		
	% organic substance	% K <sub>2</sub> SO <sub>4</sub>	% H <sub>2</sub> O
Sucrose	9.56	9.65	80.79
	18.55	8.65	72.80
	28.16	7.42	64.42
	37.24	6.35	56.41
	47.55	5.21	47.24
	57.00	4.24	38.76
Acetone	4.92	7.20	87.88
	10.06	5.02	84.92
	16.23	2.96	80.81
	24.31	1.50	74.19
	37.19	0.47	62.34
	46.29	0.20	53.51
	62.40	0.03	37.57

(Fox and Gage, Chem Soc. 1910, 97. 381.)

Sol. in 76 pts glycerine of 1.225 sp. gr. at ordinary temp. (Vogel, N. Repert. 16. 557.)

Insol. in acetone. (Krug and M'Elroy; Eidman, C. C. 1899, II. 1014.)

Insol. in CS<sub>2</sub> (Arclovski, Z. anorg. 1894, 6. 257); benzonitrile (Naumann, B. 1914, 47. 1370); methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate (Naumann, B. 1904, 37. 3802.)

100 g H<sub>2</sub>O dissolve 104 g. K<sub>2</sub>SO<sub>4</sub> + 219.0 g. sugar at 31.25°, or 100 g sat solution contain 3.8 g. K<sub>2</sub>SO<sub>4</sub> + 66.74 g. sugar (Köhler, Z. Ver. Zuckerind. 1897, 47. 447.)

Min. *Glauberite*  
+ 1½ H<sub>2</sub>O. 100 pts H<sub>2</sub>O dissolve 9.82 pts (Omer, C. R. 82. 1055.)

**Tripotassium hydrogen sulphate, K<sub>3</sub>H(SO<sub>4</sub>)<sub>2</sub>.**  
Sol. in H<sub>2</sub>O.

**Potassium hydrogen sulphate, KHSO<sub>4</sub>.**

1.07 pts. KHSO<sub>4</sub> (= 1 pt. K<sub>2</sub>S<sub>2</sub>O<sub>7</sub>) dissolve:

at 0° in 2.95 pts. H<sub>2</sub>O.

" 20° " 2.08 "

" 40° " 1.59 "

" 100° " 0.88 "

(Kremers, Pogg. 92. 497.)

Sp. gr. of KHSO<sub>4</sub> + Aq at 15° containing:

5 10 15 % KHSO<sub>4</sub>

1.0354 1.0726 1.1116

20 25 27% KHSO<sub>4</sub>

1.1516 1.1920 1.2110

(Kohlrausch, W. Ann. 1879. 1.)

Sat. solution boils at 105.5° (Griffiths); 108° (Kremers).

Alcohol dissolves out H<sub>2</sub>SO<sub>4</sub>.

K<sub>2</sub>SO<sub>4</sub> crystallises from dilute solutions.

100 g. 95% formic acid dissolve 14.6 g. KHSO<sub>4</sub> at 19.3° (Aschan, Ch. Ztg. 1913, 37. 1117.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Min. *Misinate*.

+ 5½ H<sub>2</sub>O. Deliquescent. (Senderens, Bull. Soc. (3) 2. 278.)

**Potassium dihydrogen sulphate, K<sub>2</sub>H<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.**

Sol. in H<sub>2</sub>O. (Phillips, Phil. Mag. 1. 429.)

Composition is 4K<sub>2</sub>O, 7SO<sub>3</sub> + 3H<sub>2</sub>O, according to Beithelot (A. ch. (4) 80. 442.)

**Potassium trihydrogen sulphate, KH<sub>3</sub>(SO<sub>4</sub>)<sub>2</sub>.**

Sol. in H<sub>2</sub>O with rise of temperature. (Schultz, Pogg. 133. 137.)

+ 1½ H<sub>2</sub>O. (Lescœur, C. R. 78. 1044.)

**Potassium disulphate (pyrosulphate), K<sub>2</sub>S<sub>2</sub>O<sub>7</sub>.**

When dissolved in exactly the necessary amount of hot H<sub>2</sub>O for solution, it crystallises on cooling without decomp. Decomp. by excess of H<sub>2</sub>O. (Jacquelin, A. ch. 70. 311.)

Insol. in methyl acetate. (Naumann, B. 1909. 42. 3790.)

**Potassium hydrogen disulphate, KHS<sub>2</sub>O<sub>7</sub>.**

Sol. in fuming H<sub>2</sub>SO<sub>4</sub> without decomposition

**Potassium octosulphate, K<sub>2</sub>S<sub>8</sub>O<sub>22</sub>.**

Decomp. by H<sub>2</sub>O (Weber.)

**Potassium praseodymium sulphate, 3K<sub>2</sub>SO<sub>4</sub>,**

Pr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + H<sub>2</sub>O

Sl. sol. in H<sub>2</sub>O.

Sol. in conc. HCl and HNO<sub>3</sub> (Von Scheele, Z. anorg. 1898, 18. 358.)

**Potassium rhodium sulphate, 3K<sub>2</sub>SO<sub>4</sub>,**

Rh<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Does not exist (Leidie, C. R. 107. 234.)

K<sub>2</sub>SO<sub>4</sub>, Rh<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + 24H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Piccini, Z. anorg. 1901, 27. 66.)

**Potassium samarium sulphate, 9K<sub>2</sub>SO<sub>4</sub>,**

2Sm<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + 3H<sub>2</sub>O.

Sl. sol. in H<sub>2</sub>O.

Sl. sol. in sat. K<sub>2</sub>SO<sub>4</sub> + Aq.

1 l. sat. K<sub>2</sub>SO<sub>4</sub> + Aq. dissolves 0.5 g. Sm<sub>2</sub>O<sub>3</sub>. (Cleve, Bull. Soc. (2) 43. 166.)

**Potassium scandium sulphate, 3K<sub>2</sub>SO<sub>4</sub>,**

Sc<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Very slowly sol. in cold, more easily sol. in warm H<sub>2</sub>O. Insol. in sat. K<sub>2</sub>SO<sub>4</sub> + Aq.

Sol. in H<sub>2</sub>O and in dil. K<sub>2</sub>SO<sub>4</sub> + Aq. (Meyer, Z. anorg. 1914, 86. 279.)

2K<sub>2</sub>SO<sub>4</sub>, Sc<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. Sol. in K<sub>2</sub>SO<sub>4</sub> + Aq. (Cleve.)

Does not exist. (Nilson.)

**Potassium sodium sulphate, 3K<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>.**

100 pts. H<sub>2</sub>O dissolve 40.8 pts. at 103.5°. (Penny, Phil. Mag. (4) 10. 401.)

5K<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>. 100 pts. H<sub>2</sub>O at 100° dissolve 25 pts.; at 12.7°, 10.1 pts.; at 4.4°, 9.2 pts. (Gladstone, Chem. Soc. 6. 111.)

**Potassium strontium sulphate,  $K_2Sr_2(SO_4)_2$ .**

Decomp. by  $(NH_4)_2CO_3 + Aq.$  (Rose. Pogg. 33. 604.)

$K_2SO_4, SrSO_4$ . This is the only double salt formed from these two components between  $0^\circ$  and  $100^\circ$

100 pts of the sat. solution in equilibrium with  $SrSO_4$  and the double salt contain at.

17.5° 50° 75° 100°

1.27 1.88 2.71 3.9 pts.  $K_2SO_4$ .

(Barre, C. R. 1909, 149. 292.)

**Potassium tellurium sulphate,  $KHSO_4, 2TeO_3, SO_3 + 2H_2O$ .**

(Metzner, A. ch. 1898, (7) 15. 203.)

**Potassium terbium sulphate.**

Easily sol. in  $H_2O$ . Sl. sol. in  $K_2SO_4 + Aq$  (Delafontaine, Zent. Chem. (2) 2. 230.)

**Potassium thallic sulphate,  $KTI(SO_4)_2 + 4H_2O$ .**

Decomp. by  $H_2O$ . (Fortini, Gazz. ch. it. 1905, 35. (2) 453.)

$2K_2O, TI_2O_3, 4SO_3$ . Insol. in  $H_2O$ . Very difficultly sol. in warm dil.  $H_2SO_4 + Aq$  (Strecker, A. 135. 207.)

**Potassium thorium sulphate,  $K_2SO_4, Th(SO_4)_2 + 4H_2O$ .**

Sol. in hot  $H_2O$  containing a few drops  $HCl$  (Barre, A. ch. 1911, (8) 24. 227.)

$2K_2SO_4, Th(SO_4)_2 + 2H_2O$ . Slowly sol. in cold, easily and abundantly in hot  $H_2O$ , and is gradually decomp. by boiling. Easily sol. in acids. Insol. in alcohol (Berzelius.)

$3K_2SO_4, Th(SO_4)_2$ . Insol. in  $K_2SO_4 + Aq$  of concentrations above 4.5%. (Barre.)

$4K_2SO_4, Th(SO_4)_2 + 2H_2O$  (Chydenius.)

**Potassium tin (stannous) sulphate,  $K_2SO_4, SnSO_4$ .**

(Marignac.)

**Potassium tin (stannic) sulphate,  $K_2Sn(SO_4)_2$ .**

Easily sol. in  $H_2O$  with decomp. Sol. in  $HCl$ . (Weinland, Z. anorg. 1907, 54. 250.)

**Potassium tin (stannous) sulphate chloride,  $4K_2SO_4, 4SnSO_4, SnCl_2$ .**

Can be recrystallised from  $H_2O$ . (Marignac, Ann. Min. (5) 12. 62.)

**Potassium titanium sulphate,  $K_2SO_4, Ti(SO_4)_2 + 3H_2O$ .**

Difficultly sol. in  $H_2O$  or  $HCl + Aq$ . Decomp. by much  $H_2O$ . (Wallace, Pogg. 102. 453.)

**Potassium titanyl sulphate,  $2K_2SO_4, 3TiO, SO_3 + 10H_2O$ .**

Very sol. in  $H_2O$  with decomp. Insol. in conc.  $H_2SO_4$ . (Rosenheim, Z. anorg. 1901, 28. 251.)

$K_2SO_4, TiO_2SO_4 + 7H_2O$ . Very hygroscopic and sol. in  $H_2O$ . (Mazzuchelli and Pontanelli, C. C. 1909, II. 420.)

$K_2SO_4, (ThO)_2SO_4$  (Spence, C. C. 1901, II. 747.)

**Potassium uranous sulphate,  $K_2SO_4, U(SO_4)_2 + H_2O$ .**

Very al. sol. in  $H_2O$ . (Rammelsberg.)

**Potassium uranyl sulphate,  $K_2SO_4, (UO_2)_2SO_4 + 2H_2O$ .**

Sol. in 9 pts.  $H_2O$  at  $22^\circ$  and in 0.51 pt. at  $100^\circ$ . Insol. in alcohol. (Ebelmen, A. ch. (3) 5. 211.)

100 pts of aqueous solution sat. at  $25^\circ$  contain 10.5 pts. salt, at  $70^\circ$  contain 23.93 pts. salt. (Rumbach, B. 1904, 37. 478.)

$+ 3H_2O$ . (de Coninck, Chem. Soc. 1905, 88. (2) 394.)

$2K_2SO_4, (UO_2)_2SO_4 + 2H_2O$ . Decomp. by  $H_2O$ .

Cannot be cryst. from rather conc.  $H_2SO_4$ , as it is completely decomp. by it. (Rimbach, B. 1905, 38. 1572.)

$K_2O, 2UO_2, 3SO_3$ . Ppt. Identical with  $UO_2, OK, SO_3H$  of Scheller, (A. 1867, 144. 238.) (Kohlschütter, A., 1900, 311. 11.)

$2K_2SO_4, 3(UO_2)_2SO_4 + H_2O$ . Sol. in  $H_2O$  Insol. in alcohol (Berzelius.)

Does not exist. (Ebelmen.)

**Potassium vanadium sulphate,  $K_2O, V_2O_5, 2SO_3 + 6H_2O = K(VO)_2SO_4 + 3H_2O$ .**

(Friedheim, B. 24. 1183.)

$= KVO_3, K_2SO_4, V_2O_5, 2SO_3 + 9H_2O$  of Münzing (Berlin, Dissert. 1889).

$K_2SO_4, VSO_4 + 6H_2O$ . Sol. in  $H_2O$ . (Piccini, Z. anorg. 1902, 32. 61.)

$K_2V_2(SO_4)_3 + 24H_2O$ . 100 pts.  $H_2O$  dissolve 198.4 pts. salt. at  $10^\circ$ . Sp. gr. of sat. solution at  $4^\circ/20^\circ = 1.782$ . (Piccini, Z. anorg. 1897, 13. 446.)

**Potassium vanadyl sulphate,  $K_2SO_4, (VO)_2(SO_4)_2$ .**

Very slowly sol. in  $H_2O$ , still less sol. in dil. alcohol. (Gerland.)

$K_2SO_4, VOSO_4 + 3H_2O$ . Easily sol. in  $H_2O$ . Sol. in alcohol + conc.  $H_2SO_4$ . (Koppel, Z. anorg. 1903, 35. 178.)

$K_2SO_4, 2VOSO_4$ . Very hygroscopic. Very sol. in  $H_2O$  but goes into solution slowly.

(Koppel and Behrendt, B. 1901, 34. 3935.)

Easily sol. in  $H_2O$ . (Koppel, Z. anorg. 1903, 35. 174.)

**Potassium yttrium sulphate,  $4K_2SO_4, Y_2(SO_4)_3$ .**

Sol. in 16 pts. cold  $H_2O$ , and in 10 pts. sat.  $K_2SO_4 + Aq$ , and more abundantly if the latter solution contains ammonium salts or free acid (Berlin.)

$3K_2SO_4, 2Y_2(SO_4)_3$ . 100 ccm. cold sat.

$K_2SO_4 + Aq$  dissolve an amount of this salt corresponding to 4.685 g.  $K_2O_3$ . (Cleve)

**Potassium zinc sulphate,  $K_2SO_4, ZnSO_4 + 6H_2O$ .**

Sol. in 5 pts. cold  $H_2O$ . (Bucholz, N. J. Pharm. 9 2. 26.)

100 pts.  $H_2O$  dissolve at:

0° 10° 15° 25° 36°  
12.6 18.7 22.5 28.8 39.9 pts. hydrous salt,

45° 50° 58° 65° 70°  
51.2 54.0 67.6 81.3 87.9 pts. hydrous salt.  
(Tobler, A. 95. 193.)

100 pts.  $H_2O$  at 15° dissolve 14.8 pts.  $K_2SO_4, ZnSO_4 + 6H_2O$ ; sp. gr of sat.  $H_2O$  solution at 15° = 1.0939. (Schuff, A. 109. 326.)

1 l.  $H_2O$  dissolves 131.9 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

**Potassium zirconium sulphate,  $2K_2O, 6ZrO_2, 7SO_3 + 9H_2O$ .**

Decomp. by  $H_2O$ .

$8K_2O, 3ZrO_2, 7SO_3 + 9H_2O$  Insol. in  $H_2O$ .  
 $Zr_3O_5(KSO_4)_3 + 8H_2O$  Ppt (Rosenheim, B. 1905, 38. 815.)

**Potassium sulphate vanadate.**

Very difficultly sol. in  $H_2O$ . Insol. in alcohol (Berzelius)

**Potassium sulphate antimony trifluoride.**

See Antimony trifluoride potassium sulphate.

**Praseodymium sulphate, basic,  $(PrO)_2SO_4$ .**

Insol. in  $H_2O$  (Matignon, C. R. 1902, 134. 660.)

Insol. in  $H_2O$ . Nearly insol. in dil. acids. (Wöhler, B. 1913, 46. 1730.)

**Praseodymium sulphate,  $Pr_2(SO_4)_3$ .**

Sol. in  $H_2O$ , very hygroscopic. 23.64 pts are sol. in 100 pts  $H_2O$  at 0° and 17.7 pts. at 20°. (von Scheele, Z. anorg. 1898, 18. 357-358.)

+5 $H_2O$  Sol. in  $H_2O$  (von Scheele, Z. anorg. 1898, 18. 357)

Difficultly sol. in  $H_2O$ . (Kraus, Zeit. Kryst. 1901, 34. 400.)

1.50 pts.  $Pr_2(SO_4)_3$  are sol. in 100 pts.  $H_2O$  at 85°; 1.45 pts. at 90°; and 1.02 pts. at 95° (Muthmann and Röllig, B. 1898, 31. 1729.)

+8 $H_2O$ . (Kraus, Zeit. Kryst. 1901, 34. 406.)

Sol. in  $H_2O$ . (von Scheele, Z. anorg. 1898, 18. 357.)

Solubility in  $H_2O$  at t°.

t°	Pts. $Pr_2(SO_4)_3$
0	19.79
18	14.10
35	10.31
55	7.09
75	4.13

(Muthmann and Röllig, B. 1898, 31. 1727.)

+15½ $H_2O$  Sol. in  $H_2O$ . (von Scheele, Z. anorg. 1898, 18. 357)

**Praseodymium hydrogen sulphate,  $Pr(SO_3H)_3$ .**

(Brauner, Z. anorg. 1904, 38. 330.)

Solubility in boiling conc.  $H_2SO_4$  100 g. of the solution contain 1.02 g. of the acid sulphate. (Matignon, C. R. 1902, 134. 659.)

**Radium sulphate.**

Less sol. in  $H_2O$  than corresponding Ba comp. (Curie, Dissert. 1903.)

**Rhodium sulphate,  $Rh_2(SO_4)_3 + 12H_2O$ .**

Easily sol. in  $H_2O$ . (Berzelius.)

Sl sol. in, but not decomp. by  $H_2O$  when not more than 16 pts  $H_2O$  are present to 1 pt. salt. Decomp. by hot  $H_2O$  to—

$Rh_2(SO_4)_3, Rh_2O_3$ . Insol. in  $H_2O$ . (Laidié, C. R. 107. 234.)

**Rhodium rubidium sulphate,  $Rh_2(SO_4)_3, Rb_2SO_4 + 24H_2O$ .**

Sol. in  $H_2O$ ; m-pt., 108-109° (Piccini, Z. anorg. 1901, 37. 65)

**Rhodium thallium sulphate,  $Rh_2(SO_4)_3, Tl_2SO_4 + 24H_2O$ .**

Very sol.  $H_2O$ . (Piccini, Z. anorg. 1901, 37. 69.)

**Rhodium sodium sulphate,  $Rh_2Na_2(SO_4)_4$ .**

Insol. in  $H_2SO_4$  or aqua regia (Seubert and Kobbe, B. 23. 2560)

**Rubidium sulphate,  $Rb_2SO_4$ .**

100 pts.  $H_2O$  dissolve 42.4 pts. at 10°. (Bunsen.)

100 cc.  $H_2O$  at 17-18° dissolve 44.7 g.  $Rb_2SO_4$  (Tutton, Chem. Soc. 1894, 65. 632.)

Sat.  $Rb_2SO_4 + Aq$  contains at:

3° 20°  
27.4 32.5%  $Rb_2SO_4$ ,

37° 97° 170°  
37.3 43.9 49.2%  $Rb_2SO_4$ .

(Étard, A. ch. 1894, (7) 2. 550.)

Solubility of  $\text{Rb}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g $\text{Rb}_2\text{SO}_4$ per 100 g		$t^\circ$	g $\text{Rb}_2\text{SO}_4$ per 100 g	
	$\text{H}_2\text{O}$	solution		$\text{H}_2\text{O}$	solution
0	36.4	27.3	60	67.4	40.3
10	42.6	29.9	70	71.4	41.7
20	48.2	32.5	80	75.0	42.9
30	53.5	34.9	90	78.7	44.0
40	58.5	36.9	100	81.8	45.0
50	63.1	38.7	102.4*	82.6	45.2

\* B - pt. at  $742.4 \text{ mm}$ .

(Berkeley, calc. by Seidell, Solubilities, 2nd Ed., p. 587.)

Sp gr. of  $\text{Rb}_2\text{SO}_4 + \text{Aq}$  sat at  $10^\circ = 1.2978$  (Eidmann, Arch. Pharm. 1894, 232, 16.)G.-equiv. salt per l. at  $18^\circ = 0.501$  1.01Sp. gr.  $6^\circ/6^\circ$  1.05587 1.11047"  $18^\circ/18^\circ$  1.05496 1.10896"  $30^\circ/30^\circ$  1.05433 1.10810G.-equiv. salt per l. at  $18^\circ = 2.043$  3.168Sp. gr.  $6^\circ/6^\circ$  1.21888 1.33276"  $18^\circ/18^\circ$  1.21613 1.32912"  $30^\circ/30^\circ$  1.21443 1.32750

(Clausen, W. Ann. 1914, (4) 44, 1071.)

10 ccm. of sat  $\text{Rb}_2\text{SO}_4 + \text{absolute } \text{H}_2\text{SO}_4$  contain approx 5.881 g  $\text{Rb}_2\text{SO}_4$ . (Bergius, Z phys Ch 1910, 72, 355.)

Insol in methyl acetate (Naumann, B. 1909, 42, 3790), acetone (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014.)

**Rubidium pyrosulphate,  $\text{Rb}_2\text{S}_2\text{O}_7$ .**Decomp. by  $\text{H}_2\text{O}$ **Rubidium octosulphate,  $\text{Rb}_8\text{S}_8\text{O}_{32}$ .**Decomp. by  $\text{H}_2\text{O}$ . (Weber, B. 17, 2497.)**Rubidium hydrogen sulphate,  $\text{RbHSO}_4$ .**Sol. in  $\text{H}_2\text{O}$ .**Rubidium tin (stannic) sulphate,  $\text{Rb}_2\text{Sn}(\text{SO}_4)_2$ .**Decomp. by  $\text{H}_2\text{O}$ . Sol in  $\text{HCl}$  (Weinland, Z. anorg. 1907, 54, 250.)**Rubidium thallic sulphate,  $\text{RbTl}(\text{SO}_4)_2$ .**(Marshall, C. C. 1902, II, 1089)  
+  $4\text{H}_2\text{O}$ . (Fortini, Gazz. ch. it. 1905, 35, (2) 455.)**Rubidium thorium sulphate,  $\text{Rb}_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ .**Sl. sol. in  $\text{H}_2\text{O}$  (Manuelli, Gazz. ch. it. 1903, 32, (2) 523.)**Rubidium titanium sulphate,  $\text{Rb}_2\text{SO}_4 \cdot \text{Ti}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .**Sol in  $\text{H}_2\text{O}$  acidified with  $\text{H}_2\text{SO}_4$ . Decomp. in neutral aq solution. (Piccini, Z. anorg. 1898, 17, 359.)Insol in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ . Insol. in  $\text{H}_2\text{SO}_4$ . Decomp. by boiling with conc.  $\text{H}_2\text{SO}_4$ . (Stähler, B. 1905, 38, 2623.)**Rubidium uranyl sulphate,  $\text{Rb}_2(\text{UO}_2)(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ .**Somewhat less sol in  $\text{H}_2\text{O}$  than K salt. (Rumbach, B. 1904, 37, 479.)**Rubidium vanadium sulphate,  $\text{Rb}_2\text{V}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .**0.177 gram mols of anhydrous salt are sol in 1 l  $\text{H}_2\text{O}$  (Locke, Am. Ch. J. 1901, 26, 175.)Insol in  $\text{H}_2\text{O}$ Insol in  $\text{H}_2\text{SO}_4$ . Decomp. by boiling with conc  $\text{H}_2\text{SO}_4$ .Sol in  $\text{HCl}$  (Stähler, B. 1905, 38, 3080.)100 pts.  $\text{H}_2\text{O}$  dissolve 2.56 pts salt at  $10^\circ$ .Sp. gr. of solution at  $4^\circ/20^\circ = 1.915$ . (Piccini, Z. anorg. 1897, 13, 446.)**Rubidium zinc sulphate,  $\text{Rb}_2\text{SO}_4 \cdot \text{ZnSO}_4 + 6\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$  (Bunsen and Kopp, Pogg. 113, 337.)1 l.  $\text{H}_2\text{O}$  dissolves 101 g anhydrous salt at  $25^\circ$  (Locke, Am. Ch. J. 1902, 27, 459.)**Rubidium zirconium sulphate,  $\text{Zr}_2\text{O}_3$**  $(\text{RbSO}_4)_2 + 15\text{H}_2\text{O}$ .

Ppt (Rosenheim, B. 1905, 38, 815.)

**Ruthenic sulphate,  $\text{Ru}(\text{SO}_4)_3$ .**Deliquescent, and easily sol in  $\text{H}_2\text{O}$ . (Claus, A. 59, 246.)**Samarium sulphate, basic,  $(\text{SmO})_2\text{SO}_4$ .**Insol in  $\text{H}_2\text{O}$  and in cold dil.  $\text{H}_2\text{SO}_4$ . (Matignon, C. R. 1905, 141, 1231.)**Samarium sulphate,  $\text{Sm}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .**\* Difficultly sol. in  $\text{H}_2\text{O}$ .Much less sol. than  $\text{D}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ . (Cleve.)2.06 pts anhydrous salt are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Keyes and James, J. Am. Chem. Soc. 1914, 36, 635.)100 g  $\text{Sm}_2(\text{SO}_4)_3 + \text{Aq}$  sat at  $25^\circ$  contain 3.426 g anhyd  $\text{Sm}_2(\text{SO}_4)_3$  (Wirth, Z. anorg. 1912, 76, 174.)Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ . $\bar{n}$  = equiv. % of  $\text{H}_2\text{SO}_4$  in 1 l. of solvent. $c$  = g  $\text{Sm}_2\text{O}_3$  in 100 g of solution. $c_1$  = g.  $\text{Sm}_2(\text{SO}_4)_3$  in 100 g of solution.

$\bar{n}$	$c$	$c_1$	$\bar{n}$	$c$	$c_1$
0	2.029	3.426	2.18	1.43	2.416
0.1	2.038	3.441	8.175	0.416	0.7025
0.505	1.985	3.352	12.6	0.0656	0.1107
1.1	1.821	3.075			

(Wirth, Z. anorg. 1912, 76, 174.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at 25°

Pts $\text{Sm}_2(\text{SO}_4)_3$ per 100 pts. $\text{H}_2\text{O}$	Pts $(\text{NH}_4)_2\text{SO}_4$ per 100 pts. $\text{H}_2\text{O}$	Solid phase
2.1	0.3	$\text{Sm}_2(\text{SO}_4)_3$
2.0	0.8	
2.8	1.1	
1.5	1.9	
1.2	2.7	
0.8	7.4	
0.8	9.5	
0.8	8.7	
0.8	18.8	
0.8	12.2	
0.8	12.3	$\text{Sm}_2(\text{SO}_4)_3, (\text{NH}_4)_2\text{SO}_4, 7\text{H}_2\text{O}$
0.9	32.5	
1.0	46.3	
0.9	40.3	
1.3	77.5	
0.2	77.2	
0.3	77.3	
0.6	76.8	
		$(\text{NH}_4)_2\text{SO}_4$

(Keyes and James, J. Am. Chem. Soc. 1914, 36, 637.)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 25°

Pts $\text{Na}_2\text{SO}_4$ per 100 pts. $\text{H}_2\text{O}$	Pts $\text{Sm}_2(\text{SO}_4)_3$ per 100 pts. $\text{H}_2\text{O}$	Solid phase
0.1	2.0	$\text{Sm}_2(\text{SO}_4)_3$
0.5	0.11	
1.9	0.03	
3.44	0.016	
7.00	0.008	
9.02	0.016	
10.51	0.012	
11.48	0.012	
13.58	0.010	
14.71	0.010	
14.47	0.009	$2\text{Sm}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4 + 6\text{H}_2\text{O}$
20.02	0.012	
23.42	0.012	
23.68	0.018	
25.93	0.015	
27.40	0.011	

These results seem to indicate that there is only one double salt formed by the union of  $\text{Sm}_2(\text{SO}_4)_3$  with  $\text{Na}_2\text{SO}_4$ . Formula of this salt is  $2\text{Sm}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4, 6\text{H}_2\text{O}$ .

(Keyes and James, J. Am. Chem. Soc. 1914, 36, 635.)

Samarium hydrogen sulphate,  $\text{Sm}(\text{HSO}_4)_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Matignon, C. R. 1905, 141, 1230.)

Ppt (Brauner, Z. anorg. 1904, 38, 331.)

Samarium sodium sulphate,  $\text{Sm}_2(\text{SO}_4)_3, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ 

Sl. sol. in sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$ . (Cleve, Bull. Soc. (2) 43, 166.)

$2\text{Sm}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4 + 6\text{H}_2\text{O}$  Only double salt formed at 25°. (Keyes and James, J. Am. Chem. Soc. 1914, 36, 385.)

Scandium sulphate, basic,  $\text{Sc}_2\text{O}(\text{SO}_4)_2$ .

(Crookes, Roy. Soc. Proc. 1908, 80, A, 518.)

Scandium sulphate,  $\text{Sc}_2(\text{SO}_4)_3$ .

Anhydrous Easily sol. in  $\text{H}_2\text{O}$ .

+  $2\text{H}_2\text{O}$ .

+  $5\text{H}_2\text{O}$ , 54.61 g. of pentahydrate are sol. in 100 cc  $\text{H}_2\text{O}$  at 25°. (Wirth, Z. anorg. 1914, 87, 10.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at 25°.

$\text{H}_2\text{SO}_4 + \text{Aq}$	g. $\text{Sc}_2(\text{SO}_4)_3$ in 100 g. of the solution
0.00	28.52
0.5-n	29.29
1.0-n	19.87
4.86-n	8.363
9.73-n	1.315

In 22.35-n  $\text{H}_2\text{SO}_4$  the solid phase is  $\text{Sc}_2(\text{SO}_4)_3, 3\text{H}_2\text{SO}_4$  and 100 g. sat. solution contain 0.484 g.  $\text{Sc}_2(\text{SO}_4)_3$ .

(Wirth, Z. anorg. 1914, 87, 10.)

+  $6\text{H}_2\text{O}$ . Extremely sol. in  $\text{H}_2\text{O}$ , but not deliquescent

Scandium hydrogen sulphate,  $\text{Sc}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$ .

(Wirth.)

Scandium sodium sulphate,  $\text{Sc}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

+  $10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and in excess of  $\text{Na}_2\text{SO}_4 + \text{Aq}$ . (Meyers, Z. anorg. 1914, 86, 279.)

Silver (argentoargentic) sulphate,  $\text{Ag}_2\text{SO}_4, \text{Ag}_2\text{SO}_4 + \text{H}_2\text{O}$ .

Gradually sol. in conc., but not attacked by dil.  $\text{HNO}_3 + \text{Aq}$ . Not attacked by hot conc.  $\text{H}_2\text{SO}_4$ . (Lea, Sil. Am. J. 144, 322.)

Silver sulphate,  $\text{Ag}_2\text{SO}_4$ .

Sol. in 200 pts. cold, and less than 100 pts. boiling  $\text{H}_2\text{O}$ . (Wittstein.)

Sol. in 88 pts. boiling  $\text{H}_2\text{O}$  (Schnaubart); in 87.25 pts. boiling  $\text{H}_2\text{O}$  (Wenzel); in 68.85 pts.  $\text{H}_2\text{O}$  at 100° (Kremer).

100 pts.  $\text{H}_2\text{O}$  at 15.5° dissolve 1.15 pts.  $\text{Ag}_2\text{SO}_4$ . (Ure's Dict.)

Sol. in 160 pts.  $\text{H}_2\text{O}$  at 18.75°. (Abl.)

1 l.  $\text{H}_2\text{O}$  dissolves  $2.57 \times 10^{-2}$  g.-mol.  $\text{Ag}_2\text{SO}_4$  at 25°. (Drucker, Z. anorg. 1901, 28, 362.)

1 l.  $\text{H}_2\text{O}$  dissolves 7.707 g.  $\text{Ag}_2\text{SO}_4$  at 17°. (Euler, Z. phys. Ch. 1904, 49, 314.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0267 mol.  $\text{Ag}_2\text{SO}_4$  at 25°. (Rothmund, Z. phys. Ch. 1909, 69, 539.)

1 l.  $\text{H}_2\text{O}$  dissolves 8.35 g.  $\text{Ag}_2\text{SO}_4$  at 25°.

(Hill and Simmons, Z. phys. Ch. 1909, 67, 803.)

1 l  $H_2O$  dissolves 8.344 g.  $Ag_2SO_4$  at 25°  
Sp. gr of solution = 1.0052. (Harkins, J  
Am. Chem. Soc 1911, 33, 1812.)

#### Solubility in $H_2O$ at t°.

t°	Pts $Ag_2SO_4$ in 100 pts of the solution
14.5	0.730
33	0.909
51.5	1.062
75	1.237
100	1.393

(Barre, A. ch. 1911, (8) 24, 211.)

More sol in  $H_2SO_4 + Aq$  than in pure  $H_2O$ .  
Still more sol in  $HNO_3 + Aq$  and still more in conc  $H_2SO_4$ , from which it is pptd. by  $H_2O$  (Schnaubart)

#### Solubility in $H_2SO_4 + Aq$ at 25°.

$\frac{1}{2}H_2SO_4 + Aq$ . Normality	Solubility of $Ag_2SO_4$ g.-mol per litre
0.02	$2.60 \times 10^{-2}$
0.04	$2.64 \times 10^{-2}$
0.10	$2.71 \times 10^{-2}$
0.20	$2.75 \times 10^{-2}$

(Drucker, Z. anorg. 1901, 28, 362.)

Solubility of  $Ag_2SO_4$  in acids + Aq at 25°.  
C = concentration of acid in acid + Aq in milliequivalents per l.

S = Solubility of  $Ag_2SO_4$  in acid + Aq in milliequivalents per l.

Acid	C	S
$HNO_3$	0.0	53.98
	15.89	59.86
	31.78	65.32
	63.57	75.90
$H_2SO_4$	0.0	53.98
	29.02	54.88
	58.02	55.04
	105.26	56.82

(Swan, J. Am. Chem. Soc. 1911, 33, 1814)

#### Solubility in $HNO_3 + Aq$ at 25°.

Normality $HNO_3$	Sp gr of the solution	g $Ag_2SO_4$ dissolved per l
0.000	1.0054	8.350
1.0046	1.061	34.086
2.0452	1.1069	49.010
4.017	1.1871	71.166
4.209	1.1956	73.212
5.564	1.2456	84.609
8.487	1.3226	94.671
10.034	1.3676	90.806

(Hill and Simmons, Z. phys. Ch. 1909, 67, 803.)

Sol. in  $NH_4OH$ , and  $(NH_4)_2CO_3 + Aq$ .

100 pts.  $H_2O$  dissolve 0.58 pt at 18°. 100 pts.  $(NH_4)_2SO_4 + Aq$  (15%) dissolve 0.85 pt.  $Ag_2SO_4$  at 18°. Other sulphates have little effect (Eder, J pr (2) 17, 44.)

Determinations of the solubility of  $Ag_2SO_4$  in  $(NH_4)_2SO_4$  at temp. between 16.5° and 100° show that no double salt is formed by these two sulphates (Étard, A. ch 1911, (8) 24, 221.)

#### Solubility of $Ag_2SO_4$ in $(NH_4)_2SO_4 + Aq$ .

G. per 100 g.  $H_2O$ .

$(NH_4)_2SO_4$	$Ag_2SO_4$	$(NH_4)_2SO_4$	$Ag_2SO_4$
Temp. = 33°		Temp. = 51°	
8.85	1.101	8.90	1.362
15.90	1.331	16.27	1.680
22.22	1.500	22.43	1.887
27.25	1.585	32.10	2.061
30.80	1.619	35.38	2.095
35.88	1.627	39.03	2.082
39.46	1.600	42.37	2.055
43.22	1.557	45.05	2.026
Temp. = 75°		Temp. = 100°	
8.80	1.758	9.23	2.221
15.23	2.155	15.00	2.626
22.30	2.490	22.01	3.075
28.25	2.734	27.00	3.325
32.00	2.823	34.90	3.663
35.82	2.889	38.70	3.772
41.16	2.929	44.15	3.854
46.46	2.902	47.63	3.867

(Barre, A. ch. 1911, (8) 24, 149, 202, 210.)

#### Solubility of $Ag_2SO_4$ in $K_2SO_4 + Aq$ .

G. per 100 g  $H_2O$ .

$K_2SO_4$	$Ag_2SO_4$	$K_2SO_4$	$Ag_2SO_4$
Temp. = 33°		Temp. = 51°	
3.22	0.863	3.20	1.023
5.62	0.940	5.61	1.127
8.37	1.046	8.40	1.247
10.41	1.117	10.55	1.340
11.80	1.177	13.16	1.450
..	...	14.37	1.524
Temp. = 75°		Temp. = 100°	
3.12	1.273	3.23	1.488
5.73	1.406	5.60	1.675
8.43	1.554	8.45	1.890
10.55	1.665	11.30	2.115
13.17	1.806	15.07	2.410
17.06	2.021	18.53	2.677

(Barre, A. ch. 1911, (8) 24, 149, 202, 210.)

Solubility in $K_2SO_4 + Aq$ at $25^\circ$ .		
$\frac{1}{2}K_2SO_4 + Aq$ Normality	Solubility of $Ag_2SO_4$ g.-mol. per litre	
0.02	$2.46 \times 10^{-2}$	
0.04	$2.36 \times 10^{-2}$	
0.10	$2.31 \times 10^{-2}$	
0.20	$2.32 \times 10^{-2}$	
(Drucker, Z. anorg. 1901, 22, 362.)		
Solubility in $Na_2SO_4 + Aq$ at $t^\circ$ .		
$t^\circ$	$Ag_2SO_4$ in 100 pts. $H_2O$	$Na_2SO_4$ in 100 pts. $H_2O$
14.5	0.741	5.278
	0.904	10.103
	1.003	13.045
33	0.972	5.345
	1.150	10.056
	1.320	15.185
	1.448	20.093
	1.548	25.412
	1.570	29.556
	1.549	34.732
	1.462	39.447
	1.199	44.693
	0.932	46.976
51	1.173	5.407
	1.377	10.116
	1.572	15.146
	1.705	20.247
	1.787	25.196
	1.802	29.230
	1.727	34.625
	1.540	39.302
	1.188	42.914
	0.882	44.464
75	1.458	5.368
	1.697	9.813
	1.934	15.260
	2.075	19.978
	2.161	25.556
	2.138	29.662
	1.910	35.278
	1.603	38.944
	1.166	41.365
100	1.651	5.336
	2.012	10.153
	2.312	15.532
	2.351	26.451
	2.260	29.714
	2.012	34.718
	1.687	38.635
	1.156	40.160

Up to  $33^\circ$ , the solubility of  $Ag_2SO_4$  in  $Na_2SO_4 + Aq$  increases with the concentration of  $Na_2SO_4$ ; above  $33^\circ$  the solubility of  $Ag_2SO_4$  rises to a maximum at a certain concentration of  $Na_2SO_4$  dependent on the temp. The

solubility curves for various temp. all end at a concentration of 40%  $Na_2SO_4$ , that is, the mixed crystals formed at this concentration are equally sol. at all temp.

(Barre, C. R. 1910, 150. 1323.)

Solubility in $Na_2SO_4 + Aq$ at $t^\circ$		
$t^\circ$	100 pts. $H_2O$ dissolve	
	$Na_2SO_4$	$Ag_2SO_4$
18	0.0	0.766
	0.25	0.712
	0.51	0.682
	0.74	0.675
	1.00	0.665
	1.48	0.670
	2.01	0.673
	2.50	0.689
	3.04	0.703
	4.00	0.736
	4.99	0.768
	10.10	0.932
	13.04	1.028
33	0.0	0.917
	0.25	0.861
	0.51	0.835
	0.75	0.825
	0.98	0.818
	1.50	0.820
	2.01	0.832
	2.48	0.849
	3.00	0.867
51	0.00	1.081
	0.25	1.032
	0.49	1.010
	0.68	0.000
	1.02	0.995
	1.51	1.002
	1.90	1.017
	2.46	1.034
	2.92	1.053
	3.95	1.103
75	0.00	1.267
	0.20	1.215
	0.47	1.208
	0.80	1.206
	0.98	1.210
	1.52	1.222
	1.96	1.238
	2.50	1.269
	2.98	1.296
	4.08	1.366
100	0.00	1.404
	0.50	1.341
	1.01	1.363
	1.44	1.382
	1.94	1.418
	3.02	1.494

(Barre, A. ch. 1911, (8) 24, 215.)

## Solubility in salts + Aq at 25°.

C = concentration of salt in salt + Aq in milliequivalents per l.

$d_1$  = sp. gr. 25°/4° of salt + Aq.

S = solubility of  $\text{Ag}_2\text{SO}_4$  in salt + Aq expressed in milliequivalents per l.

$d_2$  = sp. gr. 25°/4° of  $\text{Ag}_2\text{SO}_4$  + salt + Aq

Salts	C	$d_1$	S	$d_2$
none	...	...	53.52	
$\text{KNO}_3$	24.914 49.774 99.870	0.9986 1.0002 1.0034	57.70 61.13 67.93	1.0072 1.0092 1.0094
$\text{Mg}(\text{NO}_3)_2$	24.764 49.595 99.460	0.9985 0.9999 1.0026	59.44 64.32 72.70	1.0073 1.0094 1.0133
$\text{AgNO}_3$	24.961 49.86 99.61	1.0007 1.0044 1.0112	39.09 28.45 16.96	1.0065 1.0084 1.0137
$\text{K}_2\text{SO}_4$	25.024 50.044 100.0 200.03	0.9989 1.0006 1.0041 1.0110	50.66 49.35 48.04 48.30	1.0064 1.0079 1.0112 1.0180
$\text{MgSO}_4$	20.22 50.069 100.04 200.05	0.9984 1.0002 1.0032 1.0092	52.21 50.93 49.95 49.60	1.0061 1.0079 1.0105 1.0164

(Harkins, J. Am. Chem. Soc. 1911, 33, 1813.)

Solubility of  $\text{Ag}_2\text{SO}_4$  in salts + Aq at 25°.

C = concentration of salt in salt + Aq in milliequivalents per l.

S = solubility of  $\text{Ag}_2\text{SO}_4$  in salt + Aq in milliequivalents per l.

Salt	C	S
$\text{KHSO}_4$	0.0 52.64 105.26	53.98 52.18 51.76
$\text{K}_2\text{SO}_4$	0.0 27.18 54.34	53.98 50.90 49.30

(Swan, J. Am. Chem. Soc. 1911, 33, 1814.)

Decomp. by alkali thiosulphates + Aq. (Herschell)

100 conc.  $\text{Ag}_2\text{SO}_4$  +  $\text{Ag}_2\text{C}_2\text{H}_3\text{O}_2$  + Aq. sat. at 17° contain 3.95 g.  $\text{Ag}_2\text{SO}_4$  and 8.30 g.  $\text{Ag}_2\text{C}_2\text{H}_3\text{O}_2$  and solution has sp. gr. = 1.0094. (Euler, C. C. 1904, I, 1316)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Chem. J. 1898 20, 829.)

## Solubility in organic compds. + Aq at 25°.

Solvent	Mol. $\text{Ag}_2\text{SO}_4$ sol in 1 litre
Water	0.0267
0.5-N Methyl alcohol	0.0249
" Ethyl alcohol	0.0228
" Propyl alcohol	0.0218
" Tert. amyl alcohol	0.0204
" Acetone	0.0220
" Ether	0.0206
" Formaldehyde	0.0227
" Glycol	0.0259
" Glycerine	0.0263
" Mannitol	0.0297
" Glucose	0.0283
" Sucrose	0.0270
" Urea	0.0303
" Dimethylpyrone	0.0216
" Urethane	0.0227
" Formamide	0.0270
" Acetamide	0.0253
" Acetonitrile	0.0525
" Glycecol	0.0433
" Acetic acid	0.0252
" Phenol	0.0379
" Chloral	0.0233
" Methylal	0.0205
" Methyl acetate	0.0212

(Rothmund, Z. phys. Ch. 1909, 69, 539.)

Insol in methyl acetate (Bezdol, Dissert. 1906; Naumann, B. 1909, 42, 3790); ethylacetate (Naumann, B. 1904, 37, 3601); liquid methylamine (Franklin, J. Am. Chem. Soc. 1906, 28, 1420); acetone. (Naumann, B. 1904, 37, 4329; Erdmann, C. C. 1899, II, 1014.)

Very sol. in a hot mixture of  $\text{H}_2\text{SO}_4$  and monobromobenzene, less sol. in cold. (Couper, A. ch. (3) 52, 311.)

Silver hydrogen sulphate,  $\text{AgHSO}_4$ .

Decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{SO}_4$ . (Stas.)  
 $\text{Ag}_2\text{O}, 3\text{H}_2\text{O}, 4\text{SO}_3 + 2\text{H}_2\text{O} = \text{Ag}_4\text{H}_4(\text{SO}_4)_2 + \text{H}_2\text{O}$  As above. (Schultz, Pogg. 133, 137.)  
 $2\text{Ag}_2\text{O}, 3\text{H}_2\text{O}, 5\text{SO}_3 + 2\text{H}_2\text{O} = \text{Ag}_4\text{H}_4(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ . As above (Schultz.)

Silver pyrosulphate,  $\text{Ag}_2\text{S}_2\text{O}_7$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weber, B. 17, 2497.)

Silver thallic sulphate,  $\text{AgTi}(\text{SO}_4)_2$ .

(Lepsius, Chem. Ztg. 1890, 1827.)

Silver tin (stannic) sulphate,  $\text{Ag}_2\text{Sn}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$ .

Ppt. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ . (Weinland, Z. anorg. 1907, 54, 250.)

Silver sulphate acetylde,  $\text{Ag}_2\text{SO}_4, 2\text{Ag}_2\text{C}_2$ .

(Phampton, Proc. Chem. Soc. 1892, 8, 109.)

**Silver sulphate ammonia,  $\text{Ag}_2\text{SO}_4 \cdot 2\text{NH}_3$ .**

Completely sol. in  $\text{H}_2\text{O}$  (Rose, Pogg 20. 153.)

$\text{Ag}_2\text{SO}_4 \cdot 4\text{NH}_3$ . Easily sol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp. (Mitscherlich.)

**Silver sulphate mercuric oxide,  $\text{Ag}_2\text{SO}_4 \cdot \text{HgO}$ .**

Insol. in  $\text{H}_2\text{O}$ , but decomp even in the cold. Sol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  (Finci, Gazz. ch. it. 1911, 41. (2) 648.)

**Silver sulphate sulphide,  $\text{Ag}_2\text{SO}_4 \cdot \text{Ag}_2\text{S}$ .**

Decomp. by hot  $\text{H}_2\text{O}$  or cold  $\text{HCl} + \text{Aq}$ . Sol. in boiling  $\text{HNO}_3 + \text{Aq}$  (Poleck and Thümmel, B. 16. 2435.)

**Sodium sulphate,  $\text{Na}_2\text{SO}_4$ .***Anhydrous.*

1 pt.  $\text{Na}_2\text{SO}_4$  is sol. in 7.387 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach), in 8.52 pts.  $\text{H}_2\text{O}$  at  $13.3^\circ$  (Poggendorf); in 10 pts.  $\text{H}_2\text{O}$  at  $13^\circ$ , and in 8.3 pts.  $\text{H}_2\text{O}$  at  $02.2^\circ$  (Wenzel).

100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 5.155 pts.  $\text{Na}_2\text{SO}_4$  (Pfaff, A. 99 220), at  $100^\circ$  dissolve 46.985 pts.  $\text{Na}_2\text{SO}_4$  (Griffiths).

See below for further data.

+  $7\text{H}_2\text{O}$ . Efflorescent. Insol. in alcohol

See below for further data.

+  $10\text{H}_2\text{O}$

$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol. in  $\text{H}_2\text{O}$  with absorption of heat; 20 pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  mixed with 100 pts.  $\text{H}_2\text{O}$  at  $12.5^\circ$  lower the temperature  $6.8^\circ$ . (Rüdorff, B. 2. 88)

Sol in 2.33 pts.  $\text{H}_2\text{O}$  at  $19^\circ$ , or 100 pts.  $\text{H}_2\text{O}$  at  $19^\circ$  dissolve 42.8 pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  (Schiff, A. 109 323)

100 pts.  $\text{H}_2\text{O}$  dissolve a pts.  $\text{Na}_2\text{SO}_4$  and b pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	a	b	$t^\circ$	a	b
0	5.02	12.17	33.88	50.04	312.11
11.67	10.12	26.38	40.15	48.78	291.44
13.30	11.74	31.33	45.04	47.81	278.91
17.91	16.73	48.28	50.40	46.82	262.35
25.05	28.11	69.48	59.79	45.42	
28.76	37.35	101.53	70.01	44.35	
30.75	43.05	215.77	84.42	42.98	
31.84	47.37	270.22	103.17	42.05	
32.73	50.65	322.12			

(Gay-Lussac, A. ch (2) 11. 312.)

Maximum solubility is at  $33^\circ$  from experiment and theoretical considerations. At this temp  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is converted into  $\text{Na}_2\text{SO}_4$ . (Kopp, A. 34. 271.)

100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .

$t^\circ$	Pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
2.6	11.89	37.50	294.04	75	241.88
7.6	16.38	43.75	291.04	81.25	217.20
12.5	20.03	50	285.06	87.50	220.65
18.76	30.78	56.25	248.11	93.75	225.46
25	143.35	62.5	222.22	100	241.09
31.25	479.97	68.75	242.88		

(Brandes and Firnhaber, 1824.)

1 pt.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol. in 6.1 pts.  $\text{H}_2\text{O}$  at  $7.5^\circ$ , 3.44 pts. at  $12.5^\circ$ , 2.41 pts. at  $18.75^\circ$ , and 1.731 pts. at  $20^\circ$ . (Karsten)

1 pt.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol. in 2.86 pts. cold, and 0.8 pt. boiling  $\text{H}_2\text{O}$  (Bergmann); in 3 pts. cold, and 0.5 pt. boiling  $\text{H}_2\text{O}$  (Wittstein); in 4 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$  (Fourcroy); in 3 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abt).

100 pts.  $\text{H}_2\text{O}$  dissolve 12.494 pts.  $\text{Na}_2\text{SO}_4$ , or 35.492 pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  at  $15^\circ$ , and sp. gr. of solution = 1.0847 (Mehl and Kraft, A. ch (3) 41. 478)

100 pts.  $\text{H}_2\text{O}$  dissolve 39.4 pts. cryst. salt at  $15.5^\circ$ , 80 pts. cryst. salt at  $100^\circ$  (Ure's Diet)

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Na}_2\text{SO}_4$  at  $t^\circ$

$t^\circ$	Pts. $\text{Na}_2\text{SO}_4$	$t^\circ$	Pts. $\text{Na}_2\text{SO}_4$
0	4.53	24.1	25.92
17.9	16.28	33	50.81

(Diachon, J. B. 1866. 61.)

Solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at various pressures and temp. Pts.  $\text{Na}_2\text{SO}_4$  contained in 100 pts. sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at A pressure in atmos and  $t^\circ$  are given

A	$0^\circ$	$10^\circ$	$15.4^\circ$	A	$15^\circ$
1	4.40	11.32	11.4	30	10.05
20	4.53	10.78	10.74	40	10.33

(Möller, Pogg 117. 386.)

The solubility of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  increases with the temperature from  $0$  to  $34^\circ$ . At  $34^\circ$  and above, it is converted into the anhydrous salt, the solubility of which is least at  $103.17^\circ$ , which is the boiling point of the saturated solution, and increases by cooling from that temp. down to  $18-17^\circ$ . Below the latter temperature the anhydrous salt cannot exist in the presence of  $\text{H}_2\text{O}$ , but is converted into  $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$ , or  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ . The solubility of  $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$  increases with the temperature from  $0-26^\circ$ , and at  $27^\circ$  it is converted into the anhydrous salt.

Thus there are two different rates of solubility for  $\text{Na}_2\text{SO}_4$  for temperatures from  $0-18^\circ$ , three different rates from  $18-26^\circ$ , two from  $26-34^\circ$ , and only one above  $34^\circ$ .

1. By heating  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  to fusion and raising the heat until the liquid boils, placing in a closed vessel and cooling, the greater part of the anhydrous salt, which separates out on heating, redissolves on cooling, and the amount increases as the temp falls until  $18^\circ$  is reached. Below  $18^\circ$   $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$  is formed. Saturated  $\text{Na}_2\text{SO}_4 + \text{Aq}$  thus obtained contains for 100 pts.  $\text{H}_2\text{O}$  at:

18° 20° 25° 26°  
53.25 52.76 51.53 51.31 pts.  $\text{Na}_2\text{SO}_4$

30° 33° 34° 36°  
50.37 49.71 49.53 49.27 pts.  $\text{Na}_2\text{SO}_4$

2. By allowing the boiling saturated solution free from undissolved salt to cool to  $0^\circ$

with exclusion of air until crystals of  $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$  are formed, then removing the greater part of the mother liquor with a warm pipette, and warming the rest of the mother liquor with the excess of crystals, the crystals dissolve in increasing quantity between  $0^\circ$  and  $26-27^\circ$ , so that at  $27^\circ$  the solution contains 56 pts  $\text{Na}_2\text{SO}_4$  to 100 pts  $\text{H}_2\text{O}$ . The remaining undissolved crystals of  $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$  begin to melt very slowly at  $27^\circ$ , more quickly at higher temperatures, and cause the separation of anhydrous crusts, and thus the strength of the solution is gradually lowered to the normal. Saturated solutions prepared in this way contain for 100 pts  $\text{H}_2\text{O}$  at:

$0^\circ$	$10^\circ$	$13^\circ$
19.62	30.49	34.27 pts. $\text{Na}_2\text{SO}_4$ ,
or 44.89	78.9	92.9 pts. $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ .
$16^\circ$	$18^\circ$	$17^\circ$
37.43	38.73	39.99 pts. $\text{Na}_2\text{SO}_4$ ,
or 106.8	117.4	111.0 pts. $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ ,
$18^\circ$	$19^\circ$	$20^\circ$
41.63	43.35	44.73 pts. $\text{Na}_2\text{SO}_4$ ,
or 124.6	133.0	140.0 pts. $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ ,
$25^\circ$	$26^\circ$	
52.94	54.97 pts. $\text{Na}_2\text{SO}_4$ ,	
or 188.5	202.6 pts. $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ .	

3. Solutions obtained by shaking  $\text{H}_2\text{O}$  with  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  contain for 100 pts.  $\text{H}_2\text{O}$  at:

$0^\circ$	$10^\circ$	$15^\circ$
5.02	9.00	13.20 pts. $\text{Na}_2\text{SO}_4$ ,
or 12.16	23.04	35.96 pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ,
$18^\circ$	$20^\circ$	$25^\circ$
16.80	19.40	28.00 pts. $\text{Na}_2\text{SO}_4$ ,
or 48.41	58.85	98.48 pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ,
$26^\circ$	$30^\circ$	
30.00	40.00 pts. $\text{Na}_2\text{SO}_4$ ,	
or 109.81	184.1 pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ,	
$33^\circ$	$34^\circ$	
50.76	55.0 pts. $\text{Na}_2\text{SO}_4$ ,	
or 223.1	412.2 pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .	

At  $34^\circ$ ,  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  begins to melt in its crystal  $\text{H}_2\text{O}$ . As long as there is a considerable quantity of unchanged crystals present, the solution contains 55 pts  $\text{Na}_2\text{SO}_4$  for 100 pts  $\text{H}_2\text{O}$ , but as the hydrous salt decreases in amount and becomes converted into the anhydrous salt, the solution becomes weaker and contains only 49.53 pts  $\text{Na}_2\text{SO}_4$  for 100 pts.  $\text{H}_2\text{O}$  after warming for 8 or 8 hours at  $34^\circ$ . In the same way temporary solutions can be obtained at  $38-40^\circ$  with 55-56 pts  $\text{Na}_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ , but this amount sinks to the normal even more quickly than at  $34^\circ$ .

\*  $\text{Na}_2\text{SO}_4$  dehydrated at  $100-150^\circ$ , after the addition of  $1\frac{1}{2}-1\frac{1}{4}$  pts  $\text{H}_2\text{O}$ , gives a solution between  $0^\circ$  and  $32^\circ$  of the same strength as  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ , but at  $34^\circ$  a solution with

55 pts  $\text{Na}_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$  cannot be obtained, but one with 49.53 pts. is formed (Löwel, A. ch. (3) 49. 32)

4 Solubility of anhydrous salt. Above  $34^\circ$ , 100 pts.  $\text{H}_2\text{O}$  dissolve at:

$35^\circ$	$40^\circ$	$45^\circ$	$50^\circ$	$55^\circ$
50.2	48.8	47.7	46.7	45.9 pts. $\text{Na}_2\text{SO}_4$ ,
$60^\circ$	$65^\circ$	$70^\circ$	$75^\circ$	$80^\circ$
45.3	44.8	44.4	44.0	43.7 pts. $\text{Na}_2\text{SO}_4$ ,
$85^\circ$	$90^\circ$	$95^\circ$	$100^\circ$	$103.5^\circ$
43.3	43.1	42.8	42.5	42.2 pts. $\text{Na}_2\text{SO}_4$ .

(Mulder.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts $\text{Na}_2\text{SO}_4$	$t^\circ$	Pts $\text{Na}_2\text{SO}_4$	$t^\circ$	Pts $\text{Na}_2\text{SO}_4$
0	4.8	35	50.2	70	44.4
1	5.1	36	49.9	71	44.3
2	5.4	37	49.6	72	44.2
3	5.7	38	49.3	73	44.2
4	6.0	39	49.1	74	44.1
5	6.4	40	48.8	75	44.0
6	6.8	41	48.5	76	44.0
7	7.3	42	48.3	77	43.9
8	7.8	43	48.1	78	43.8
9	8.4	44	47.9	79	43.7
10	9.0	45	47.7	80	43.7
11	9.7	46	47.5	81	43.6
12	10.5	47	47.3	82	43.5
13	11.4	48	47.1	83	43.5
14	12.4	49	46.9	84	43.4
15	13.4	50	46.7	85	43.3
16	14.5	51	46.6	86	43.3
17	15.7	52	46.4	87	43.2
18	16.9	53	46.2	88	43.2
19	18.2	54	46.1	89	43.1
20	19.5	55	45.9	90	43.1
21	20.9	56	45.8	91	43.0
22	22.5	57	45.7	92	43.0
23	24.1	58	45.6	93	42.9
24	25.9	59	45.4	94	42.9
25	27.9	60	45.3	95	42.8
26	30.1	61	45.2	96	42.7
27	32.4	62	45.1	97	42.6
28	35.0	63	45.0	98	42.6
29	37.8	64	44.9	99	42.5
30	40.9	65	44.8	100	42.5
31	44.2	66	44.7	101	42.4
32	47.8	67	44.6	102	42.3
32.75	50.65	68	44.5	103	42.2
33	50.6	69	44.5	103.5	42.2
34	50.4			...	...

(Mulder, Scheik Verhand. 1864. 123.)

100 pts dissolve at:

$0^\circ$	$34^\circ$	$100^\circ$
5	78.8(?)	42.7

41.95 pts.  $\text{Na}_2\text{SO}_4$ ,

$140^\circ$	$160^\circ$	$180^\circ$	$230^\circ$
42.0	42.9	44.25	46.4

(Tilden and Shenstone, Lond. R. Soc. Proc.

35. 345.

Solubility decreases above 230°. (Etard, C. R. 113. 854.)

Sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  contains at:

0°	7°	13°	24°	28°	30°
4.1	6.2	9.9	19.3	25.2	29.5% $\text{Na}_2\text{SO}_4$
49°	62°	83°	99°	134°	150°
32.8	31.3	30.0	29.7	29.4	29.8% $\text{Na}_2\text{SO}_4$
190°	240°	279°	320°		
29.9	30.0	24.5	17.8% $\text{Na}_2\text{SO}_4$		

(Etard, A. ch. 1894, (7) 2. 548.)

Solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at t°. G. per 100 g.  $\text{H}_2\text{O}$ .

t°	$\text{Na}_2\text{SO}_4$	Sp. gr.	t°	$\text{Na}_2\text{SO}_4$	Sp. gr.
0 70	4.71	1.0432	33.5	49.39	1.3307
10.25	9 21	1.0802	38.15	48 47	1.3229
15.65	14.07	1.1150	44 85	47 49	1.3136
24.90	27.67	1.2037	60.10	45.22	1.2918
27.65	34 06	1.2459	75.05	43 59	1.2728
30.20	41.78	1.2894	89 85	42.67	1.2571
31.95	47 98	1.3230	101.9*	42.18	1.2450

\* B.-pt.

(Berkeley, Phil. Trans. Roy. Soc. 1904, 203. A, 189.)

Transition point from  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  to  $\text{Na}_2\text{SO}_4 = 32.5^\circ$  (Berkeley);  $32.383^\circ$ . (Richards and Churchill, Z. phys. Ch. 1899, 28. 814.)

100 g  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat. at  $15^\circ$  contain 11.5 g. anhydrous  $\text{Na}_2\text{SO}_4$ ; 21.9 g. at  $25^\circ$ . (Schreinemakers, Arch. Néer. Sc. 1910, (2) 15. 81.)

1 l.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat. at  $25^\circ$  contains 1.881 mols.  $\text{Na}_2\text{SO}_4$ . (Herz, Z. anorg. 1911, 70. 127.)

Solubility in  $\text{H}_2\text{O}$  at t°.

t°	Mol. % $\text{Na}_2\text{SO}_4$
62	5.39
70	5.27
72	5.25
80	5.18
120	5.04
190	5.25
192	5.27
208	5.39
241	5.39
250	5.04
279	4.12
319	2.58
252	4.9
310	3.2
340	1.8
365	0.0

(White, Z. phys. Ch. 1913, 86. 364.)

Supersaturated solutions of  $\text{Na}_2\text{SO}_4$  are easily formed; when  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat. at its b.-pt. is hermetically sealed, no crystals are deposited on cooling (Lowell). Supersat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  may also be obtained by cooling hot sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  in flasks loosely stoppered with cotton wool (Schroeder, A. 109. 45), or by covering the containing vessel with a glass plate, watch-glass, card, etc., or by covering the liquid itself with a layer of oil, and then allowing to cool.

Hot  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 1 pt.  $\text{H}_2\text{O}$  to 1 pt.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  does not crystallise on slowly cooling or on being quickly cooled by immersion in cold water, if it is contained in a barometer tube freed from air by boiling, or in an exhausted well-closed vessel, or in an open vessel with a layer of oil of turpentine on it (Gay-Lussac); or in a vessel containing air, either well stoppered or furnished with a loose cover (Schweigger); or in an open vessel under a bell jar full of air and closed at the bottom with a water joint; or in open bottles placed in a quiet situation; or in an open glass enclosed in a stoppered vessel, containing air and some KOH for drying; in this case  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  effloresces from the solution, and when washed down again does not cause instant crystallisation, but redissolves.

The crystallisation of a solution cooled in this way may often be brought about instantaneously, or often again after a short time; (1) by agitation, when the solution has been cooled in an open vessel; (2) by access of air caused by opening the vessel, the crystallisation taking place the more rapidly the larger the opening. In this case the crystallisation begins at the top, where the solution, the vessel, and the air come in contact; when a particle of dust falls in the liquid the crystallisation begins a little under the surface. When the solution has been cooled in vacuo, a bubble of air, hydrogen, carbonic acid, or nitrous oxide is sufficient to set up the crystallisation; (3) by contact with a solid body. The latter do not cause crystallisation when cooled in contact with the liquid, nor (excepting a crystal of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ) when they are moistened or warmed before contact with the solution.

Supersat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  is brought to crystallisation by addition of a crystal of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ , or an isomorphous substance as  $\text{Na}_2\text{SeO}_4 + 10\text{H}_2\text{O}$ , or  $\text{Na}_2\text{CrO}_4 + 10\text{H}_2\text{O}$ . Other crystals, as  $\text{MgSO}_4 + 7\text{H}_2\text{O}$ , etc., have no action. (Thomson, Chem. Soc. 35. 199.)

See also Hardley, Jones and Hutchinson, Chem. Soc. 1908, 93. 825, on "Spontaneous crystallisation of sodium sulphate solutions," and de Coppet (A. ch. 1907, (8) 10. 457) on same subject.

A more extended discussion of the phenomena and causes of supersaturation is not considered to be within the scope of this work.

$\text{Na}_2\text{SO}_4 + \text{Aq}$  sat. at  $15^\circ$  has sp. gr. 1.10847 (Mitschell and Kraitsir); at  $15^\circ$  has sp. gr. 1.119 (Steibba); at  $16^\circ$

has sp. gr. 1.1162 (Stolba), at 10° contains 29 pts  $\text{Na}_2\text{SO}_4$  to 100 pts  $\text{H}_2\text{O}$  (supersaturated?), and has sp. gr. 1.1250 (Karsten)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 10.5°.

% $\text{Na}_2\text{SO}_4$	Sp. gr.	% $\text{Na}_2\text{SO}_4$	Sp. gr.
2 894	1 0262	10 538	1 0977
5 589	1 0509	12 473	1 1162
7 895	1 0738		

(Kremers, *Pogg.* 95 120.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$

% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp. gr.	% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp. gr.
1 282	1 005	13 744	1 055
2 422	1 010	17 075	1 069
3 780	1 015	18 203	1 065
5 035	1 020	17 428	1 070
6 288	1 025	18 645	1 075
7 538	1 030	19 860	1 080
8 786	1 035	21 071	1 085
10 030	1 040	22 277	1 090
11 272	1 045	23 473	1 095
12 510	1 050	24 674	1 100

(Schmidt, *Pogg.* 132 132)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 19°.

% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp. gr.	% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp. gr.
1	1 0040	16	1 0642
2	1 0079	17	1 0683
3	1 0118	18	1 0725
4	1 0158	19	1 0766
5	1 0198	20	1 0807
6	1 0232	21	1 0849
7	1 0278	22	1 0890
8	1 0318	23	1 0931
9	1 0358	24	1 0973
10	1 0398	25	1 1015
11	1 0439	26	1 1057
12	1 0479	27	1 1100
13	1 0520	28	1 1142
14	1 0560	29	1 1184
15	1 0601	30	1 1226

(Schiff, *A.* 110. 70)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 15°.

%	Sp. gr. if $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp. gr. if $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	%	Sp. gr. if $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp. gr. if $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
1	1 0091	1 004	11	1 044	21 1 086
2	1 0182	1 008	12	1 047	22 1 090
3	1 0274	1 013	13	1 052	23 1 094
4	1 0365	1 016	14	1 056	24 1 098
5	1 0467	1 020	15	1 060	25 1 103
6	1 0550	1 024	16	1 064	26 1 107
7	1 0644	1 028	17	1 069	27 1 111
8	1 0737	1 032	18	1 073	28 1 116
9	1 0832	1 036	19	1 077	29 1 120
10	1 0927	1 040	20	1 082	30 1 125

(Gerlach, *Z. anal.* 8. 287)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 24.8°. a=no. of g., equivalent to  $\frac{1}{2}$  mol. wt. dissolved in 1000 g  $\text{H}_2\text{O}$ , b=sp. gr. if a is  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol. wt. = 161; c=sp. gr. if a is  $\text{Na}_2\text{SO}_4$ ,  $\frac{1}{2}$  mol. wt. = 71.

a	b	c	a	b	c
1	1 054	1 050	4	1 163	1 213
2	1 068	1 114	5	1 188	
3	1 134	1 165	6	1 209	

(Favre and Valsen, *C. R.* 79. 968)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 18°.

% $\text{Na}_2\text{SO}_4$	Sp. gr.	% $\text{Na}_2\text{SO}_4$	Sp. gr.
5	1 0450	15	1 1426
10	1 0915		

(Kohlrausch, *W. Ann.* 1879. 1)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 20° containing 0.5 mol.  $\text{Na}_2\text{SO}_4$  to 100 mols.  $\text{H}_2\text{O}$  = 1.03466; 1.0 mol.  $\text{Na}_2\text{SO}_4$  to 100 mols.  $\text{H}_2\text{O}$  = 1.06744. (Nicol, *Phil. Mag.* (5) 16. 122.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 25°.

Concentration of $\text{Na}_2\text{SO}_4 + \text{Aq}$	Sp. gr.
1-normal	1.0606
$\frac{1}{2}$ -normal	1 0309
$\frac{1}{3}$ -normal	1 0156
$\frac{1}{4}$ -normal	1 0079

(Wagner, *Z. phys. Ch.* 1890. 5. 39)

Sp. gr. at 16°/4° of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 9.4043%  $\text{Na}_2\text{SO}_4$  = 1.08655. (Schönrock, *Z. phys. Ch.* 1893. 11. 781.)

$\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 25.51%  $\text{Na}_2\text{SO}_4$  has sp. gr. 20°/20° = 1.2527.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 10.14%  $\text{Na}_2\text{SO}_4$  has sp. gr. 20°/20° = 1.0938. (Le Blanc and Rohland, *Z. phys. Ch.* 1896. 19. 278.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 17.5°, when p = per cent strength of solution; d = observed density; and w = volume conc. in grs. per cc.  $\left(\frac{pd}{100} = w\right)$

p.	d.	w.
13.06	1 1226	0.14662
11.75	1 1094	0.13043
10.68	1 0990	0.11737
8.544	1 0784	0.09214
6.762	1.0615	0.07178
4.015	1.0358	0.04159
2.599	1.0225	0.02658
2.375	1.0204	0.02423
1.818	1.0154	0.01846
1.349	1.0109	0.01364
0.5204	1.0037	0.00522
0.2921	1.0014	0.00293

(Barnes, *J. phys. Chem.* 1898. 2. 543.)

Sp. gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $20^\circ$ 

Normality of $\text{Na}_2\text{SO}_4 + \text{Aq}$	% $\text{Na}_2\text{SO}_4$	Sp. gr.
0.97	12.36	1.1138
0.48	6.41	1.0570

(Forchheimer, Z. phys. Ch. 1900, 34. 23.)

Sp. gr. of sat.  $\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	wt of 1 ccm of the solution	100 g. $\text{H}_2\text{O}$ dissolve g. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
0	1.040	12.16
5	1.058	..
10	1.078	21.04
15	1.109	35.96
18	1.137	48.41
20	1.156	58.35
25	1.209	98.48
26	1.222	109.81
30	1.287	184.1
33	1.312	323.1
34	1.317	413.2
35	1.317	.

(Tschernaj, J. Russ. Phys. Chem. Soc. 1914, 46. 8.)

Sp. gr. and b.-pt. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing P pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  for every 100 pts.  $\text{H}_2\text{O}$  has given sp. gr. and b.pt

P	Sp. gr.	B.-pt	P	Sp. gr.	B.-pt
1	1.005	100.5°	16	1.064	101.25°
2	1.008	100.62	17	1.067	101.26
3	1.014	100.62	18	1.070	101.37
4	1.020	100.75	19	1.072	101.37
5	1.021	100.75	20	1.074	101.37
6	1.028	100.87	21	1.076	101.37
7	1.030	100.87	22	1.078	101.5
8	1.032	101.0	23	1.080	101.5
9	1.030	101.0	24	1.082	101.5
10	1.040	101.0	25	1.084	101.5
11	1.043	101.12	26	1.090	101.5
12	1.050	101.12	27	1.092	101.63
13	1.055	101.25	28	1.095	101.03
14	1.060	101.25	29	1.098	101.63
15	1.062	101.25	30	1.100	101.76

(Brandes and Gruner, 1827.)

Saturated solution boils at  $103.17^\circ$  (Löwel),  $103.5^\circ$  (Mulder),  $105^\circ$  (Kremers),  $100.5^\circ$  (Griffiths),  $100.8^\circ$  (Gerlach).Crust forms at  $102.9^\circ$ ; highest temp.,  $103.2^\circ$ , and solution contains 43.9 pts.  $\text{Na}_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ . (Gerlach, Z. anal. 26. 426.)B.-pt of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing pts.  $\text{Na}_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ 

B.-pt	Pts $\text{Na}_2\text{SO}_4$	B.-pt.	Pts $\text{Na}_2\text{SO}_4$
100.5°	9.5	102.5°	39.0
101.0	13.0	103.0	44.5
101.5	26.0	103.2	46.7
102.0	33.0		

(Gerlach, Z. anal. 26. 430.)

M.-pt. of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O} = 34^\circ$ . (Tilden, Chem. Soc. 45. 409.)Sol. with decomp. in  $\text{HCl} + \text{Aq}$ .Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

1000 g. of the solution contain		Solid phase
Mols $\text{H}_2\text{SO}_4$	Mols $\text{Na}_2\text{SO}_4$	
...	1.539	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$
0.286	1.671	"
0.338	1.742	"
0.884	2.256	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$
1.576	2.363	$\text{Na}_2\text{SO}_4 + \text{Na}_2\text{H}(\text{SO}_4)_2$
1.666	2.437	"
2.611	2.091	$\text{Na}_2\text{H}(\text{SO}_4)_2 + \text{Na}_2\text{H}(\text{SO}_4)_2, \text{H}_2\text{O}$

(D'Ans, Z. anorg. 1906, 49. 356.)

Solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

1000 g of the solution contain		Solid phase
Mol $\text{Na}_2\text{SO}_4$	Mol. $\text{H}_2\text{SO}_4$	
1.55	0.08	$\text{Na}_2\text{SO}_4$
1.59	0.147	"
1.85	0.60	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$
2.00	0.763	"
0.77	4.23	$\text{NaHSO}_4, \text{H}_2\text{O}$
0.47	4.96	"
0.32	6.61	$\text{Na}_2\text{HSO}_4$
0.305	6.87	"
0.07	7.18	$\text{Na}_2\text{H}(\text{SO}_4)_2$
0.79	8.78	"

(D'Ans, Z. anorg. 1909, 61. 92.)

10 ccm. of sat.  $\text{Na}_2\text{SO}_4 + \text{absolute } \text{H}_2\text{SO}_4$  contain approx. 2.999 g.  $\text{Na}_2\text{SO}_4$ . (Bergius, Z. phys. Ch. 1910, 72. 355.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ Solid Phase,  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .

Millimoles $\text{H}_2\text{SO}_4$ in 10 ccm	Millimoles $\text{Na}_2\text{SO}_4$ in 10 ccm.
5 10	18 81
7 79	22 38
	24 65

(Heiz, Z. anorg. 1912, 73. 276.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

1000 g of the solution contain		Solid phase
Mols $\text{SO}_2$	Mols $\text{Na}_2\text{SO}_4$	
5.91	0.409	$\text{NaHSO}_4$
6.30	0.332	"
6.64	0.297	$\text{NaHSO}_4 + \text{NaH}_2(\text{SO}_4)_2, \text{H}_2\text{O}$
6.90	0.173	$\text{NaH}_2(\text{SO}_4)_2, \text{H}_2\text{O}$
7.36	0.071	"
7.74	0.047	"
7.82	0.044	"
8.12	0.037	"
8.29	0.042	"
8.40	0.046	"
8.70	0.076	"
8.86	0.158	"
8.93	0.259	"
8.93	0.269	"
8.93	0.273	"
8.84	0.527	"
8.73	0.681	"
8.70	0.808	$\text{NaH}_2(\text{SO}_4)_2, \text{H}_2\text{O}$
8.62	0.834	metastable solutions
8.62	0.844	"
8.61	0.899	"
8.87	0.445	$\text{NaH}_2(\text{SO}_4)_2, \text{H}_2\text{O} + \text{Na}_2\text{SO}_4$
	4.5H $2\text{SO}_4$	
8.93	0.437	$\text{Na}_2\text{SO}_4, 4.5\text{H}_2\text{SO}_4$
9.08	0.394	"
9.36	0.425	$\text{Na}_2\text{SO}_4, 4.5\text{H}_2\text{SO}_4 + \text{NaHSO}_4$
9.18	0.567	$\text{NaHSO}_4$
9.42	0.728	"
9.48	0.760	"
9.55	0.775	"
9.48	0.953	$\text{NaHSO}_4 + ?$
9.85	0.787	?
9.98	0.908	?
(9.77)	(1.03)	Metastable
10.16	0.797	"
10.78	0.302	"

(D'Ans, Z. anorg. 1913, 80. 236.)

Sl. sol. in conc.  $\text{HClO}_4$ . (Ure's Dict.)  
Not pptd. by addition of glacial  $\text{HClO}_4$  to  
 $\text{Na}_2\text{SO}_4 + \text{Aq}$  (Persoz.)

Solubility in  $\text{NaOH} + \text{Aq}$  at  $25^\circ$ .

1000 g of the solution contain		Solid phase
Mols ( $\text{NaOH}$ ) $_2$	Mols $\text{Na}_2\text{SO}_4$	
0	1.54	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$
0.074	1.41	"
0.70	1.08	"
1.47	0.90	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$
2.02	0.59	$\text{Na}_2\text{SO}_4$
2.82	0.24	"
3.52	0.126	"
5.83	0.013	"
6.62		$\text{NaOH}, \text{H}_2\text{O}$

(D'Ans and Schreiner, Z. anorg. 1910, 67. 437.)

Sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ .Rapidly and abundantly sol. in sat.  $\text{KCl} + \text{Aq}$  with pptn. of  $\text{K}_2\text{SO}_4$ .

$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol in sat.  $\text{NaCl} + \text{Aq}$  without pptn. If effloresced  $\text{Na}_2\text{SO}_4$  is used, a ppt. of  $\text{NaCl}$  is caused at first, and subsequently of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ . (Karsten.)

Sol. in boiling sat.  $\text{NaCl} + \text{Aq}$  with pptn. of  $\text{NaCl}$ , but from cold solutions the  $\text{Na}_2\text{SO}_4$  separates out first. (Vauquelin.)

Less sol in  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Hunt, Am. J. Sci. (2) 25. 368.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	g. $\text{NaCl}$ per 100 g. $\text{H}_2\text{O}$	g. $\text{Na}_2\text{SO}_4$ per 100 g. $\text{H}_2\text{O}$
10	0.00	9.14
	4.28	6.42
	9.60	4.76
	15.65	3.99
	21.82	3.97
	28.13	4.15
	30.11	4.34
	32.27	4.59
	33.76	4.75
21.5	0.00	21.33
	9.05	15.48
	17.48	13.73
	20.41	13.62
	26.01	15.05
	26.53	14.44
	27.74	13.39
	31.25	10.64
	31.80	10.28
	32.10	8.43
25	33.69	4.73
	34.08	2.77
	35.46	0.00
	0.00	28.74
	2.74	26.57
	8.15	23.15
	19.86	20.52
	24.58	14.86
	31.21	9.95
	32.02	9.61

Solubility in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ —*Continued.*

$t^\circ$	g $\text{NaCl}$ per 100 g $\text{H}_2\text{O}$	g $\text{Na}_2\text{SO}_4$ per 100 g $\text{H}_2\text{O}$
27	0 00	31 10
	2 66	28 73
	5 29	27 17
	7 90	26 02
	16 13	24 83
	18 91	21 39
	19.64	20 11
	20 77	19 29
	32 33	9 53
30	0 00	39 70
	2 45	38 25
	5 61	36 50
	7 91	35.96
	10 61	31.64
	12 36	29.87
	15 05	25 02
	18 44	21 30
	20 66	19 06
	32 43	9 06
33	0.00	48 48
	1 22	46 49
	1 99	45 16
	2 64	44.09
	3 47	42.61
	12 14	29.32
	21 87	16 83
	32 84	8 76
	33 99	4 63
	34 77	2 75
35	0 00	47 94
	2 14	43 75
	13 57	26 26
	18.78	19 74
	31.91	8 28
	35 63	0 00

At  $33^\circ$  and above the values represent the solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{NaCl} + \text{Aq}$ . At  $10^\circ$  the solid phase in contact with the solution is probably  $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ . Between  $17^\circ$  and  $33^\circ$  the solid phase is either  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  or  $\text{Na}_2\text{SO}_4$ . An inversion of  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  to  $\text{Na}_2\text{SO}_4$  takes place at various temp. below  $33^\circ$ , depending on the amount of  $\text{NaCl}$  contained in the solution in contact with the solid sodium sulphate.

(Seidell, Am. Ch. J. 1902, 27. 55)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $15^\circ$ 

Composition of the sat. solution		Solid Phase
% by wt. $\text{Na}_2\text{SO}_4$	% by wt. $\text{NaCl}$	
11 5	0	$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
7 86	5 42	"
5 87	11.51	"
5 23	15 97	"
5 26	21 03	"
5.64	23 39	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O} + \text{NaCl}$
2.26	25 21	$\text{NaCl}$
0	26 3	"

(Schreinemakers and de Baat, Z. phys. Ch. 1909, 67. 554.)

Sol in sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Margueritte, C. R. 38. 307.)Sol. in sat.  $\text{KNO}_3 + \text{Aq}$  with pptn. after several hours (Karsten.)

$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol. in sat.  $\text{NaNO}_3 + \text{Aq}$  without pptn., but if effloresced  $\text{Na}_2\text{SO}_4$  is used,  $\text{NaNO}_3$  is pptd. at first, and subsequently  $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$ .

The presence of  $\text{CaSO}_4$  does not affect the solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  to any great extent. (Barre, A. ch. 1911, (8) 24. 160.)

More sol. in  $\text{K}_2\text{SO}_4, \text{CuSO}_4, \text{MgSO}_4 + \text{Aq}$ . than in  $\text{H}_2\text{O}$ . (Pfaff, A. 99. 226.)

100 pts.  $\text{H}_2\text{O}$  dissolve 20.7 pts.  $\text{CuSO}_4$  and 15.9 pts.  $\text{Na}_2\text{SO}_4$ . (Rüdorff, B. 6. 484.)

Sol. in sat.  $\text{MgSO}_4, \text{K}_2\text{SO}_4, \text{CuSO}_4 + \text{Aq}$ , but if more  $\text{Na}_2\text{SO}_4$  than can be dissolved is added to the  $\text{CuSO}_4 + \text{Aq}$ , a large quantity of a double sulphate separates out. (Karsten.)

The solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{K}_2\text{SO}_4 + \text{Aq}$  has been determined at  $15^\circ, 25^\circ, 40^\circ, 50^\circ, 60^\circ, 70^\circ$  and  $80^\circ$ . From the results the conclusion is drawn that sodium and potassium sulphates form a double salt of the formula  $\text{K}_2\text{Na}(\text{SO}_4)_2$ . (Okada, Chem. Soc. 1915, 108. (2) 344.)

See also under  $\text{CuSO}_4, \text{MgSO}_4$ , and  $\text{K}_2\text{SO}_4$ .

Slowly but abundantly sol. in sat.  $\text{ZnSO}_4 + \text{Aq}$ , with separation of a double salt after a few days

Solubility of  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	grams $\text{ZnSO}_4$	grams $\text{Na}_2\text{SO}_4$
0	40 305	7 905
5	42 285	9 515

(Koppel, Z. phys. Ch. 1905, 52. 409.)

See also under  $\text{Na}_2\text{Zn}(\text{SO}_4)_4 + 4\text{H}_2\text{O}$ .

Solubility of  $\text{Na}_2\text{SO}_4 + \text{Th}(\text{SO}_4)_2$  at  $16^\circ$   
Solid phase  $\text{Th}(\text{SO}_4)_2$

Pts per 100 pts $\text{H}_2\text{O}$		Pts per 100 pts $\text{H}_2\text{O}$	
$\text{Na}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$	$\text{Na}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$
1.094	1.743	5.79	2.136
1.960	2.387	9.35	1.379
2.84	3.800	12.24	1.169
2.98	3.962	15.36	1.048
4.11	3.375		

(Barre, C. R. 1911, 150. 155.)

Solubility in Na acetate + Aq at  $25^\circ$ .

Solid phase,  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$

Composition of the solutions

% Na acetate	% $\text{Na}_2\text{SO}_4$	% $\text{H}_2\text{O}$
0	21.9	78.10
4.10	17.72	78.18
7.71	16.48	75.81
12.58	13.50	73.92
16.26	11.50	72.24
20.63	8.10	71.27

(Fox, Chem. Soc 1909, 95. 888.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Alcohol precipitates  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  from the solid saturated aqueous solution. (Brandes and Pirnhaber.)

Insol. in alcohol of from 0.817 to 0.90 sp. gr. (Kirwan.)

1000 pts. alcohol of 0.872 sp. gr. dissolve 0.7 pt  $\text{Na}_2\text{SO}_4$  at  $12.5-15^\circ$ , of 0.905 sp. gr. dissolve 3.8 pts  $\text{Na}_2\text{SO}_4$  at  $12.5-15^\circ$ .

Insol. in alcohol of 0.83-0.85 sp. gr. (Anthony.)

From supersaturated solution in alcohol, crystals with  $7\text{H}_2\text{O}$  are formed. (Schiff, A. 106. 11.)

100 pts 10% alcohol at  $15^\circ$  contain 14.35 pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ; 20% alcohol at  $15^\circ$  contain 5.6 pts  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ; 40% alcohol at  $15^\circ$  contain 1.3%  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ . (Schiff, A. 118. 365.)

Very sl sol in abs. alcohol at ord. temp.;

somewhat more, though still exceedingly sparingly, sol. in abs. alcohol acidulated with  $\text{H}_2\text{SO}_4$ . (Fresenius.)

Alcohol does not affect crystal  $\text{H}_2\text{O}$  of

$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .

Solubility of  $\text{Na}_2\text{SO}_4$  in alcohol + Aq at  $t^\circ$

$t^\circ$	% alcohol	g per 100 g solution			solid phase
		$\text{H}_2\text{O}$	alcohol	$\text{Na}_2\text{SO}_4$	
15	0.7	88.7	0.0	11.3	$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
	9.2	85.1	8.6	6.3	"
	19.4	78.6	18.9	2.9	"
	30.7	60.0	39.5	0.5	"
	58.9	41.1	58.8	0.1	"
	72.0	28.0	72.0	0.0	"
	0.0	72.8	0.0	27.2	$\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$
	11.2	76.5	9.5	14.0	"
	20.6	74.3	19.2	6.5	"
	30.2	68.4	29.6	2.0	"
25	0.0	78.1	0.0	21.9	$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
	10.6	78.5	9.3	12.2	"
	24.0	72.8	22.9	4.3	"
	54.0	45.6	54.0	0.4	"
36	0.0	67.0	0.0	33.0	$\text{Na}_2\text{SO}_4$
	8.8	70.0	6.8	22.6	"
	12.8	71.2	10.5	18.3	"
	17.9	71.1	15.5	13.4	"
	18.1	71.0	15.7	13.3	"
	28.9	66.5	28.4	5.1	"
	48.7	50.9	48.3	0.8	"
45	0.0	67.6	0.0	32.4	"
	9.0	71.3	7.1	21.6	"
	14.5	71.8	12.1	16.1	"
	20.6	70.6	18.4	10.0	"
	31.0	65.6	29.5	4.9	"

Between certain concentrations of alcohol, the liquid separates into two layers at  $25^\circ$ ,  $36^\circ$  and  $45^\circ$ , of the following composition.

$t^\circ$	Upper Layer			Lower Layer		
	% $\text{H}_2\text{O}$	% alcohol	% $\text{Na}_2\text{SO}_4$	% $\text{H}_2\text{O}$	% alcohol	% $\text{Na}_2\text{SO}_4$
25	66.5	27.3	6.2	67.4	5.1	27.5
	68.1	23.9	8.0	68.5	6.0	25.5
	68.3	23.1	8.6	68.3	6.7	25.0
36	57.7	38.4	3.9	66.6	4.1	29.3
	65.0	28.3	6.7	68.8	5.9	25.3
	68.1	21.2	10.7	68.9	9.4	21.7
45	61.8	32.9	5.3	...	...	...
	65.8	25.3	8.9	68.4	8.8	22.8
	66.0	24.0	10.0	68.6	10.1	21.3

(de Bruyn, Z. phys. Ch. 1900, 32. 101.)

## Solubility in alcohol + Aq at 25°

Composition of the sat. solution			Solid phase
% by wt. H <sub>2</sub> O	% by wt. alcohol	% by wt. Na <sub>2</sub> SO <sub>4</sub>	
63.41	34.84	1.75	Na <sub>2</sub> SO <sub>4</sub> , 10H <sub>2</sub> O
49.0	50.5	0.5	
46.6	53.0	0.4	Na <sub>2</sub> SO <sub>4</sub> , 10H <sub>2</sub> O + Na <sub>2</sub> SO <sub>4</sub>
34.9	64.95	0.15	Na <sub>2</sub> SO <sub>4</sub>

(Schreinemakers, Z. phys. Ch. 1909, 67, 552)

Solubility data for solution of NaCl in ethyl alcohol + Aq at 15°, 25°, and 30° are given by Schreinemakers (Z. phys. Ch. 1909, 67, 556)

## Solubility in propyl alcohol + Aq at 20°.

% propyl alcohol	g Na <sub>2</sub> SO <sub>4</sub> per 100 g solution	% propyl alcohol	g Na <sub>2</sub> SO <sub>4</sub> per 100 g solution
42.20	1.99	56.57	0.55
49.77	1.15	60.64	0.44
55.65	0.72	62.81	0.38

(Linebarger, Am. Ch. J. 1892, 14, 380)

Sol in glycerine.

Insol in acetone. (Naumann, B. 1904 37, 4329; Eidmann, C. C. 1899, II, 1014.); benzonitrile. (Naumann, B. 1914, 47, 1370) methyl acetate (Naumann, B. 1909, 42, 7790); ethyl acetate. (Naumann, B. 1910, 43, 314.)

100 g. H<sub>2</sub>O dissolve 183.7 g sugar + 30.5 g. Na<sub>2</sub>SO<sub>4</sub> at 31.25°, or 100 g sat. solution contain 52.2 g. sugar + 9.6 g. Na<sub>2</sub>SO<sub>4</sub> (Köhler, Z. Ver. Zuckerind., 1897, 47, 447)

Min. Anhydrous, *Thenardite*. +10H<sub>2</sub>O, *Merrillite*.

Sodium hydrogen sulphate, NaHSO<sub>4</sub>.

Not deliquescent. Very sol. in H<sub>2</sub>O with decomposition.

Sol. in 2 pts. H<sub>2</sub>O at 0° (Lank); 1 pt. H<sub>2</sub>O at 100° (Schubarth) 100 pts. H<sub>2</sub>O at 15.5° dissolve 92.72 pts. Sol. in 2 pts. H<sub>2</sub>O at 18.75° (Abl); decomp. by alcohol.

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20, 829)

+H<sub>2</sub>O. Deliquescent, and decomp. by the H<sub>2</sub>O which it takes up.

NaH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>. Decomp. by H<sub>2</sub>O. (Schultz.)

Trisodium hydrogen sulphate, Na<sub>3</sub>H(SO<sub>4</sub>)<sub>2</sub>.

Sol. in H<sub>2</sub>O with decomp.

+H<sub>2</sub>O. (Rose)

Sodium pyrosulphate, Na<sub>2</sub>S<sub>2</sub>O<sub>7</sub>.

Sol. in fuming H<sub>2</sub>SO<sub>4</sub> without decomp.

Sodium thallic sulphate, Na<sub>2</sub>SO<sub>4</sub>, Tl<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.

Sol. in H<sub>2</sub>O. (Strecker, A. 135, 207.)

Sodium thorium sulphate, Na<sub>2</sub>SO<sub>4</sub>, Th(SO<sub>4</sub>)<sub>2</sub> + 6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O 100 pts cold sat. Na<sub>2</sub>SO<sub>4</sub> + Aq dissolve 4 pts of this salt. (Cleve)

See also under Na<sub>2</sub>SO<sub>4</sub> + ThSO<sub>4</sub>.

Sodium titanium sesquisulphate, Na<sub>2</sub>Ti<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> + 5H<sub>2</sub>O.

Sol. in H<sub>2</sub>O (Spence, Chem. Soc. 1904, 86, (2) 412.)

Insol in alcohol (Knecht, B. 1903, 36, 169.)

Sodium titanyl sulphate, Na<sub>2</sub>TiO<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> + 10H<sub>2</sub>O.

Hygroscopic (Mazzuchelli and Pantanelli, C. C. 1909, II, 420.)

Sodium uranyl sulphate, Na<sub>2</sub>(UO<sub>2</sub>)(SO<sub>4</sub>)<sub>2</sub> + 3H<sub>2</sub>O.

(de Coninck, C. C. 1905, I, 919)

Sodium vanadium sulphate, Na<sub>3</sub>V<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> + 24H<sub>2</sub>O.

Very sol. in H<sub>2</sub>O (Piccini, Z. anorg 1897, 13, 444.)

Sodium vanadyl sulphate, Na<sub>2</sub>SO<sub>4</sub>, VOSO<sub>4</sub> + 4H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O and alcohol + conc. H<sub>2</sub>SO<sub>4</sub>. (Koppel, Z. anorg 1903, 35, 177.) Na<sub>2</sub>SO<sub>4</sub>, 2VOSO<sub>4</sub> + 2½H<sub>2</sub>O Slowly sol. in H<sub>2</sub>O.

Can be cryst. from H<sub>2</sub>SO<sub>4</sub> at 100°. (Koppel.)

Sodium yttrium sulphate, Na<sub>2</sub>SO<sub>4</sub>, Y<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + 2H<sub>2</sub>O.

Quite sol. in H<sub>2</sub>O. (Cleve)

The only double salt capable of existing at 25°. (James and Holden, J. Am. Chem. Soc. 1913, 35, 562.)

Sodium zinc sulphate, Na<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub> + 4H<sub>2</sub>O.

Deliquescent in moist air.

Decomp. into constituents on dissolving in H<sub>2</sub>O. (Graham, Phil. Mag. 18, 417.)

Solubility of Na<sub>2</sub>Zn(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
25	26.32	23.40
30	26.475	23.445
35	26.365	23.525
40	26.68	23.63

(Koppel, Z. phys. Ch. 1905, 52, 409.)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{ZnSO}_4$ .  
7H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>	t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
10	45.79	11.24	25	55.155	7.215
15	48.81	10.175	30	60.55	6.34
20	52.34	8.625	35	65.25	5.64

(Koppel.)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{ZnSO}_4$ .  
6H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
38	66.64	4.98
40	64.89	4.71

(Koppel.)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ .  
10H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
10	43.495	12.35
15	39.925	16.71
20	28.77	21.98
25	19.935	29.875
30	10.67	42.515

(Koppel.)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ .  
(anhydrous) in 100 g. H<sub>2</sub>O at t°.

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
35	8.725	46.61
40	9.16	43.835

(Koppel.)

Sodium sulphate fluoride,  $\text{Na}_2\text{SO}_4 \cdot \text{NaF}$ .

Cryst. from H<sub>2</sub>O without decomp. (Marignac, Ann. Min. (5) 15. 236.)

Sodium sulphate antimony trifluoride.

See Antimony trifluoride sodium sulphate.

Strontium sulphate,  $\text{SrSO}_4$ .

Very sl. sol. in cold, and still less in boiling H<sub>2</sub>O.

1 l. H<sub>2</sub>O at 11–15° dissolves 0.066 g.  $\text{SrSO}_4$  (Brandes and Silber); 0.145 g.  $\text{SrSO}_4$  (Fresenius); 0.154–0.167 g.  $\text{SrSO}_4$  (Marignac); 0.187 g.  $\text{SrSO}_4$  (Kremers); 0.278 g.  $\text{SrSO}_4$  (Andrews).

1 l. boiling H<sub>2</sub>O dissolves 0.104 g.  $\text{SrSO}_4$  (Fresenius); 0.232 g.  $\text{SrSO}_4$  (Brandes and Silber).

When a Sr salt is precipitated by H<sub>2</sub>SO<sub>4</sub>, 1 pt.  $\text{SrSO}_4$  remains dissolved in 700 pts. H<sub>2</sub>O. (Marignac.)

Sol. in about 8000 pts. H<sub>2</sub>O (Schweitzer, J. B. 1877. 1054.).

Calculated from electrical conductivity of the solution,  $\text{SrSO}_4$  is sol. in 10,070 pts. H<sub>2</sub>O at 16.1° and 10,090 pts. at 20.1° (Holleman, Z. phys. Ch. 12. 131.)

1 l. H<sub>2</sub>O dissolves 107 mg.  $\text{SrSO}_4$  at 18° and not much more at higher temp. (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

100 g. H<sub>2</sub>O dissolve

at t°      0°–5°      10°–12°      20°      30°  
g.  $\text{SrSO}_4$     0.0983    0.0994    0.1479    1.0600

at t°      50°      80°      90°      95–98°  
g.  $\text{SrSO}_4$     0.1629    0.1688    0.1727    0.1789

(Wolfmann, C. C. 1897, I. 632.)

1 l. H<sub>2</sub>O dissolves 114 mg.  $\text{SrSO}_4$  at 18°. (Kohlrausch, Z. phys. Ch. 1904, 50. 356.); 114.3 mg. at 18°. (Kohlrausch, Z. phys. Ch. 1908, 64. 163.)

Sol. in 6895 pts. cold, and 9638 pts. boiling H<sub>2</sub>O, in 11,000–12,000 pts. H<sub>2</sub>O containing H<sub>2</sub>SO<sub>4</sub>; in 474 HCl+aq containing 8.5% HCl; in 432 pts. HNO<sub>3</sub>+aq containing 4.8% N<sub>2</sub>O<sub>5</sub>; in 7843 pts. HCl+aq containing 15.6% HCl+H<sub>2</sub>O<sub>2</sub>. (Fresenius.)

Or, 1 l. cold HCl+aq of 8.5% dissolves 2.11 g.  $\text{SrSO}_4$ ; 1 l. cold HNO<sub>3</sub>+aq of 4.8% N<sub>2</sub>O<sub>5</sub> dissolves 2.31 g.  $\text{SrSO}_4$ ; 1 l. cold HCl+aq of 15.6% HCl+H<sub>2</sub>O<sub>2</sub> dissolves 0.1275 g.  $\text{SrSO}_4$ . (Fresenius.)

Solubility of  $\text{SrSO}_4$  in HCl+aq.

No. cc. HCl+ aq containing 1 mg. equiv. HCl	g. per 100 cc. solution	
	HCl	$\text{SrSO}_4$
0.2	18.23	0.161
0.5	7.29	0.207
1.0	3.65	0.188
2.0	1.82	0.126
10.0	0.36	0.048

(Banthisch, J. pr. 1884, (2) 29. 54.)

Solubility of  $\text{SrSO}_4$  in HNO<sub>3</sub>+aq.

No. cc. HNO <sub>3</sub> + aq containing 1 mg. equiv. HNO <sub>3</sub>	g. per 100 cc. solution	
	HNO <sub>3</sub>	$\text{SrSO}_4$
0.2	31.52	0.381
0.5	12.61	0.307
1.0	6.30	0.217
2.0	3.15	0.138
10.0	0.63	0.049

(Banthisch, J. pr. 1884, (2) 29. 54.)

Sol. in conc. H<sub>2</sub>SO<sub>4</sub>. See under  $\text{SrH}_2(\text{SO}_4)_2$ . Insol. in NH<sub>4</sub>Cl+aq or conc. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+aq. (Rose.)

Slowly but completely sol. in NaCl+aq. (Wackenroder.)

H<sub>2</sub>O containing Na<sub>2</sub>SO<sub>4</sub> dissolves less  $\text{SrSO}_4$ .

than pure  $H_2O$ ;  $H_2O$  containing  $H_2SO_4$  still less. (Andrews, Phil Mag. Ann 7. 406.)

Insol. in  $Na_2S_2O_3 + Aq$

Insol. in boiling, conc.  $(NH_4)_2SO_4 + Aq$  (Rose, Pogg 110. 292)

Sol. in 16.949 pts  $(NH_4)_2SO_4 + Aq$  (1.4) (Fresenius, Z anal. 32. 195.)

Pptn. is hindered by alkali metaphosphates and citrates, but not by citric acid.

Decomp. at ord. temp., and more rapidly on boiling by alkali carbonates +  $Aq$ .

Sol. in  $MgCl_2$  or  $KCl + Aq$ , solubility increasing with strength of solution; sol. in  $NaCl$  or  $CaCl_2 + Aq$ , maximum solubility occurring when the solutions are of a medium concentration. The numerical results are as follows.

100 pts. of the salt solutions containing given pts. salt dissolve pts  $SrSO_4$ .

Salt	Pts salt	Pts. $SrSO_4$
NaCl	22.17	0.1811
	15.54	0.2186
	8.44	0.1653
KCl	18.08	0.2513
	12.54	0.1933
	8.22	0.1925
$MgCl_2$	13.63	0.2419
	4.03	0.2057
	1.59	0.1986
$CaCl_2$	33.70	0.1706
	16.51	0.1863
	8.67	0.1756

(Virek, C. C. 1862. 402.)

Solubility in  $H_2O$ , and in solutions of the sulphates chlorides and nitrates of the alkalies and alkaline earths and in solutions of salts of the alkalies with strong organic acids has been determined. No data in abstract (Wolfmann, Chem Soc. 1898, (2) 74. 220.)

Solubility in  $H_2O$  is considerably decreased by the presence of  $K_2SO_4$ . (Barre, A. ch. 1911, (8) 24. 175.)

Solubility of  $SrSO_4$  in  $Ca(NO_3)_2 + Aq$  at ord. temp.

G. per 100 cc. sat. solution

$Ca(NO_3)_2$	$SrSO_4$	$Ca(NO_3)_2$	$SrSO_4$
0.5	0.0483	4	0.1489
1	0.0619	5	0.1689
2	0.1081	6	0.1955
3	0.1275	...	...

(Raffo and Rossi, Gazz. ch. it. 1915, 45. (1) 45.)

Insol. in liquid  $NH_3$ . (Franklin, Am Ch J. 1898, 20. 829)

100 g. 95% formic acid dissolve 0.02 g.  $SrSO_4$  at 18.5°. (Aschan, Chem. Ztg. 1913, 37. 1117.)

Insol. in absolute alcohol; scarcely sol. in dil. alcohol.

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); acetone (Naumann, B. 1904, 37. 4329, Eidmann, C. C. 1899, II. 1014)

Min. Celestite

Strontium hydrogen sulphate,  $SrH_2(SO_4)_2$ .

100 pts  $H_2SO_4$  dissolve 2.2 pts.  $SrSO_4$  (Lieb-Bodart and Jacquemin); 100 pts.  $H_2SO_4$  dissolve 5.68 pts (Struve, Z anal 9. 34), 100 pts fuming  $H_2SO_4$  dissolve 9.77 pts (Struve).

1 g  $SrSO_4$  dissolves in 1256 g 91%  $H_2SO_4 + Aq$  (Varenne and Pauleau, C. R 93. 1016); boiling  $H_2SO_4$  dissolves about 15%  $SrSO_4$ , and still more at 100° (Schultz, Pogg. 133. 147)

Sol. in 1519 pts 91%  $H_2SO_4$  (Varenne and Pauleau, C. R 93. 1016.)

100 pts.  $H_2SO_4$  (sp. gr. 1.843) dissolve 14 pts  $SrSO_4$  at 70°. (Garside, C N 31. 245)

Decomp by  $H_2O$ .

100 pts hot conc.  $H_2SO_4$  dissolve about 9.0 pts  $SrSO_4$ . (Rohland, Z. anorg. 1910, 66. 208)

10 cc of sat  $SrSO_4$  + absolute  $H_2SO_4$  contain approx 2.17 g  $SrSO_4$ . (Bergius, Z phys. Ch. 1910, 72. 355)

+  $H_2O$  Decomp by  $H_2O$

Strontium tin (stannic) sulphate,  $SrSO_4$ ,  $Sn(SO_4)_2 + 3H_2O$ .

Decomp. by  $H_2O$  Sol in  $HCl$  (Weinland and Kühl, Z. anorg. 1907, 54. 249.)

Strontium titanium sulphate,  $SrSO_4$ ,  $Ti(SO_4)_2$ .

Ppt; decomp by  $H_2O$  giving titanic acid. (Weinland and Kühl, Z. anorg. 1907, 54. 254.)

Tantalum sulphate,  $3Ta_2O_5$ ,  $SO_3 + 9H_2O$ .

(Hermann, J. pr. 70. 201)

Tellurium sulphate, basic,  $TeO_2$ ,  $SO_3$ .

Sol. in cold dil  $H_2SO_4$ . Decomp. by hot  $H_2O$ . (Klein, C R 99. 326)

Terbium sulphate,  $Tr_2(SO_4)_3 + 8H_2O$ .

Sol. in  $H_2O$

Sol. in  $H_2O$ , pptd. by alcohol. (Urban, C. R 1908, 146. 127.)

Thallos sulphate,  $Th_2SO_4$ .

1 pt. dissolves at t° in pts.  $H_2O$ , according to C=Crookes; L=Lamy:

15°	18°	32°	100°	101.2°
21.1	20.8	8.7	5.4	5.22 pts. $H_2O$ .
C	L	L	C	L

Solubility of  $\text{Th}_2\text{SO}_4$  in  $\text{H}_2\text{O}$ 

$t^\circ$	% $\text{Th}_2\text{SO}_4$	$t^\circ$	% $\text{Th}_2\text{SO}_4$
0	2.63	60	9.85
10	3.57	70	11.31
20	4.64	80	12.75
30	5.80	90	14.19
40	7.06	99.7*	15.57
50	8.44		

B-pt. at  $748\text{ mm}$   
 Berkeley, Phil. Trans. Roy. Soc. 1904, 203.  
 1, 189; calc. by Landolt-Bornstein.)

100 g.  $\text{H}_2\text{O}$  dissolve 3.36 g.  $\text{Th}_2\text{SO}_4$  at  $6.5^\circ$ ,  
 1.3 g at  $12^\circ$ , 19.14 g at  $100^\circ$ . (Tutton, Proc.  
 Roy. Soc. 1907, 79. A, 351.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.1928 equivalents  
 $\text{Th}_2\text{SO}_4$  at  $20^\circ$ , or 48.59 g in 1 l. of solution  
 (Noyes, J. Am. Chem. Soc. 1911, 33. 1657.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.1083 g. equiv.  $\text{Th}_2\text{SO}_4$   
 at  $25^\circ$ , or 27.28 g in 1 l. of solution. (Noyes.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Strength of $\text{H}_2\text{SO}_4 + \text{Aq}$ g. mole per l.	g mole $\text{Th}_2\text{SO}_4$ per l.
0.0494	0.1172
0.0987	0.1249

(Noyes, J. Am. Chem. Soc. 1911, 33. 1662.)

1 l.  $\text{TiClO}_3 + \text{Aq}$  containing 0.1058 equiv-  
 alents  $\text{TiClO}_3$ , dissolves 0.1366 equivalents  
 $\text{Th}_2\text{SO}_4$  at  $20^\circ$ . (Noyes.)

See also  $\text{TiClO}_3$ .

Solubility in salts + Aq at  $25^\circ$ .

g. mole. per l.	g mole per l $\text{Th}_2\text{SO}_4$ dissolved
0.0996 $\text{TiNO}_3$	0.08365
0.0497 $\text{Na}_2\text{SO}_4$	0.1080
0.1988 $\text{Na}_2\text{SO}_4$	0.1173
0.1010 $\text{NaHSO}_4$	0.1161

(Noyes)

Thallous hydrogen sulphate,  $\text{ThHSO}_4$ .

Sl. hygroscopic.

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

1000 g. of the solution contain:

Mols. $\text{H}_2\text{SO}_4$	Mols. $\text{Th}_2\text{SO}_4$
4.55	0.56
4.79	0.55
4.89	0.59
4.92	0.66
4.78	0.75
4.26	1.01
4.03	1.08

(D'Ans, Z. anorg. 1910, 65. 232.)

$\text{Th}_2\text{SO}_4$ ,  $\text{ThHSO}_4$ . Sol. in  $\text{H}_2\text{O}$ . (Storten-  
 becker, R. t. c. 1902, 21. 90.)

Thallous pyrosulphate,  $\text{Th}_2\text{S}_2\text{O}_7$ .

Decomp. by  $\text{H}_2\text{O}$  (Weber, B. 17. 2502.)

Thallous octosulphate,  $\text{Th}_2\text{S}_8\text{O}_{22}$ .

Decomp. by  $\text{H}_2\text{O}$  (Weber, B. 17. 2502.)

Thallic sulphate, basic,  $\text{Th}_2\text{O}_3 \cdot 2\text{SO}_3 + 3\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ .

+5 $\text{H}_2\text{O}$  As above (Willm, A. ch. (4) 5.  
 5.)

Thallic sulphate,  $\text{Th}_2(\text{SO}_4)_3 + 7\text{H}_2\text{O}$ .

Decomp. by cold  $\text{H}_2\text{O}$  with separation of  
 $\text{TiO}(\text{OH})$  (Crookes.)

Thallothallic sulphate,  $2\text{Th}_2\text{O}_3 \cdot 3\text{Th}_2\text{O}_3 \cdot 12\text{SO}_3 + 25\text{H}_2\text{O}$ 

Gradually efflorescent. (Willm.)

$\text{Th}_2(\text{SO}_4)_3$ . (Lepsius, Chem. Ztg. 1890.  
 1327.)

$\text{TiH}(\text{SO}_4)_3$ . (Lepsius.)

Thallous uranyl sulphate,  $\text{Th}_2(\text{UO}_2)(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .

Sl. sol in cold  $\text{H}_2\text{O}$ .

Easily forms supersat. solutions. (Kohn,  
 Z. anorg. 1908, 59. 112.)

Thallium vanadium sulphate,  $\text{Th}_2\text{V}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

100 pts  $\text{H}_2\text{O}$  dissolve 11.06 pts salt at  $10^\circ$ .

Sp. gr. of solution at  $4^\circ/20^\circ = 2.342$

Very sol in hot  $\text{H}_2\text{O}$  (Pecqin, Z. anorg.  
 1897, 13. 446.)

256 g. anhydrous, or 433 g. hydrated salt,  
 or 0.573 g. mols. of anhydrous salt are sol. in  
 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ .

Melts in crystal  $\text{H}_2\text{O}$  at  $48^\circ$ . (Locke, Am.  
 Ch. J. 1901, 26. 175.)

Thallous zinc sulphate,  $\text{Th}_2\text{Zn}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ .

1 l.  $\text{H}_2\text{O}$  dissolves 86 g. anhydrous salt  
 at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

Thallothallic sulphate bromide,  $\text{Th}_2\text{Br}_2\text{SO}_4$ .

Very sol in cold  $\text{H}_2\text{O}$ . Decomp. by much  
 $\text{H}_2\text{O}$ . (Meyer and Goldschmidt, B. 1903, 36.  
 242.)

Thorium sulphate, basic,  $3(\text{Th}(\text{SO}_4)_2 + 2\text{H}_2\text{O})$ ,  
 $\text{Th}(\text{SO}_4)_3 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; very slowly attacked by dil.  
 acids. (Demarcay.)

$\text{ThO}(\text{SO}_4) + 2\text{H}_2\text{O}$ . Stable in aq. solution  
 at  $100^\circ$ . (Hauser, B. 1910, 43. 2776.)

+5 $\text{H}_2\text{O}$ . Somewhat sol in hot conc.  
 $\text{MgSO}_4 + \text{Aq}$  (Halla, Z. anorg. 1912, 79. 260.)

Thorium sulphate,  $\text{Th}(\text{SO}_4)_2$ .

Anhydrous. Easily sol. if brought into a  
 large amount of  $\text{H}_2\text{O}$ , but very slowly sol. if  
 only a little  $\text{H}_2\text{O}$  is added to the salt.

100 pts  $\text{H}_2\text{O}$  dissolve about 4.86 pts.  $\text{Th}(\text{SO}_4)_2$  at  $0^\circ$  (Cleve)

When heated, anhydrous salt separates out, which redissolves on cooling. (Cleve.)

Solubility of anhydrous salt cannot be determined, as it begins to separate out  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  before a saturated solution is reached. At  $0^\circ$ , 100 pts.  $\text{H}_2\text{O}$  dissolved 22.97 pts  $\text{Th}(\text{SO}_4)_2$  in 15 minutes; at  $25^\circ$ , 27.00 pts  $\text{Th}(\text{SO}_4)_2$  were dissolved in 5 minutes (Roozeboom, Z. phys. Ch. 5. 198)

+  $2\text{H}_2\text{O}$ . Shows same behaviour as anhydrous salt. 100 pts.  $\text{H}_2\text{O}$  dissolved 35.50 pts.  $\text{Th}(\text{SO}_4)_2$  from this salt at  $1^\circ$ , but this is not the maximum solubility (Roozeboom)

+  $4\text{H}_2\text{O}$  Pptd by alcohol from hot aqueous solution; also formed by heating  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  in aqueous solution above  $60^\circ$ .

100 pts  $\text{H}_2\text{O}$  dissolve pts.  $\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$ . D = according to Demarcay (C. R. 96. 1860); R = according to Roozeboom (Z. phys. Ch. 5. 202).

$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$
17	9.41 D	50	2.54 R	70	1.09 R
35	4.50 D	55	1.94 D	75	1.32 D
40	4.04 R	60	1.634 R	95	0.71 D

+  $6\text{H}_2\text{O}$  Behaves as the anhydrous salt, but action is much slower.

100 pts  $\text{H}_2\text{O}$  dissolve pts.  $\text{Th}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$ .

$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$
0	1.50	45	3.85
15	1.63	60	6.64
30	2.45	.	.

(Roozeboom)

This determination gives too low figures, especially at the higher temperatures (Roozeboom)

+  $8\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts  $\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$

$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$
0	1.00	25	1.85
15	1.38	44	3.71

(Roozeboom.)

100 g.  $\text{Th}(\text{SO}_4)_2 + \text{Aq}$  sat. with  $\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$  at  $30^\circ$  contain 2.152 g. anhydrous  $\text{Th}(\text{SO}_4)_2$ . (Koppel and Holzkampf, Z. anorg. 1910, 87. 274.)

100 g.  $\text{H}_2\text{O}$  dissolve 1.722 g. at  $25^\circ$ . (Barre, Bull. Soc. 1912, (4) 11.)

+  $9\text{H}_2\text{O}$ . Pptd. by alcohol from cold

aqueous solution Sol in about 88 pts  $\text{H}_2\text{O}$  at  $0^\circ$ . (Cleve) Extremely slowly sol in  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$

$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$
0	0.88	30	1.85	50	4.86
10	1.02	40	2.83	55	6.5 =
20	1.25	..	..		

Above  $55^\circ$ ,  $\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$  separates out. (Demarcay C. R. 96. 1860, calculated by Roozeboom.)

100 pts  $\text{H}_2\text{O}$  dissolve pts.  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$ .

$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$
0	0.74	30	1.995	51	5.22
10	0.98	40	2.998	55	6.76
20	1.38				

Above  $60^\circ$ ,  $\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$  separates out. (Roozeboom, Z. phys. Ch. 5. 201.)

For further data, see Roozeboom (Z. phys. Ch. 5. 198), where there is a full discussion of the subject.

100 g sat. solution of  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $25^\circ$  contain 1.593 g. anhyd. salt (Wirth, Z. anorg 1912, 76. 174.)

Solubility of  $\text{Th}(\text{SO}_4)_2$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{H}_2\text{SO}_4$	% $\text{ThSO}_4$	Solid phase
30	0.000	2.152	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
	0.466	2.055	"
	0.72	2.085	"
	1.468	2.267	"
	2.983	2.311	"
	4.38	2.367	"
	4.97	2.323	"
	9.95	1.961	"
	15.03	1.484	"
	18.95	1.078	"
	23.64	0.7196	"
	32.68	0.3364	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
20	37.80	0.077	"
	43.28	0.0213	"
	45.69	0.0047	"
	74.0	0.1208	"
	80.5	0.000	"
	5	1.722	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
	15	0.9752	"
Boiling temp.	25	0.3838	"
	40	0.0103	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
	5	0.7407	"
	10	0.4808	"
	15	0.3852	"

(Koppel and Holzkampf, Z. anorg. 1910, 87. 274.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Per 100 g. of solution

% $\text{Th}(\text{SO}_4)_2$	% $\text{H}_2\text{SO}_4$
1 722	0 000
1 919	1.072
2 017	1 941
2 060	2 821
2 061	3 843
2 035	5.212
1 803	8.055
1 702	10 105

(Barre, Bull. Soc. 1912, (4) 11. 647.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Normality $\text{H}_2\text{SO}_4$	In 100 g. of the liquid are dissolved		Solid phase
	g. oxide	% anhydrous sulphate	
0	1.015	1 593	$\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$
1 1	1.14	1.831	
2 16	0 9265	1 488	
4 32	0.545	0 8751	
6.68	0 2585	0.4312	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
9 68	0 0651	0 1045	
10 89	0 0396	0 0636	
15 15	0 0192	0 0308	

(Wirth, Z. anorg. 1912, 76. 186)

Solubility of  $\text{Th}(\text{SO}_4)_2$  in  $\text{HCl} + \text{Aq}$  at  $30^\circ$ .

% $\text{HCl}$	% $\text{Th}(\text{SO}_4)_2$	Solid phase
0 0	2.15	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
4.55	3 541	
6.95	3 431	
12 14	2 811	
15 71	2 360	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
18 33	2 199	
20	2 13	
23 9	1 277	

(Koppel and Holzkampf, Z. anorg. 1910, 67. 274.)

Solubility of  $\text{Th}(\text{SO}_4)_2$  in  $\text{HNO}_3 + \text{Aq}$  at  $30^\circ$ .

% $\text{HNO}_3$	% $\text{Th}(\text{SO}_4)_2$	Solid phase
0 0	2 15	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
5 17	3 68	
10.04	4 20	
16 68	4.84	
21.99	4 47	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
28.33	3 96	
28 51	3 88	
33.17	3.34	
38 82	2 61	

(Koppel and Holzkampf, Z. anorg. 1910, 67. 274.)

The presence of phosphoric acid increases the solubility of thorium sulphate in  $\text{HCl}$  and  $\text{HNO}_3$ . (Koppel and Holzkampf, Z. anorg. 1910, 67. 280.)

For solubility of  $\text{Th}(\text{SO}_4)_2$  in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Li}_2\text{SO}_4$  and  $\text{K}_2\text{SO}_4$ , see respective sulphates.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

Thorium hydrogen sulphate,  $\text{ThH}_2(\text{SO}_4)_2$ .

Hydroscopic.

Sol. in excess of hot  $\text{H}_2\text{SO}_4$ ; insol. in cold  $\text{H}_2\text{SO}_4$ . (Brauner, Z. anorg. 1904, 38. 333.)

Thulium sulphate,  $\text{Tm}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .

Insol. in alcohol. (James, J. Am. Chem. Soc. 1911, 33. 1343.)

Tin (stannic) sulphate, basic,  $(\text{SnO})\text{SO}_4 + \text{H}_2\text{O}$ .

Easily sol. in cold  $\text{H}_2\text{O}$ , but quickly decomp. with separation of stannic hydroxide. (Ditte, C. R. 104. 178.)

$3\text{SnO}$ ,  $\text{SO}_2$ . Easily sol. in dil. acids. (Ditte, A. ch. 1882, (5) 27. 159.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . Not decomp. by cold  $\text{H}_2\text{O}$ . (Ditte)

Tin (stannous) sulphate,  $\text{SnSO}_4$ .

Sol. in 5.3 pts.  $\text{H}_2\text{O}$  at  $19^\circ$ , and 5.5 pts. at  $100^\circ$ . (Marignac) Solution soon decomposes with separation of a basic salt. Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Bouquet.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329)

Tin (stannic) sulphate,  $\text{Sn}(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ ; decomp. by much  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Slowly sol. in  $\text{HCl} + \text{Aq}$ . Decomp. by absolute alcohol. (Ditte, C. R. 104. 178.)

Titanium sulphate,  $\text{Ti}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . The aqueous solution is decomp. on boiling. (Glatzel, B. 9. 1833)

Titanium sesquisulphate,  $\text{Ti}_2(\text{SO}_4)_3$ .

Very deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution is decomp. by boiling. (Ebelmen.)

Insol. in  $\text{H}_2\text{O}$ , alcohol, ether and conc.  $\text{H}_2\text{SO}_4$ . Slowly sol. in dil.  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$ . (Stahler, B. 1905, 38. 2624)

Not sol. in alcohol. (Knecht, B. 1903, 36. 169.)

+  $8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Glatzel, B. 9. 1833)

Titanium hydrogen sesquisulphate,  $3\text{Ti}_2(\text{SO}_4)_3 + \text{H}_2\text{SO}_4 + 25\text{H}_2\text{O}$ .Gradually sol. in  $\text{H}_2\text{O}$ 

Insol. in 60%  $\text{H}_2\text{SO}_4$ , alcohol, ether and glacial acetic acid. (Stahler, B. 1905, 38. 2621)

**Titanyl sulphate, (TiO)SO<sub>4</sub>.**

Decomp. by H<sub>2</sub>O. Slowly sol. in cold, rapidly in warm HCl+Ag (Merz, J pr. 99. 157.)

+2H<sub>2</sub>O. Sol in H<sub>2</sub>O. (Blondel, Bull. Soc. 1899, (3) 21. 262.)

2TiO<sub>2</sub>, 3SO<sub>3</sub>+3H<sub>2</sub>O. Sol. in H<sub>2</sub>O acidified with HCl. (Blondel, Bull. Soc. 1899, (3) 21. 262.)

5TiO<sub>2</sub>, SO<sub>3</sub>+5H<sub>2</sub>O. (Blondel)

7TiO<sub>2</sub>, 28SO<sub>3</sub>+7H<sub>2</sub>O (Blondel.)

2TiO<sub>2</sub>, SO<sub>3</sub>+2H<sub>2</sub>O (Blondel.)

**Uranous sulphate, basic, U(OH)<sub>2</sub>SO<sub>4</sub>+H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O. H<sub>2</sub>O dissolves out H<sub>2</sub>SO<sub>4</sub>, (Ebelmen, A. ch. (3) 5. 217.)

+5H<sub>2</sub>O Sol in alcohol.

Pptd. by ether. (Rosenheim, Z. anorg. 1901, 26. 251)

**Uranous sulphate, U(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O.**

Sol in H<sub>2</sub>O with immediate decomp. Easily sol. in dil. H<sub>2</sub>SO<sub>4</sub>+Ag. (Kohlschutter, B. 1901, 34. 3629.)

Decomp by H<sub>2</sub>O into insol. basic, and sol. acid salt. Sol in dil. H<sub>2</sub>SO<sub>4</sub> or HCl+Ag. Difficultly sol in conc. acids (Ebelmen, A. ch. (3) 5. 215)

**Solubility of U(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in H<sub>2</sub>O at t°.**

t°	% U(SO <sub>4</sub> ) <sub>2</sub>	t°	% U(SO <sub>4</sub> ) <sub>2</sub>
29	9.8	48.2	8.1
37	8.3	63	7.3

(Giollitti and Bucci, Gazz. ch. it. 1905, 35. (2) 162.)

1 pt. is sol. in 4.23 pts. H<sub>2</sub>O at 13°; 4.3 pts. at 11.3°; 4.4 pts. at 9.1°. (de Coninck, A. ch. 1903, (7) 28. 12.)

+8H<sub>2</sub>O.

**Solubility of U(SO<sub>4</sub>)<sub>2</sub>+8H<sub>2</sub>O in H<sub>2</sub>O at t°.**

t°	% U(SO <sub>4</sub> ) <sub>2</sub>	t°	% U(SO <sub>4</sub> ) <sub>2</sub>
18	10.17	48.2	28.72
25.6	13.32	62	36.8
37	19.98	93	63.2

(Giollitti and Bucci, Gazz. ch. it. 1905, 35. (2) 162.)

**Sp. gr. of U(SO<sub>4</sub>)<sub>2</sub>+Ag at t°**

t°	% salt	Sp. gr.
16	1	1.0058
16.8	2	1.0107
16	3	1.0165
17.8	4	1.0218
17.2	5	1.0272
18	6	1.0320
18.3	7	1.0379
17.4	8	1.0429
15.2	9	1.0485
15.6	10	1.0539

(de Coninck, A. ch. 1903, (7) 28. 11.)

**Solubility in acids+Ag**

1 pt. U(SO<sub>4</sub>)<sub>2</sub> is sol. in pts. acid at t°.

t°	Acid	Concentration of acid	Pts. acid
9.7	HCl	1.4	5.74
9.2	"	"	5.8
11.2	HNO <sub>3</sub>	1.4	5.4
10.3	"	"	5.53
11.4	H <sub>2</sub> SeO <sub>4</sub>	1.4	4.57
10.7	(sp. gr. 1.4)	"	4.66
15	HBr	1.4	4
14.2	"	"	4.23
15.5	HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub>	1.4.5	4.1
14.4	"	"	4.3
16.5	"	1.2	3.72
15.9	"	"	3.85
11.7	H <sub>2</sub> SO <sub>4</sub>	1.4	6.36
10.9	"	"	6.42
10.1	"	"	6.45
9	"	"	6.5

(de Coninck, Chem. Soc. 1902, 82. (2) 459)

Sp. gr. of U(SO<sub>4</sub>)<sub>2</sub>+HCl (d=1.046) at t°.

d<sub>1</sub>=Sp. gr. referred to H<sub>2</sub>O.

d<sub>2</sub>=Sp. gr. referred to HCl

t°	% salt	d <sub>1</sub>	d <sub>2</sub>
16	1	1.0525	1.0063
17	2	1.0572	1.0109
18	3	1.0619	1.0154
18.4	4	1.0667	1.0199
17.6	5	1.0714	1.0243

(de Coninck, A. ch. 1903, (7) 28. 11.)

Sp. gr. of U(SO<sub>4</sub>)<sub>2</sub>+H<sub>2</sub>SO<sub>4</sub> (d=1.14) at t°.

d<sub>1</sub>=Sp. gr. referred to H<sub>2</sub>O.

d<sub>2</sub>=Sp. gr. referred to H<sub>2</sub>SO<sub>4</sub>.

t°	% salt	d <sub>1</sub>	d <sub>2</sub>
18.7	1	1.1442	1.0088
18.3	2	1.1494	1.0083
17.4	3	1.1539	1.0123
17.6	4	1.1583	1.0162
18.1	5	1.1626	1.0204

(de Coninck, A. ch. 1903, (7) 28. 11.)

1 pt. is sol. in 8 pts. alcohol (94°)+Ag. (1.4) at 10.4°. (de Coninck.)

Solubility in glycol at 14.8°=3.15% (de Coninck, C. C. 1905, II. 883.)

Min. *Johannite*. Sl. sol. in H<sub>2</sub>O

**Uranous hydrogen sulphate, U(SO<sub>4</sub>)<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>+10H<sub>2</sub>O.**

(Giollitti, C. C. 1905, II. 1226.)

**Uranyl sulphate, basic,  $3\text{UO}_3 \cdot \text{SO}_3 + 2\text{H}_2\text{O}$ .**

(Athanasesco)  
 $+14\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Ordway, Sil Am. J. (2) 26, 208)  
 $4\text{UO}_3 \cdot \text{SO}_3 + 7\text{H}_2\text{O}$  (Athanasesco, C R 103, 271.)

$\text{UO}_3 \cdot 4\text{UOSO}_4 + 8\text{H}_2\text{O}$ . Less sol. in min. acids, especially dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , than  $\text{UOSO}_4 + 2\text{H}_2\text{O}$ . (de Coninck, C C 1901, II 1038.)

**Uranyl sulphate,  $(\text{UO}_2)\text{SO}_4$ .**

$+ \text{H}_2\text{O}$ . (de Coninck.)  
 $+ 3\text{H}_2\text{O}$ . Efflorescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol

1 pt. is sol. in 0.6 pt. cold  $\text{H}_2\text{O}$ ; in 0.45 pt. boiling  $\text{H}_2\text{O}$ ; in 25 pts cold absolute alcohol; in 20 pts boiling absolute alcohol. (Bueholz.)

Sol. in 0.47 pt.  $\text{H}_2\text{O}$  at  $21^\circ$ , and 0.28 pt. boiling  $\text{H}_2\text{O}$  (Ebelmen.)  
 100 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 160 pts., and at  $100^\circ$ , 220 pts. (Ure's Diet)

1 pt is sol. in 5.3 pts  $\text{H}_2\text{O}$  at  $13.2^\circ$ ; 5.16 pts at  $14.1^\circ$ ; 4.96 pts. at  $15.1^\circ$ ; 4.88 pts at  $15.5^\circ$  (de Coninck, A. ch 1903, (7) 28. 8.)

Sp. gr. of  $(\text{UO}_2)\text{SO}_4 + \text{Aq}$  at  $t^\circ$

$t^\circ$	% $(\text{UO}_2)\text{SO}_4$	Sp. gr.
14	1	1.0062
15.5	2	1.0113
11.3	3	1.0172
10.2	4	1.0229
10.2	5	1.0280
10	6	1.0338
14	7	1.0389
15.6	8	1.0442
11	9	1.0503
10.3	10	1.0557
11.4	11	1.0612
11.6	12	1.0669

(de Coninck, A. ch. 1903, (7) 28. 7)

**Solubility in acids + Aq.**

1 pt  $(\text{UO}_2)\text{SO}_4$  is sol. in:

3.4 pts. conc.  $\text{HCl}$  at  $12.8^\circ$

3.25 " " " "  $13.6^\circ$

5.9 "  $\text{HBr}$  (d=1.21) "  $12.9^\circ$

6.1 " " " "  $11.2^\circ$

10.8 " conc.  $\text{HNO}_3$  "  $12.3^\circ$

11.2 " " " "  $10.8^\circ$

4.3 "  $\text{H}_2\text{SO}_4$  (d=1.38) "  $12.7^\circ$

4.1 " " " "  $14.0^\circ$

5.6 " aqua regia (equal vol.  $\text{HCl} + \text{HNO}_3$ ) at  $15.4^\circ$

5.47 pts. aqua regia (equal vol.  $\text{HCl} + \text{HNO}_3$ ) at  $16.4^\circ$ .

3.7 pts. selenic acid (d=1.4) at  $15.3^\circ$ .

(de Coninck, A. ch. 1903, (7) 28. 8.)

Sp. gr. of  $(\text{UO}_2)\text{SO}_4 + \text{H}_2\text{SO}_4$  (d=1.168) at  $t^\circ$ .

$d_1 = \text{Sp. gr. referred to } \text{H}_2\text{O}$ .

$d_2 = \text{Sp. gr. referred to } \text{H}_2\text{SO}_4$ .

$t^\circ$	% salt	$d_1$	$d_2$
20.6	1	1.1738	1.0050
22.2	2	1.1775	1.0082
21.1	3	1.1880	1.0129
22.7	4	1.1872	1.0165
22.3	5	1.1918	1.0204

(de Coninck, A. ch. 1903, (7) 28. 7.) \*

1 pt is sol. in 37.9 pts. alcohol ( $85^\circ$ ) at  $16.7^\circ$ , 38.6 pts at  $15.8^\circ$  (de Coninck, A. ch 1903, (7) 28. 8.)

Very sl. sol. in formic and glacial acetic acids. (de Coninck, A. ch 1903, (7) 28. 9.)

Completely pptd from  $(\text{UO}_2)\text{SO}_4 + \text{Aq}$  by  $\text{HC}_2\text{H}_3\text{O}_2$ . (Persoz)

**Uranyl hydrogen sulphate,  $(\text{UO}_2)\text{SO}_4 \cdot \text{H}_2\text{SO}_4$ .**

Very deliquescent. (Schultz-Sellack.)

$2(\text{UO}_2)\text{SO}_4 \cdot \text{H}_2\text{SO}_4 + 5\text{H}_2\text{O}$ . Very deliquescent. (Wyruboff, Bull. Soc Min 1909, 22. 351)

**Uranyl pyrosulphate,  $(\text{UO}_2)_2\text{S}_2\text{O}_7$ .**

Very deliquescent. Fuses with  $\text{H}_2\text{O}$ . (Schultz-Sellack.)

**Uranouranyl sulphate,  $\text{USO}_4 \cdot (\text{UO}_2)\text{SO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Ebelmen.) Decomp. by boiling. (Berzelius)

Mm *Voghanate*.

**Uranyl sulphate ammoniac,  $(\text{UO}_2)\text{SO}_4 \cdot 2\text{NH}_3$ .**

(v. Unruh, Dissert. 1903.)

$(\text{UO}_2)\text{SO}_4 \cdot 3\text{NH}_3$ . (v. Unruh)

$(\text{UO}_2)\text{SO}_4 \cdot 4\text{NH}_3$ . (v. Unruh)

**Vanadous sulphate,  $\text{V}_2\text{O}_3 \cdot 4\text{SO}_3 + 9\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Brierley, Chem. Soc. 49. 882)

**Vanadium sulphate,  $\text{V}_2\text{O}_5 \cdot 2\text{SO}_3 = (\text{VO}_2)_2\text{S}_2\text{O}_7$ .**

Deliquescent. Easily sol in  $\text{H}_2\text{O}$ .

$\text{V}_2\text{O}_5 \cdot 3\text{SO}_3$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol.

$+ 3\text{H}_2\text{O}$ . Deliquescent. Very sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. Sol. in alcohol. (Ditte, C. R. 102, 757.)

$\text{VSO}_4 + 7\text{H}_2\text{O}$ . Decomp. by air; very unstable; sol. in  $\text{H}_2\text{O}$ . (Piccini, Z. anorg. 1899, 19. 204.)

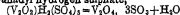
**Vanadium sesquisulphate,  $\text{V}_2(\text{SO}_4)_3$ .**

*Anhydrous*.

Insol. in  $\text{H}_2\text{O}$ .

Insol. in conc.  $\text{H}_2\text{SO}_4$ , but slowly sol. in boiling dil  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{HCl}$ .

Insol. in alcohol and ether. (Stähler, B. 1905, 38. 3979)

**Vanadium hydrogen sulphate,**Sol. in  $H_2O$ .Sol. in HCl. Insol. in 60%  $H_2SO_4$  + Aq, alcohol, ether and acetic acid. (Stähler, B 1905, 38. 3978.)**Divanadyl sulphate,  $V_2O_5(SO_4)_2$ .**Insol. in  $H_2O$ , HCl, or  $H_2SO_4$  + Aq, but on heating to 400° becomes sol. in  $H_2O$  if heated to 130° therewith (Gerland.)+  $4H_2O$ . Very slowly sol. in  $H_2O$  at 10°, quickly at 60°, and still more rapidly at 100°.Deliquesces in warm moist air more quickly than it dissolves in  $H_2O$  at 10°. Insol. in absolute alcohol. Very sol. in alcohol of 0.833 sp. gr. (Berzelius.)+  $5H_2O$ . (Koppell and Behrendt, Z. anorg. 1903, 35. 168.)+  $7H_2O$ , and  $10H_2O$ .+  $13H_2O$ . Efflorescent (Gerland.) $2V_2O_5, 5SO_3 + 18H_2O$ . (Gain, C. R. 1906, 143. 1154.) $V_2O_5, 3SO_3 + 10H_2O$ . (G.) $2V_2O_5, 7SO_3 + 20H_2O$ . (G.) $2V_2O_5, 9SO_3 + 22H_2O$ . (G.) $V_2O_5, 5SO_3 + 12H_2O$ . (G.)**Divanadyl hydrogen sulphate,**+  $2H_2O$ .+  $3H_2O$ . Deliquescent. Very slowly sol. in cold  $H_2O$  or alcohol. Easily sol. in hot  $H_2O$ . (Gerland.)+  $5H_2O$ . Deliquescent. Insol. in ether. Scarcely sol. in alcohol. Slowly sol. in cold, easily in hot  $H_2O$ . (Crow.)+  $14H_2O$ . Easily sol. in cold  $H_2O$  or dil. alcohol. (Gerland.) $2V_2O_5, 3SO_3$ . Sl. sol. in  $H_2O$ . (Koppell and Behrendt, Z. anorg. 1903, 35. 163.) $2VOSO_4, H_2SO_4 + H_2O$ . Very slowly sol. in  $H_2O$ . (Koppell and Behrendt, Z. anorg. 1903, 35. 163.) $2VOSO_4, 3H_2SO_4 + 15H_2O$ . (Gain, C. R. 1906, 143. 1156.) $2VOSO_4, 4H_2SO_4 + 16H_2O$ . (G.) $2VOSO_4, 5H_2SO_4 + 15H_2O$ . (G.) $2VOSO_4, 7H_2SO_4 + 15H_2O$ . (G.) $2VOSO_4, 8H_2SO_4 + 16H_2O$ . (G.)**Ytterbium sulphate,  $Yb_2(SO_4)_3 + 8H_2O$ .**Quite slowly sol. in  $H_2O$  even at 100°. Anhydrous salt is easily sol. in much  $H_2O$ , but if little  $H_2O$  is used the hydrous salt is formed, which only slowly dissolves. Sol. in  $K_2SO_4$  + Aq.100 pts.  $H_2O$  dissolve at:0° 15.5° 35° 55° 60°  
44.2 34.8 19.1 11.5 10.4 pts.  $Yb_2(SO_4)_3$ .70° 80° 90° 100°  
7.22 6.93 5.83 4.67 pts.  $Yb_2(SO_4)_3$ .

(Cleve, Z. anorg. 1902, 32. 143.)

**Yttrium sulphate, basic,  $Y_2O_3, SO_3 = (YO)_2SO_4$ .**Insol. in  $H_2O$  (Berzelius.) $2Y_2O_3, SO_3 + 10H_2O$  (Cleve)**Yttrium sulphate,  $Y_2(SO_4)_3$ .***Anhydrous* More sol. in  $H_2O$  than the hydrous salt, and more sol. in cold than hot  $H_2O$ . Solution sat at 0° separates  $Y_2(SO_4)_3 + 8H_2O$  at 50°. 100 pts.  $H_2O$  dissolve 15.2 pts. anhydrous salt at ord. temp.5.38 pts. are sol. in 100 pts.  $H_2O$  at 25°. (James and Holden, J. Am. Chem. Soc. 1913, 35. 561.)Easily sol. in large amount of sat.  $K_2SO_4$  + Aq, from which  $3K_2SO_4, 2Y(SO_4)_3$  is pptd on warming (Cleve and Höglund, Sv. V. A. H. Bib. 1. No. 8.)Solubility of  $Y_2(SO_4)_3$  in  $Na_2SO_4$  + Aq at 25°.

Pts. $Y_2(SO_4)_3$ per 100 pts. $H_2O$	Pts. $Na_2SO_4$ per 100 pts. $H_2O$	Solid phase
5.61	1.29	$Y_2(SO_4)_3$
6.38	3.85	
7.40	6.21	
8.43	8.53	
5.86	7.57	
4.75	7.72	
3.42	10.14	
2.36	11.36	
2.02	13.42	
1.90	14.80	
1.79	16.51	$Y_2(SO_4)_3, Na_2SO_4 + 2H_2O$
1.86	18.44	
2.99	19.96	
3.04	21.05	
2.27	27.14	
1.52	28.22	
1.61	28.13	
5.38	0.0	
		$Na_2SO_4 + 10H_2O$

(James and Holden, J. Am. Chem. Soc. 1913, 35. 560.)

+  $8H_2O$ . 100 pts.  $H_2O$  dissolve 9.3 pts. of cryst. salt at ord. temp., and 4.8 pts. at 100°. (Cleve, Bull. Soc. (2) 21. 344.)Less sol. in  $H_2O$  containing  $H_2SO_4$  than in pure  $H_2O$  (Berzelius.)Completely pptd. by  $HCl + H_2O_2$  + Aq. Insol. in alcohol.**Yttrium hydrogen sulphate,  $Y_2(SO_4)_3$ .**

(Brauner, Z. anorg. 1904, 38. 332.)

**Zinc sulphate, basic,  $8ZnO, SO_3 + 2H_2O$ .**Insol. in  $H_2O$ . (Schindler, Mag. Pharm. 31. 181.) $6ZnO, SO_3 + 10H_2O$ . Insol. in  $H_2O$ . (Kane, A. ch. 72. 310.) $4ZnO, SO_3 + 2H_2O$ . Scarcely sol. in hot or cold  $H_2O$ . Sol. in  $ZnSO_4$  + Aq. (Kühn, Schw. J. 60. 337.)

+3H<sub>2</sub>O. (Werner, B. 1907, 40. 4443.)  
 +5H<sub>2</sub>O. Nearly insol. in H<sub>2</sub>O (Habermann, M 5. 432.)  
 +6H<sub>2</sub>O (Kraut, Z. anorg. 1897, 13. 5.)  
 +7H<sub>2</sub>O (Athanasesco, C. R. 103. 271.)  
 +8H<sub>2</sub>O. Extremely slowly decomp. by H<sub>2</sub>O. (Remdel, J. pr. 1869, (1) 106. 373.)  
 +10H<sub>2</sub>O. (Schindler)  
 3ZnO, SO<sub>3</sub>. Insol. in cold, sl. sol. in hot H<sub>2</sub>O (Vogel.)  
 2ZnO, SO<sub>3</sub>. (Athanasesco.)  
 5ZnO, SO<sub>3</sub>. (Piekering, Chem. Soc. 1907, 91. 1886.)  
 +4H<sub>2</sub>O (Moody, Am. J. Sci. 1906, [4] 22. 184.)  
 9ZnO, 2SO<sub>3</sub>+12H<sub>2</sub>O (Remdel, J. pr. 1869, (1) 106. 374.)

Zinc sulphate, ZnSO<sub>4</sub>.

Sol. in H<sub>2</sub>O with evolution of heat.  
 Sol. in HCl+Aq.  
 +H<sub>2</sub>O. (Etard.)  
 +2H<sub>2</sub>O. Insol. in alcohol. (Kuhn.)  
 +3½H<sub>2</sub>O. (Anthon)  
 +5H<sub>2</sub>O. Insol. in boiling alcohol of 0.86 sp. gr. (Kuhn.)  
 +8H<sub>2</sub>O. (Marignac)  
 +7H<sub>2</sub>O. Slowly efflorescent.  
 M.pt. of ZnSO<sub>4</sub>+7H<sub>2</sub>O=50° (Tilden, Chem. Soc. 45. 409)  
 For solubility data on hydrated salts, see below

Sol. in 2+ pts. H<sub>2</sub>O at ord. temp., and in less at 100° (Bergmann)  
 100 pts. H<sub>2</sub>O at 104° dissolve 81.81 pts. ZnSO<sub>4</sub>. (Griffiths.)  
 100 pts. H<sub>2</sub>O at ord. temp. dissolve 140 pts. ZnSO<sub>4</sub>+7H<sub>2</sub>O. (Dumas.)  
 Sol. in 2.29 pts. H<sub>2</sub>O at 18.75° (Abl.)  
 100 pts. H<sub>2</sub>O at 15.56° dissolve 140 pts. ZnSO<sub>4</sub>+7H<sub>2</sub>O (Ure's Diss.)  
 100 pts. H<sub>2</sub>O at 18° dissolve 140.53 pts. ZnSO<sub>4</sub>+7H<sub>2</sub>O, and has sp. gr. = 1.4442 (Münch and Kraft.)  
 1 pt. of the crystals dissolves in 0.923 pt. H<sub>2</sub>O at 17.5°, and forms a solution of 1.4353 sp. gr. (Karsten)

100 pts. ZnSO<sub>4</sub>+Aq. sat. at 18-20° contain 35.36 pts. ZnSO<sub>4</sub>. (v. Hauer, J. B. 1866. 59.)  
 100 pts. H<sub>2</sub>O dissolve at:  
 0° 20° 50° 75°  
 41.8 53.0 66.9 80.4 pts. ZnSO<sub>4</sub>. (Tobler, J. B. 1855. 309.)

100 pts. H<sub>2</sub>O at 20.5° dissolve 163.2 pts. ZnSO<sub>4</sub>+7H<sub>2</sub>O. (Schiff, A. 109. 336.)

100 pts. H<sub>2</sub>O at t° dissolve pts. anhydrous ZnSO<sub>4</sub>, and pts. ZnSO<sub>4</sub>+7H<sub>2</sub>O.

t°	Pts. ZnSO <sub>4</sub>	Pts. ZnSO <sub>4</sub> +7H <sub>2</sub> O	t°	Pts. ZnSO <sub>4</sub>	Pts. ZnSO <sub>4</sub> +7H <sub>2</sub> O
0	43.02	115.22	60	74.20	313.48
10	48.36	138.21	70	79.25	369.36
20	53.13	161.49	80	84.60	442.62
30	58.40	190.90	90	89.78	533.02
40	63.52	224.05	100	95.03	653.59
50	68.75	263.84			

(Poggiale, A. ch. (3) 8. 467.)

Solubility of ZnSO<sub>4</sub> in 100 pts. H<sub>2</sub>O at t°

t°	Pts. ZnSO <sub>4</sub>	t°	Pts. ZnSO <sub>4</sub>	t°	Pts. ZnSO <sub>4</sub>
0	44.0	14	52.8	27	62.1
1	44.6	15	53.5	28	62.8
2	45.2	16	54.2	29	63.6
3	45.8	17	54.9	30	64.3
4	46.4	18	55.6	31	65.1
5	47.0	19	56.3	32	65.8
6	47.6	20	57.0	33	66.6
7	48.3	21	57.7	34	67.3
8	48.9	22	58.4	35	68.1
9	49.5	23	59.2	36	78.8
10	50.2	24	59.9	37	69.3
11	50.8	25	60.7	38	70.4
12	51.5	26	61.4	39	71.2
13	52.2				

Decomp. into basic salt above 40°

(Mulder, Scheik. Verhandel. 1864. 74.)

If solubility S represents number of pts. anhydrous salt in 100 pts. of solution, S=27.6+0.2604t from -5° to +81°; S=50.0-0.2244t from 81° to 175° (Etard, C. R. 106. 207)

Sat. ZnSO<sub>4</sub>+Aq. contains at:

1°	13°	20°	41°	49°		
29.1	32.6	34.8	40.2	40.9%	ZnSO <sub>4</sub> .	
55°	62°	70°	77°	100°		
43.4	45.0	47.0	46.5	44.7%	ZnSO <sub>4</sub> .	
111°	12°	137°	144°	169°	171°	
43.0	40.7	38.0	37.4	30.0	29.0%	ZnSO <sub>4</sub> .

(Etard, A. ch. 1894, (7) 2. 551.)

• Transition point from +6H<sub>2</sub>O to +1H<sub>2</sub>O is 70° (Etard.)

Solubility of ZnSO<sub>4</sub>+6H<sub>2</sub>O in H<sub>2</sub>O at t°.

t°	g. ZnSO <sub>4</sub> in 100 g. H <sub>2</sub> O
-5.0	47.08
+0.1	49.48
9.1	54.20
15.0	57.15
25.0	63.74
30.0	65.82
35.0	67.99
39.0	70.08

(Cohen, Z. phys. Ch. 1900, 34. 182.)

Solubility of the hepta- and hexa-hydrates of  $\text{ZnSO}_4$  at  $t^\circ$ .

p = wt. of salt expressed in percent of solution

$t^\circ$	p
0	29.43
0	29.53
0	29.49
15.00	33.66
15.88	33.85
30.70	38.46
39.92	41.36
39.95	41.37
40.73	41.43
41.49	41.70
46.40	42.68
49.97	43.51
49.99	43.41
50.00	43.50
50.02	43.51

Transition point from  $+7\text{H}_2\text{O}$  to  $+6\text{H}_2\text{O}$  is  $39^\circ$ .

The formula representing the change of solubility between  $0^\circ$  and  $39^\circ$  is

$$p = 29.5 + 0.270t + 0.00068t^2$$

while the expression for the hexahydrate above  $40^\circ$  is

$$p = 41.35 + 0.210t + 0.00070t^2$$

(Barnes, J. phys. Chem. 1900, 4. 19)

Solubility of  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. $\text{ZnSO}_4$ in 100 g. $\text{H}_2\text{O}$
-5	39.30
+0.1	41.93
9.1	47.09
15.0	50.88
25.0	57.90
35.0	66.61
39.0	70.05

(Cohen, Z. phys. Ch. 1900, 34. 182.)

Solubility in  $\text{H}_2\text{O}$  at high pressures:

Pressure in atm	$t^\circ$	g. $\text{ZnSO}_4$ in 100 g. $\text{H}_2\text{O}$	Solubility at $25^\circ$
1	26	57.95	57.95
500	26	58.43	57.92
500	25.8	58.32	57.91
1000	25.8	57.95	57.55
1000	25.8	57.95	57.55

(Cohen and Sinnige, Z. phys. Ch. 1909, 67. 444.)

Liable to form supersaturated solutions

Sat.  $\text{ZnSO}_4 + \text{Aq}$  at  $8^\circ$  has sp. gr. = 1.421. (Anthon.)

Sp. gr. of  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$  at  $20.5^\circ$ .

$$\% = \% \text{ZnSO}_4 \cdot 7\text{H}_2\text{O}.$$

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0057	21	1.1288	41	1.2754
2	1.0115	22	1.1355	42	1.2834
3	1.0173	23	1.1423	43	1.2917
4	1.0231	24	1.1491	44	1.3000
5	1.0289	25	1.1560	45	1.3083
6	1.0348	26	1.1629	46	1.3167
7	1.0407	27	1.1699	47	1.3252
8	1.0467	28	1.1770	48	1.3338
9	1.0527	29	1.1842	49	1.3424
10	1.0588	30	1.1914	50	1.3511
11	1.0649	31	1.1987	51	1.3599
12	1.0710	32	1.2060	52	1.3688
13	1.0772	33	1.2134	53	1.3779
14	1.0835	34	1.2209	54	1.3871
15	1.0899	35	1.2285	55	1.3964
16	1.0962	36	1.2362	56	1.4057
17	1.1026	37	1.2439	57	1.4151
18	1.1091	38	1.2517	58	1.4246
19	1.1156	39	1.2595	59	1.4342
20	1.1222	40	1.2674	60	1.4439

(Schiff, A. 110. 72.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at  $15^\circ$ .

$$\% = \% \text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$$

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.006	21	1.130	41	1.280
2	1.013	22	1.137	42	1.288
3	1.019	23	1.143	43	1.295
4	1.024	24	1.150	44	1.304
5	1.0288	25	1.1574	45	1.3100
6	1.035	26	1.164	46	1.320
7	1.041	27	1.171	47	1.330
8	1.047	28	1.179	48	1.337
9	1.053	29	1.185	49	1.346
10	1.0593	30	1.1933	50	1.3532
11	1.066	31	1.200	51	1.362
12	1.073	32	1.209	52	1.380
13	1.079	33	1.216	53	1.370
14	1.085	34	1.224	54	1.390
15	1.0905	35	1.231	55	1.3986
16	1.097	36	1.240	56	1.408
17	1.103	37	1.246	57	1.416
18	1.110	38	1.255	58	1.425
19	1.116	39	1.263	59	1.435
20	1.1236	40	1.2709	60	1.4451

(Gerlach, Z. anal. 8. 288.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at 23.5° a=no. of g. equivalent to  $\frac{1}{2}$  mol wt., dissolved in 1000 g  $\text{H}_2\text{O}$ ; b=sp gr if a is  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol. wt = 143.5; c=sp gr if a is  $\text{ZnSO}_4$ ,  $\frac{1}{2}$  mol wt. = 80.5

a	b	c	a	b
1	1 077	1 084	7	1 368
2	1 143	1 162	8	1 400
3	1 199	1 236	9	1 428
4	1 249	1 307	10	1 453
5	1 294	1 376	11	1 476
6	1 333	1 443		

(Favre and Valson, C R 79. 968.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at 18°.

% $\text{ZnSO}_4$	Sp gr	% $\text{ZnSO}_4$	Sp gr	% $\text{ZnSO}_4$	Sp gr
5	1 0509	15	1 1675	32	1 3045
10	1 1369	20	1 2313	50	1 3788

(Kohlrausch, W. Ann 1879. 1.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at room temp. containing:

7 12	16 64	23 09%	$\text{ZnSO}_4$ .
1 1064	1 1953	1.2814	

(Wagner, W. Ann 1883, 18. 271)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at 19.5°.

Mass of salt per unit mass of solution	Density of solution. (g per cc)
0.00186	1.00179
0.00371	1.00356
0.00556	1.00530
0.00740	1.00711
0.01106	1.01065
0.01469	1.01410
0.01829	1.01753
0.02187	1.02112
0.02542	1.02446
0.02895	1.02798

(McGregor, C. N 1887, 55. 4.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at 25°.

Concentration of $\text{ZnSO}_4 + \text{Aq}$	Sp gr.
1—normal	1 0792
$\frac{1}{2}$ —	1 0402
$\frac{1}{4}$ —	1 0188
$\frac{1}{8}$ —	1 0094
$\frac{1}{16}$ —	1.0047

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Sp gr of  $\text{ZnSO}_4 + \text{Aq}$ .

g salt in 100 g solution	Sp. gr.
24 7170	1 3152
21.4444	1.2665
17.7573	1 2145
14 0307	1.1645
9.7426	1 1106
5 1110	1 0565

(Charpy, A. ch. 1893, (6) 29. 27.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$

g equivalents $\text{ZnSO}_4$ per liter	t°	Sp. gr. t°/t°
0 001309	13 59	1.0001126
0 002616	13 575	1 0002258
0 005212	13 573	1 0004451
0 01039	13 585	1 000886
0 06818	13 621	1 008189
0 18842	13 642	1 015587
0 1890	16 11	1 01550
2.493	15 88	1 19385

(Kohlrausch and Hallwachs, W. Ann. 1894, 53. 27.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at 18.5°, when p=percent strength of solution, d=observed density; and w=volume conc.

in grams per cc  $\left(\frac{pd}{100} = w\right)$

p	d	w
29.22	1 3718	0 40057
25 14	1 3091	0 32910
21 28	1 2528	0 26659
17 08	1.1957	0 20422
11 20	1 1220	0 12567
8 44	1 0894	0 09195
6 65	1 0696	0 07112
3 82	1 0387	0.03968
3 18	1 0318	0 03281
1.46	1 0138	0 01480
0.577	1 0045	0 00580

(Barnes, J. phys. Chem. 1898, 2. 542)

Sp gr of dil  $\text{ZnSO}_4 + \text{Aq}$  at 20.004°.

Conc = g. equiv per l. at 20.004°.

Sp gr. compared with  $\text{H}_2\text{O}$  at 20.004° = 1.

Conc	Sp. gr.
0.0000	1 000,000,0
0.0001	1 000,008,6
0.0002	1 000,017,2
0 0005	1 000,043,2
0.0010	1 000,086,3
0 0020	1 000,172,3
0 0050	1,000,429,1
0 0080	1 000,514,3
1 0100	1 000,853,9

(Lamb and Lee, J. Am. Chem. Soc. 1913, 35. 1690.)

Sat  $\text{ZnSO}_4 + \text{Aq}$  boils at  $104.4^\circ$ , and solution contains 45 pts  $\text{ZnSO}_4$  to 100 pts  $\text{H}_2\text{O}$ . (Griffiths.)

Crust forms at  $108.5^\circ$ , the solution containing 68 pts.  $\text{ZnSO}_4$  to 100 pts  $\text{H}_2\text{O}$ . Highest temp observed,  $105^\circ$ . (Gerlach, Z. anal. 26. 426.)

B-pt. of  $\text{ZnSO}_4 + \text{Aq}$  containing pts.  $\text{ZnSO}_4$  to 100 pts  $\text{H}_2\text{O}$

B-pt.	Pts $\text{ZnSO}_4$	B-pt.	Pts $\text{ZnSO}_4$
100 $5^\circ$	13.1	103.0*	61 0
101 0	25.0	103 5	68 0
101 5	37 7	104 0	74 9
102 0	45 4	104 5	80 7
102.5	53 9	105 0	85 7

(Gerlach, Z. anal. 26 432.)

B-pt. of  $\text{ZnSO}_4 + \text{Aq}$ .

g. $\text{ZnSO}_4$ in 100 g. $\text{H}_2\text{O}$	Rise of the b-pt.	Barometric pressure mm.
2 886	0.080	743 0
6 647	0 169	"
10 139	0 266	"
13 389	0 372	"
17 713	0.461	"
22.202	0 591	"
25 199	0 690	"
28.249	0 811	"
30.470	0 899	742.0
32 89	0 995	"
35.18	1 122	"
37.36	1.240	"
39.83	1 381	"
41.30	1.459	"
44.56	1.671	"

(Kahlenberg, J. phys. Chem. 1901, 6. 370.)

1 l. absolute  $\text{H}_2\text{SO}_4$  dissolves 0.0021 mols.  $\text{ZnSO}_4$  at  $25^\circ$ . (Bergius, Z. phys. Ch. 1912, 72. 853.)

Completely pptd from  $\text{ZnSO}_4 + \text{Aq}$  by  $\text{HC}_2\text{H}_3\text{O}_2$ . (Pergoz.)

Solubility of  $\text{ZnSO}_4$  in  $\text{KOH} + \text{Aq}$ .

Mols. $\text{KOH}$ to 1 mol. $\text{ZnSO}_4$	per cent $\text{ZnO}$ in ppt
0.25	17.11
0.50	35.10
1.00	68.08
1.62	100.00
2.00	98.49
3.00	96.79
5.00	89.76
7.00	68.87
13.20	0 00

(Linebarger, J. Am. Chem. Soc. 1895, 17. 380.)

Difficultly and slowly sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ , with separation of a double sulphate

Sol. in considerable quantity in sat.  $\text{NaCl} + \text{Aq}$ , without pptn at first, but finally  $\text{Na}_2\text{SO}_4$  separates out. See under  $\text{NaCl}$

Sol. in sat.  $\text{NaNO}_3 + \text{Aq}$  as in  $\text{NaCl} + \text{Aq}$ . See under  $\text{NaNO}_3$

Sol. in sat.  $\text{KNO}_3 + \text{Aq}$  with immediate pptn. of double sulphate. (Karsten.) See under  $\text{KNO}_3$

Very rapidly sol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ , with separation of a double salt. (Karsten.) See under  $\text{K}_2\text{SO}_4$

Abundantly. in sat.  $\text{CuSO}_4 + \text{Aq}$ .

Slowly sol. in sat.  $\text{MgSO}_4 + \text{Aq}$

Very rapidly and abundantly sol. in sat.  $\text{NaSO}_4 + \text{Aq}$

For solubility of  $\text{ZnSO}_4 + \text{Na}_2\text{SO}_4$ , see under  $\text{Na}_2\text{SO}_4$  and  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Insol. in alcohol of 0.88 sp. gr.; 1000 pts. alcohol of 0.905 sp. gr. dissolve 2 pts (Anthon.)

100 pts. of a saturated solution in 40% alcohol contain 3.48 pts.  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$ ; 20%, 39 pts., 10%, 51.1 pts. (Schiff, J. B. 1861. 87.)

100 pts. absolute methyl alcohol dissolve 0.65 pt.  $\text{ZnSO}_4$  at  $18^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

100 pts. absolute methyl alcohol dissolve 59 pts.  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$  at  $17^\circ$

100 pts 50% methyl alcohol dissolve 15.7 pts  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$  at  $17^\circ$ . (de Bruyn.)

Insol. in acetone (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

100 pts glycerine dissolve 35 pts  $\text{ZnSO}_4$  at ord. temp (Klever, Bull. Soc. 1872, (2) 18. 372.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Min. Gosslarite.

Zinc hydrogen sulphate,  $\text{ZnH}_2(\text{SO}_4)_2 + 8\text{H}_2\text{O}$ .

Somewhat difficultly sol. in cold, easily in hot  $\text{H}_2\text{O}$  (v. Kobell, J. pr. 28. 492.)

Zinc sulphate ammonia, basic,  $4\text{NH}_3$ ,  $4\text{ZnO}$ ,  $\text{SO}_3 + 4\text{H}_2\text{O}$ .

Ppt. (Schindler)

Zinc sulphate ammonia,  $\text{ZnSO}_4$ ,  $2\text{NH}_3$ .

$+ \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into basic zinc sulphate

$\text{ZnSO}_4$ ,  $4\text{NH}_3$ ,  $+ 4\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Kane, A. ch. 72. 304.)

$+ 3\text{H}_2\text{O}$ . (André, C. R. 100. 241.)

$\text{ZnSO}_4$ ,  $5\text{NH}_3$  Sol. in  $\text{H}_2\text{O}$  with partial decomp (Rose, Pogg. 20. 149.)

Zinc sulphate cupric oxide,  $\text{ZnSO}_4$ ,  $2\text{CuO} + 5\text{H}_2\text{O}$ .

(Mailhe, A. ch. 1902, (7) 27. 169.)

$\text{ZnSO}_4$ ,  $3\text{CuO} + x\text{H}_2\text{O}$ . (Recours, C. R. 1901, 132. 1415.)

+5H<sub>2</sub>O  
 2ZnSO<sub>4</sub>, 3CuO+12H<sub>2</sub>O. (Mailhe, A. ch. 1902, (7) 27, 189.)  
 7ZnSO<sub>4</sub>, 24CuO+ $\pi$ H<sub>2</sub>O. (Reccour, C. R. 1901, 132, 1415.)

**Zinc sulphate hydrazine, ZnSO<sub>4</sub>, 2N<sub>2</sub>H<sub>4</sub>.**

Sol in NH<sub>4</sub>OH+Ag (Franzen, Z. anorg 1908, 60, 278.)

Sol in NH<sub>4</sub>OH+Ag without decomp. (Curtius, J. pr 1894, (2) 50, 345.)

ZnH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, N<sub>2</sub>H<sub>4</sub>. 1 pt. is sol in 185 pts. H<sub>2</sub>O at 12°. Sl. sol. in chl. acids. Decomp. by conc. HNO<sub>3</sub> and by hot conc. H<sub>2</sub>SO<sub>4</sub>. Very sol. in NH<sub>4</sub>OH+Ag. (Curtius, J. pr. 1894, (2) 50, 331.)

**Zirconium sulphate, basic, 3ZrO<sub>2</sub>, 2SO<sub>3</sub>.**

Insol in H<sub>2</sub>O. Sol. in HCl+Ag. (Paykull, B 12, 1719.)

4ZrO<sub>2</sub>, 3SO<sub>3</sub>+14H<sub>2</sub>O. Ppt. Difficulty sol. in H<sub>2</sub>O. (Hauser, B. 1904, 37, 2024.)

3ZrO<sub>2</sub>, SO<sub>3</sub>. Insol. in boiling H<sub>2</sub>O. (Franz, B. 3, 58.)

7ZrO<sub>2</sub>, 6SO<sub>3</sub>. Insol. in H<sub>2</sub>O. (Endemann, J. pr (2) 11, 219.)

ZrO<sub>2</sub>, SO<sub>3</sub>. Sol. in very little H<sub>2</sub>O. More H<sub>2</sub>O decomp. into 3ZrO<sub>2</sub>, 2SO<sub>3</sub> and Zr(SO<sub>4</sub>)<sub>2</sub>. (Berzelius.)

3ZrO<sub>2</sub>, 4SO<sub>3</sub>+15H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Paykull)

6ZrO<sub>2</sub>, 7SO<sub>3</sub>+19H<sub>2</sub>O Sol in H<sub>2</sub>O. (Paykull)

**Zirconium sulphate, Zr(SO<sub>4</sub>)<sub>2</sub>.**

*Anhydrous.* Slowly but completely sol. in cold, quickly in hot H<sub>2</sub>O

Sol. in warm H<sub>2</sub>SO<sub>4</sub>, but separates on cooling. Precipitated from aqueous solution by alcohol.

+4H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O.  
 100 pts. of the solution contain 59.3 pts. of the hydrated salt at 39.5°. (Hauser, B. 1904, 37, 2025.)

**Solubility of Zr(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in H<sub>2</sub>SO<sub>4</sub>+Aq at t°.**

100 g of the solution contain:

t°	g. ZrO <sub>2</sub>	g. SO <sub>3</sub>
39.5	19.5	25.46
	19.3	25.6
	19.6	25.99
	19.3	26.5
	18.8	27.0
	18.15	27.6
	17.3	28.3
	16.2	29.1
	9.6	32.3
	5.3	34.7
	3.51	36.01
	1.03	38.2
	0.46	39.8
	0.31	42.0

**Solubility of Zr(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in H<sub>2</sub>SO<sub>4</sub>+Aq at t°.—Continued.**

t°	g. ZrO <sub>2</sub>	g. SO <sub>3</sub>
	0.33	42.1
	0.14	46.8
	0.13	47.1
	0.15	56.7
	0.20	56.8
	0.27	57.1
	0.50	57.5
	0.60	57.8
	2.00	59.5
	3.25	60.4
	4.40	61.4
22	0.10	56.1
	0.13	46.5
	0.21	57.2

(Hauser, Z. anorg 1907, 54, 197)

**Zirconium hydrogen sulphate, Zr(SO<sub>4</sub>)<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>+H<sub>2</sub>O.**

Solubility in H<sub>2</sub>SO<sub>4</sub>+Aq. at 39.5°. 100 g. of the solution contain:

0.11	0.10	0.10	g. ZrO <sub>2</sub>
81.4	81.6	81.5	g. SO <sub>3</sub>

(Hauser, Z. anorg. 1907, 54, 200.)

**+3H<sub>2</sub>O.**

Solubility in H<sub>2</sub>SO<sub>4</sub>+Aq at t°.

100 g of the solution contain:

t°	g. ZrO <sub>2</sub>	g. SO <sub>3</sub>
39.5	4.55	61.5
	3.25	62.5
	3.33	63.8
	3.35	63.8
	1.80	64.2
	1.60	64.6
	1.55	65.0
	1.12	66.8
	0.96	68.4
22	0.80	66.4
	0.65	67.5
	0.60	68.1

(Hauser, Z. anorg. 1907, 54, 200)

**Persulphuric acid, HSO<sub>4</sub>.**

*See Persulphuric acid.*

**Pyrosulphuric acid and pyrosulphates.**

*See under Sulphuric acid and sulphates.*

**Sulphuric boric acid.**

*See Borosulphuric acid.*

**Sulphuric vanadic acid, V<sub>2</sub>O<sub>5</sub>, 3SO<sub>3</sub>+3H<sub>2</sub>O.**

*See Sulphate, vanadium.*

**Sulphurous acid, anhydrous,  $\text{SO}_2$ .**

See Sulphur dioxide.

**Sulphurous acid,  $\text{H}_2\text{SO}_3$ .**

Known only in aqueous solution, from which  $\text{SO}_2$  is given off upon heating. Crystallizes in cold, with various amounts of water, forming compounds which approximate  $\text{H}_2\text{SO}_3 + 8\text{H}_2\text{O}$  (Pierre, A. 68. 228);  $\text{H}_2\text{SO}_3 + 10\text{H}_2\text{O}$  (Döpping, Bull. Ac. St. Pétersb. 7. 100);  $\text{H}_2\text{SO}_3 + 14\text{H}_2\text{O}$  (Schonfeld, A. 95. 22);  $\text{H}_2\text{SO}_3 + 6\text{H}_2\text{O}$  (Roozeboom, R. t. c. 3. 29, 59, 75, 84; Geuther, A. 224. 218). Crystals are sol in 2 pts  $\text{H}_2\text{O}$  at  $10^\circ$ . (Pierre.)

For sp. gr. of solutions, etc., see sulphur dioxide

**Sulphites.**

*Normal.* Only the alkali sulphites are sol. in  $\text{H}_2\text{O}$ , and they are insol or only sl sol in alcohol.

Insol. in liquid  $\text{NH}_3$  (Franklin, Am. ch. J. 1898, 20. 824.)

*Acid.* All the acid sulphites are sol. in  $\text{H}_2\text{O}$ .

In general it is rarely possible to determine whether the compd described is a pure chemical compound or not. It is probable that many substances described by Svenssen and others are isomorphous mixtures whose composition depends upon the temp and conc. of the solution in which it was pptd (Rosenheim, Z. anorg. 1900, 25. 72.)

**Aluminum sulphite, basic,  $\text{Al}_2\text{O}_3, \text{SO}_2 + 4\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ . (Fourcroy and Vauquelin.)

$6\text{Al}(\text{OH})_3, \text{Al}_2(\text{SO}_3)_3 + 9\text{H}_2\text{O}$  Ppt. (Seubert, Z. anorg. 1893, 4. 56.)

**Ammonium sulphite, basic,  $(\text{NH}_4)_2\text{SO}_3, \text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$ .**

Sol in  $\text{H}_2\text{O}$ . Pptd. from aqueous solution by alcohol. (Muspratt.)

Does not exist (Maignac.)

**Ammonium sulphite,  $(\text{NH}_4)_2\text{SO}_3$ .**

Very hygroscopic (Divers, Chem. Soc. 1900, 77. 336.)

Insol. in acetone. (Eidmann, C.C. 1899, II. 1014.)

$+\text{H}_2\text{O}$ . Slowly sol. in  $\text{H}_2\text{O}$ . (Muspratt, A. 50. 268.)

Sol. in 1 pt.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Fourcroy and Vauquelin, Crell. Ann. 1800, 2. 415.)

Mbrs sol. in hot  $\text{H}_2\text{O}$  with evolution of  $\text{NH}_3$ . Sl sol. in absolute alcohol. (Muspratt.)

Much more sol. in alcohol than  $\text{K}_2\text{SO}_3$ . (Pierre.)

Loses  $\text{NH}_3$  in the air.

Sol. in  $\text{H}_2\text{O}$ . Conc solution charged with  $\text{NH}_3$  will deposit salt on evaporation over  $\text{KOH}$ . Dil. solution decomp. on evaporation (Divers, Chem. Soc. 1900, 77. 335.)

Insol in acetone (Naumann, B. 1904, 37. 4329.)

**Ammonium hydrogen sulphite,  $\text{NH}_4\text{HSO}_3$ .**

Insol. in acetone. (Eidmann, C.C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Ammonium pyrosulphite,  $(\text{NH}_4)_2\text{S}_2\text{O}_5$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol. Insol in ether (Fock and Kluss, B. 23. 3149.)

Very sol. in  $\text{H}_2\text{O}$ ; very hygroscopic. Aq solution is sl decomp. on evaporation. (Divers, Chem. Soc. 1900, 77. 336.)

**Ammonium cadmium sulphite,  $(\text{NH}_4)_2\text{SO}_3, \text{CdSO}_3$ .**

Nearly insol in  $\text{H}_2\text{O}$ . Partly sol in excess of  $\text{H}_2\text{SO}_3 + \text{Aq}$ , but separates out on boiling. (Schuler, A. 87. 34.)

**Ammonium cobaltous sulphite,  $(\text{NH}_4)_2\text{SO}_3, \text{CoSO}_3 + x\text{H}_2\text{O}$ .**

Decomp. on air. (Berglund, B. 7. 469.)

**Ammonium cobaltocobaltic sulphite.**

See Cobaltisulphite, ammonium cobalt.

**Ammonium cuprous sulphite,  $(\text{NH}_4)_2\text{SO}_3, 2\text{Cu}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .**

(Bottlinger, A. 51. 411.)  
 $(\text{NH}_4)_2\text{SO}_3, \text{Cu}_2\text{SO}_3$  Insol in cold, decomp. by boiling  $\text{H}_2\text{O}$  (Rogojaski, J. B. 1851. 366.)

Decomp. by warming with  $\text{H}_2\text{O}$ , in which it is insol. Sol. in acids with evolution of  $\text{SO}_2$ . (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 99.)

$+2\text{H}_2\text{O}$  (Commaile, J. B. 1867. 300.)  
 $2(\text{NH}_4)_2\text{SO}_3, \text{Cu}_2\text{SO}_3 + 3\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Solution decomp. on standing. Decomp by acids. (Rosenheim and Steinhäuser.)

$5(\text{NH}_4)_2\text{SO}_3, \text{Cu}_2\text{SO}_3 + 2\text{H}_2\text{O}$ . Decomp. on air. Sol in  $\text{H}_2\text{O}$  with decomp. (Svensson.)

$6(\text{NH}_4)_2\text{SO}_3, \text{Cu}_2\text{SO}_3 + 4\text{H}_2\text{O}$ . Easily decomp. (Rosenheim and Steinhäuser.)

$7(\text{NH}_4)_2\text{SO}_3, \text{Cu}_2\text{SO}_3 + 4\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Solution soon decomp. (Rosenheim and Steinhäuser.)

$+10\text{H}_2\text{O}$ . Decomp. on air. Sl. sol in warm, less sol in cold  $\text{H}_2\text{O}$  (de Saint-Gilles.)

$+14\text{H}_2\text{O}$ . Decomp. on air. Sol. in  $\text{H}_2\text{O}$ , but solution decomp.

Very easily sol in mother liquor. (Svensson, Acta Lund 1899. 13.)

**Ammonium cuproscopic sulphite,  $(\text{NH}_4)_2\text{SO}_3, 2\text{Cu}_2\text{SO}_3, \text{CuSC}_2 + 5\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  and weak acids. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (de Saint-Gilles, A. ch. (3) 42. 31.)

$+6\frac{1}{2}\text{H}_2\text{O}$ . Ppt. (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 98.)

**Ammonium glucinum sulphite,**  
 $(\text{NH}_4)_2\text{O}, 2\text{GIO}, 3\text{SO}_3 + 4\text{H}_2\text{O}.$

Ppt Very unstable in the air (Rosen-  
 haem, Z anorg 1897, 15. 310)

**Ammonium gold (aurous) sulphite,**  
 $3(\text{NH}_4)_2\text{SO}_3 \cdot \text{Au}_2\text{SO}_3$

Very easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.  
 (Haase, Z Ch 1869, 535)

**Ammonium gold (aurous) sulphite ammonia,**  
 $(\text{NH}_4)_2\text{SO}_3, 3\text{Au}_2\text{SO}_3, 6\text{NH}_3 + \text{H}_2\text{O}.$

Decomp. by  $\text{H}_2\text{O}$  Sol. in warm  $\text{NH}_4\text{OH} +$   
 Aq, but decomp. by boiling  
 $(\text{NH}_4)_2\text{Au}_2(\text{SO}_3)_3, 3\text{NH}_3 + 4\text{H}_2\text{O}.$  Decomp.  
 by  $\text{H}_2\text{O}$ . (Rosenheim, Z anorg. 1908, 59.  
 201.)

**Ammonium iridium sulphite.**

See Iridosulphite, ammonium.

**Ammonium iron (ferrous) sulphite,**  
 $(\text{NH}_4)_2\text{SO}_3, \text{FeSO}_3 + x\text{H}_2\text{O}.$

(Berglund.)

**Ammonium iron (ferric) sulphite sulphate,**  
 $\text{FeSO}_3 \cdot \text{SO}_3 \cdot \text{NH}_4 + \text{H}_2\text{O}$

Sl. sol. in cold  $\text{H}_2\text{O}$  Decomp. by cold  
 dil HCl (Hofmann, Z. anorg 1897, 14.  
 287)

**Ammonium magnesium sulphite,**  
 $(\text{NH}_4)_2\text{Mg}_3(\text{SO}_3)_4 + 18\text{H}_2\text{O}$

Very al sol in  $\text{H}_2\text{O}$ . (Fourcroy and Vau-  
 quelin)  
 Sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}.$   
 $+ 5\text{H}_2\text{O}.$  Much more sol in  $\text{H}_2\text{O}$  than  
 $\text{MgSO}_3$ . (Rammelsberg.)

**Ammonium manganous sulphite,  $(\text{NH}_4)_2\text{SO}_3,$**   
 $\text{MnSO}_3.$

Relatively easily decomp by  $\text{H}_2\text{O}$ . (Berg-  
 lund, Bull Soc. (2) 21. 213)  
 Not easily decomp. (Gorgeu, C R. 96.  
 376.)

**Ammonium mercuric sulphite,  $(\text{NH}_4)_2\text{SO}_3,$**   
 $\text{HgSO}_3.$

Very easily sol in  $\text{H}_2\text{O}$ , but  $\text{H}_2\text{O}$  solution  
 gradually decomp, even in the cold.

**Ammonium nickel sulphite,  $(\text{NH}_4)_2\text{SO}_3,$**   
 $3\text{NiSO}_3 + 18\text{H}_2\text{O}.$

Sol in  $\text{H}_2\text{O}$ . (Berglund, B 7. 469)

**Ammonium platinous sulphite.**

See Platousulphite, ammonium.

**Ammonium potassium sulphite,  $10(\text{NH}_4)_2\text{SO}_3,$**   
 $\text{K}_2\text{SO}_3 + 11\text{H}_2\text{O}.$

Decomp. by  $\text{H}_2\text{O}$ , etc. (Hartog, C. R.  
 109. 221)

**Ammonium scandium sulphate,**  
 $(\text{NH}_4)_2\text{SO}_3, \text{Sc}_2(\text{SO}_4)_3 + 7\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ . Difficulty sol in  $\text{H}_2\text{SO}_3 +$   
 Aq. (Meyer, Z anorg 1914, 88. 281)

**Ammonium silver sulphite,  $(\text{NH}_4)_2\text{SO}_3,$**   
 $\text{Ag}_2\text{SO}_3.$

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp.  
 thereby. (Svensson, B 4. 714)  
 $6(\text{NH}_4)_2\text{SO}_3, \text{Ag}_2\text{SO}_3 + 19\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$   
 without decomp (Svensson.)  
 $3(\text{NH}_4)_2\text{SO}_3, 4\text{NH}_4\text{HSO}_3, \text{Ag}_2\text{SO}_3 + 18\text{H}_2\text{O}.$   
 Easily sol in  $\text{H}_2\text{O}$ , but decomp. by warming.

**Ammonium sodium hydrogen sulphite,**  
 $\text{NH}_4\text{Na}_2\text{H}(\text{SO}_3)_2 + 4\text{H}_2\text{O}$

Not deliquescent (Marignac, Ann. Min.  
 (5) 12. 29.)

100 pts  $\text{H}_2\text{O}$  dissolve 42.3 pts salt at  $12.4^\circ$ ,  
 and 45.5 pts. at  $15^\circ$  (Schwicker, B 22. 1732)  
 $+ 5\text{H}_2\text{O} = 2\text{Na}_2\text{SO}_3, (\text{NH}_4)_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}.$   
 (Tauber, Techn. J. B 1888. 444)

**Ammonium tellurium sulphite,  $(\text{NH}_4)_2\text{SO}_3,$**   
 $\text{TeSO}_3 + x\text{H}_2\text{O}$

Sol. in  $\text{H}_2\text{O}$ . (Berglund, B. 7. 469.)

**Ammonium uranyl sulphite,**  
 $\text{NH}_4(\text{UO}_2)(\text{OH})\text{SO}_3.$

Insol in pure  $\text{H}_2\text{O}$  More sol. in  $\text{H}_2\text{SO}_3 +$   
 Aq than the K salt, and less than the Na  
 salt (Scheller, A. 144. 240)

$(\text{NH}_4)_2\text{O}, 2\text{UO}_3, 3\text{SO}_3$   
 $(\text{NH}_4)_2\text{O}, 4\text{UO}_3, 5\text{SO}_3$   
 $(\text{NH}_4)_2\text{O}, 3\text{UO}_3, 2\text{SO}_3$   
 $(\text{NH}_4)_2\text{O}, \text{UO}_3, 2\text{SO}_3$  (Kohlschütter, A.  
 1900, 311. 10)

**Ammonium vanadium sulphite.**

See Vanadiousulphite, ammonium.

**Ammonium vanadyl sulphite,**  
 $(\text{NH}_4)_2\text{SO}_3, \text{VOSO}_3 + 2\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$  with decomp. (Koppel, Z.  
 anorg. 1903, 35. 184.)

$(\text{NH}_4)_2\text{O}, 3\text{VO}_3, 2\text{SO}_3 + \text{H}_2\text{O}$  Sol. in cold  
 $\text{H}_2\text{O}$  without decomp.  
 Easily sol in mineral acids and alkalies  
 Sl. sol in alcohol and ether. (Koppel  
 Z anorg 1903, 35. 182)

**Ammonium zinc sulphite,  $(\text{NH}_4)_2\text{SO}_3, \text{ZnSO}_3.$**

Sol. in  $\text{H}_2\text{O}$ . (Berglund, B 7. 469)

**Ammonium sulphite mercuric chloride,**  
 $2(\text{NH}_4)_2\text{SO}_3, \text{HgCl}_2.$

Sl. sol. in cold, decomp. by boiling  $\text{H}_2\text{O}$ .  
 (de St-Giles, A. ch (3) 35. 95)

**Antimony sulphite,  $\text{Sb}_2\text{O}_3, 3\text{SO}_3(?)$ .**

Insol. in  $\text{H}_2\text{O}$  (Berzelius.)  
 Could not be obtained. (Röhrig, J pr  
 (2) 37. 241.)

**Barium sulphite, BaSO<sub>3</sub>**

Very sl. sol. in H<sub>2</sub>O (Fourcroy and Vauquelin, A. ch. 24. 301.)

Sol. in about 46,000 pts H<sub>2</sub>O at 16° (Autenrieth, Z. anst. 1898, 37. 294.)

Sol. in H<sub>2</sub>SO<sub>3</sub>+Aq.

Insol. in acetone. (Naumann B 1904, 37. 4329); methyl acetate (Naumann, B 1909, 42. 3790)

Solubility in sugar+Aq at t°.

Solvent	t°	100 ccm of solution contain g BaSO <sub>3</sub>
water	20	0.01974
sucrose+Aq 10° Brix		0.01040
" " 20° "		0.00968
" " 30° "		0.00782
" " 40° "		0.00484
" " 50° "		0.00298
(sat.) " " 60° "		0.00223
water	80	0.00177
sucrose+Aq 10° Brix		0.00335
" " 20° "		0.00239
" " 30° "		0.00223
" " 40° "		0.00158
" " 50° "		0.00149
(sat.) " " 60° "		0.00112

(Rogowicz, C. C. 1905, II 1223.)

**Barium cobaltic sulphite.**

See Cobaltisulphate, barium.

**Barium gold (aurous) sulphite, 3BaSO<sub>3</sub>,**

Au<sub>2</sub>SO<sub>3</sub>+xH<sub>2</sub>O.

Ppt. (Haase)

**Barium mercuric sulphite, BaSO<sub>3</sub>, HgSO<sub>3</sub>+H<sub>2</sub>O.**

Ppt. (Barth, Z. phys. Ch. 9. 196)

**Barium mercuric sulphite chloride,**

BaSO<sub>3</sub>, BaCl<sub>2</sub>, 2HgSO<sub>3</sub>+3½H<sub>2</sub>O.

(Barth, Z. phys. Ch 1892, 9. 208.)

**Bismuth sulphite, basic, Bi<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>+5H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O, alcohol, or ether. Sl. sol. in H<sub>2</sub>SO<sub>3</sub>+Aq. (Rohrig, J. pr. (2) 37. 241.)

(BiO)<sub>2</sub>SO<sub>3</sub>, 3(BiOH)SO<sub>3</sub>+H<sub>2</sub>O (Seubert and Elten, Z. anorg. 1893, 4. 72-5.)

2(BiO)<sub>2</sub>SO<sub>3</sub>, 3(BiOH)SO<sub>3</sub>+2H<sub>2</sub>O (S and E.)

3(BiO)<sub>2</sub>SO<sub>3</sub>, 7(BiOH)SO<sub>3</sub>+10H<sub>2</sub>O. (S. and E.)

4(BiO)<sub>2</sub>SO<sub>3</sub>, (BiOH)SO<sub>3</sub>+5H<sub>2</sub>O. (S. and E.)

9(BiO)<sub>2</sub>SO<sub>3</sub>, (BiOH)SO<sub>3</sub>+2H<sub>2</sub>O. (S. and E.)

**Bismuth cobaltic sulphite.**

See Cobaltisulphite, bismuth.

**Cadmium sulphite, CdSO<sub>3</sub>.**

Difficultly sol. in H<sub>2</sub>O. Easily sol. in dil. acids. (Rammelsberg, Pogg 67. 256.)

+2H<sub>2</sub>O. Difficultly sol. in H<sub>2</sub>O Sol. in H<sub>2</sub>SO<sub>3</sub>+Aq Sol. in NH<sub>4</sub>OH+Aq Insol in alcohol. (Muspratt, Phil. Mag. (3) 30. 414)

Insol in acetone. (Naumann, B 1904, 37. 4329.)

Contains 2½H<sub>2</sub>O (Deniges, Bull. Soc. (3) 7. 569.)

**Cadmium sodium sulphite, 3CdSO<sub>3</sub>, Na<sub>2</sub>SO<sub>3</sub>.**

Sol. in H<sub>2</sub>O. (Berglund, B. 7. 469)

**Cadmium sulphite, ammonia, CdSO<sub>3</sub>, NH<sub>3</sub>.**

Decomp. by H<sub>2</sub>O Sol without decomp. in hot NH<sub>4</sub>OH+Aq (Rammelsberg, Pogg 67. 256)

**Cæsium sulphite, Cs<sub>2</sub>SO<sub>3</sub>.**

Easily sol. in H<sub>2</sub>O. Sl. sol. in alcohol. (Chabré, C. R. 1901, 133. 297.)

**Cæsium hydrogen sulphite, CaHSO<sub>3</sub>.**

Easily sol. in H<sub>2</sub>O. Sl. sol. in alcohol. (Chabré, C. R. 1901, 133. 297.)

**Calcium sulphite, basic, Ca<sub>3</sub>S<sub>2</sub>O<sub>7</sub>=6CaO, 5SO<sub>3</sub>.**

(Schott, Dingl. 202. 52.)

**Calcium sulphite, CaSO<sub>3</sub>+2H<sub>2</sub>O**

Slowly effloresces. Sol in 800 pts. cold H<sub>2</sub>O. (Berzelius)

Insol. in H<sub>2</sub>O (Rohrig, J. pr. (2) 37. 230)

0.043 g is sol. in 1 l H<sub>2</sub>O at 18°. (Weisberg, Bull. Soc. 1896, (3) 15. 1249)

CaSO<sub>3</sub> equiv. to 78 mg CaO is sol. in 1 l. H<sub>2</sub>O at 100°. (Robart, C. A. 1913. 2500.)

Very sol. in H<sub>2</sub>SO<sub>3</sub>+Aq. See CaH<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>.

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)

CaSO<sub>3</sub> equiv. to 37 mg. CaO is sol. in 1 l 12% cane sugar+Aq at 100°. (Robart, C. A. 1913. 2500.)

0.0825 g. is sol. in 1 l. 10% sugar +Aq at 18°, 0.0800 g. is sol. in 1 l. 30% sugar +Aq. at 18°. (Weisberg, Bull. Soc 1896, (3) 15. 1249.)

Insol in acetone. (Krug and M'Elroy)

Insol. in methyl acetate. (Naumann, B 1909, 42. 3790; ethyl acetate. (Naumann, B 1904, 37. 3601.)

+½H<sub>2</sub>O. (Rammelsberg.)

**Calcium hydrogen sulphite, CaH<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>.**

Know only in solution.

100 ccm. H<sub>2</sub>O containing 9 g. SO<sub>2</sub> dissolve 0.553 g. CaSO<sub>3</sub> to form a solution of 1.06 sp. gr. (Gerland, J. pr. (2) 4. 119.)

**Calcium cobaltic sulphite.**

See Cobaltisulphite, calcium.

Cerous sulphite,  $\text{Ce}_2(\text{SO}_3)_3 + 3\text{H}_2\text{O}$ .

More sol. in cold than hot  $\text{H}_2\text{O}$ .  
Solution gradually decomposes (Berthier, A. ch. (3) 7. 77.)

Chromous sulphite,  $\text{CrSO}_3$ .

Precipitate. Insol. in  $\text{H}_2\text{O}$ . (Moberg.)

Chromium sulphite, basic,  $\text{Cr}_2\text{O}_3, \text{SO}_3$ .

Colloidal modification. Sol. in  $\text{H}_2\text{O}$ .  
 $2\text{Cr}_2\text{O}_3, 3\text{SO}_3 + 16\text{H}_2\text{O}$ . Ppt. (Recoura, Bull. Soc. 1898, (3) 19. 169)

Chromic sulphite.

Known only in aqueous solution, which precipitates a basic salt on boiling.

$2\text{Cr}_2\text{O}_3, 3\text{SO}_3 + 16\text{H}_2\text{O}$ . Precipitate. (Danson, Chem. Soc. 2. 205.)

Chromic potassium sulphite,  $\text{K}_2\text{O}, \text{Cr}_2\text{O}_3, 2\text{SO}_3 + x\text{H}_2\text{O}$ .

Precipitate. (Berglund, B. 7. 470.)

Cobaltous sulphite, basic.

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Berthier)  
 $\text{Co}(\text{OH})_2, 5\text{CoSO}_3 + 10\text{H}_2\text{O}$  Ppt (Seubert and Elten, Z. anorg. 1893, 4. 89.)  
 $\text{Co}(\text{OH})_2, 10\text{CoSO}_3 + 15\text{H}_2\text{O}$ . (Seubert and Elten)

Cobaltous sulphite,  $\text{CoSO}_3$ .

+  $3\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ . (Rammelsberg.)  
Partly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
+  $5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ . (Muspratt, A. 30. 282.)

Cobaltocobaltic sulphite.

See Cobaltisulphite, cobaltous.

Cobaltic sulphite with  $\frac{3}{2}\text{M}_2\text{SO}_3$ .

See Cobaltisulphite, M.

Cobaltous potassium sulphite,  $\text{CoSO}_3, \text{K}_2\text{SO}_3 + x\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ . (Schultze, J. B. 1864 270.)

Cobaltic potassium sulphite,  $\text{Co}_2(\text{SO}_3)_3, \text{K}_2\text{SO}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$  or  $\text{HCl} + \text{Aq}$ . (Schultze.)

Cobaltous sodium sulphite,  $3\text{CoO}, \text{Na}_2\text{O}, 3\text{SO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Schultze.)

Cobaltic sodium sulphite,  $\text{Co}_2\text{O}_3, \text{Na}_2\text{O}, 3\text{SO}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Schultze.)

Cuprous sulphite,  $\text{Cu}_2\text{SO}_3 + \text{H}_2\text{O}$ .

(a) Red. Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$  or  $\text{HCl} + \text{Aq}$ . (Rogowski, J. B. 1864. 366.)  
Could not be obtained by St. Gilles or Svensson (B. 4. 713)

Insol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Étard, C. R. 95. 38.)

Composition is  $(\text{Cu}_2)_2\text{H}_{12}(\text{SO}_3)_3$ , "Cuprous isosulphite," according to Étard.

+  $\frac{1}{2}\text{H}_2\text{O}$ . Étard's formula,  $\text{Cu}_2\text{SO}_3 + \text{H}_2\text{O}$  is incorrect.

The salt is almost colorless. (Ramberg Z. phys. Ch. 1909, 69. 512)

(8) White Normal salt. Insol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Étard.)

Cupric sulphite, basic,  $4\text{CuO}, \text{SO}_3 + 7\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , and decomp. by washing therewith. (Millon and Commaille.)

$7\text{CuO}, 4\text{SO}_3 + 8\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4$ . (Seubert and Elten, Z. anorg. 1893, 4. 48.)

$3\text{CuO}, 2\text{SO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Newbury, Am. Ch. J. 14. 232)

$7\text{CuO}, 4\text{SO}_3 + 8\text{H}_2\text{O}$ , or  $4\text{CuSO}_3, 3\text{Cu}(\text{OH})_2 + 5\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Seubert and Elten, Z. anorg. 1893, 4. 50.)

Cuprocupric sulphite,  $\text{CuSO}_3, \text{Cu}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling

Sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ ,  $\text{HCl}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Berthier.)

Sol. in very dil.  $\text{HNO}_3 + \text{Aq}$  (Döpping, J. B. 1851. 365.)

Insol. in  $\text{H}_2\text{SO}_3, \text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{Cu}$  salts +  $\text{Aq}$ . (de St Gilles)

+  $5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ ,  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , in cupric salts +  $\text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , or  $\text{HCl} + \text{Aq}$ . (de St. Gilles, A. ch. (3) 42. 34.)

Composition is  $(\text{Cu})\text{Cu}_2\text{H}_{10}(\text{SO}_3)_3 + 21\text{H}_2\text{O}$ , "acid cuprocupric octosulphite." (Étard, C. R. 96. 1475)

Cuprous ferroferric sodium sulphite,  $\text{Cu}_2\text{O}, 2\text{FeO}, \text{Fe}_2\text{O}_3, \text{Na}_2\text{O}, 6\text{SO}_3 + 16\text{H}_2\text{O}$ .

Sol. in about 1000 pts.  $\text{H}_2\text{O}$ .

Sol. in cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; sol. in cold dil.  $\text{HCl} + \text{Aq}$  with a residue of  $\text{Cu}_2\text{Cl}_2$ . (Stromeyer, A. 109. 237.)

Cuprous lithium sulphite,  $\text{Cu}_2\text{SO}_3, \text{Li}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. thereby. (Étard, C. R. 95. 138.)

Cupric mercuric sulphite,  $\text{CuSO}_3, \text{HgSO}_3$ .

Sol. in  $\text{H}_2\text{O}$  in all proportions, but decomp. on boiling.

Cuprous potassium sulphite,  $\text{Cu}_2\text{SO}_3$ ,

$\text{K}_2\text{SO}_3$  (?).

(Vohl, J. pr. 95. 219.)

+  $2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp.

(Rosenheim and Steinhäuser, Z. anorg. 1890, 25. 96.)

$\text{Cu}_2\text{SO}_3 \cdot 2\text{K}_2\text{SO}_4$ . (Chevreul, Graham, etc.)

Does not exist (Svensson.)

$\text{Cu}_2\text{O}$ ,  $3\text{K}_2\text{O}$ ,  $6\text{SO}_2 + 7\text{H}_2\text{O} = 4\text{KHSO}_3$ ,  $\text{K}_2\text{SO}_3$ ,  $\text{Cu}_2\text{SO}_3 + 5\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . (Svensson, B. 4. 713.)

Could not be obtained. (Rosenheim and Steinhäuser.)

$\text{Cu}_2\text{O}$ ,  $4\text{K}_2\text{O}$ ,  $8\text{SO}_2 + 3\text{H}_2\text{O} = 6\text{KH}_2\text{SO}_3$ ,  $\text{K}_2\text{SO}_3$ ,  $\text{Cu}_2\text{SO}_3$  Decomp. by  $\text{H}_2\text{O}$ . (Svensson.)

Could not be obtained. (Rosenheim and Steinhäuser.)

$\text{Cu}_2\text{SO}_3$ ,  $8\text{K}_2\text{SO}_3 + 16\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  with decomp. (Rammelsberg, Pogg. 57. 391.)

Does not exist, according to Svensson

**Cuprocupric potassium sulphite**,  $3\text{Cu}_2\text{SO}_3$ ,  $3\text{CuSO}_3$ ,  $\text{K}_2\text{SO}_3$

Properties as cuprous potassium sulphite (Rogojski, J. B. 1851. 367.)

$2\text{Cu}_2\text{SO}_3$ ,  $\text{CuSO}_3$ ,  $\text{K}_2\text{SO}_3 + 5\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  and weak acids (de St-Gilles.)

$\text{Cu}_2\text{SO}_3$ ,  $4\text{CuSO}_3$ ,  $\text{K}_2\text{SO}_3 + 16\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser)

**Cuprous sodium sulphite**,  $\text{Cu}_2\text{SO}_3$ ,  $\text{Na}_2\text{SO}_3$ ,  $+2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Svensson, 1870.)

$\text{Cu}_2\text{SO}_3 + 11\text{H}_2\text{O}$  Insol. in cold  $\text{H}_2\text{O}$ , but decomp. by excess. (Étard, C. R. 95. 138.)

$2\text{Cu}_2\text{SO}_3$ ,  $3\text{Na}_2\text{SO}_3 + 29\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser, Z. anorg 1900, 25. 94.)

$\text{Cu}_2\text{SO}_3$ ,  $5\text{Na}_2\text{SO}_3 + 38\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Svensson.)

$\text{Cu}_2\text{SO}_3$ ,  $7\text{Na}_2\text{SO}_3 + 19\text{H}_2\text{O}$  Completely sol. in  $\text{H}_2\text{O}$ , but solutions decomp. on standing (Svensson.)

**"Cuprous sodium octosulphite,"**  
( $\text{Cu}_2$ ),  $\text{H}_{10}\text{Na}_{18}\text{S}_8\text{O}_{22} + 43\text{H}_2\text{O}$ . (Étard)  
 $5\text{Cu}_2\text{SO}_3$ ,  $2\text{Na}_2\text{SO}_3 + 30\text{H}_2\text{O}$  Easily decomp. (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 94.)

**Cuprocupric sodium sulphite**,

$\text{Cu}_2\text{SO}_3$ ,  $2\text{CuSO}_3$ ,  $2\text{Na}_2\text{SO}_3 + 6\text{H}_2\text{O}$

Nearly insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser, Z. anorg 1900, 25. 95.)

$+8\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser.)

**Cuprocupric sodium hydrogen sulphite**,

$\text{Na}_5\text{Cu}_2^{\text{II}}(\text{Cu}_2^{\text{I}})\text{H}_4(\text{SO}_3)_3, 6\text{H}_4(\text{SO}_3) + 5\text{H}_2\text{O}$

Insol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 94. 1422.)

( $\text{Cu}_2^{\text{I}}\text{Cu}_2^{\text{II}}\text{Na}_5\text{H}_{18}(\text{SO}_3)_8$ . (Étard.)

**Copper sodium sulphites.**

Doubtless many of the compds. described in this class are in reality isomorphous mixtures whose composition depends upon the temp and conc. of the solution in which pptd.

(Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 92-95.)

**Dydymium sulphite**,  $\text{Dy}_2(\text{SO}_3)_3 + 3\text{H}_2\text{O}$ , or  $6\text{H}_2\text{O}$ .

Precipitate. Insol. in  $\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{SO}_4$  + Aq, from which it is reprecipitated by heating, redissolving on cooling. (Marignac, A. ch. (3) 38. 167.)

**Erbium sulphite**,  $\text{Er}_2(\text{SO}_3)_3 + 3\text{H}_2\text{O}$ .

Precipitate

**Glucinum sulphite**, basic,  $2\text{GISO}_3$ ,  $9\text{Gl}(\text{OH})_2 + 6\text{H}_2\text{O}$

Ppt (Seubert, Z. anorg 1893, 4. 52.)

$\text{GlSO}_3$ ,  $\text{GlO}$  Decomp. by  $\text{H}_2\text{O}$  or alcohol (K and M)

$3\text{GISO}_3$ ,  $\text{GlC}$  Sol. in alcohol (K and M)

**Glucinum sulphite**,  $\text{GlSO}_3$ .

Decomp. by  $\text{H}_2\text{O}$  or alcohol (Krtiss and Morant, B. 23. 734.)

**Glucinum potassium sulphite**,

$2\text{GISO}_3$ ,  $\text{K}_2\text{SO}_3 + 9\text{H}_2\text{O}$

Unstable in the air. (Rosenheim, Z. anorg. 1897, 15. 310.)

**Gold (aurous) potassium sulphite**,  $\text{Au}_2\text{SO}_3$ ,  $3\text{K}_2\text{SO}_3$ .

Very sol. in  $\text{H}_2\text{O}$ , insol. in alcohol (Haase.)

**Gold (auric) potassium sulphite**,  $\text{Au}_2\text{O}_3$ ,  $5\text{K}_2\text{O}$ ,  $8\text{SO}_2 + 5\text{H}_2\text{O} = 5\text{K}_2\text{SO}_3$ ,  $\text{Au}_2(\text{SO}_3)_3 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Decomp. by acids; insol. in alkalies. (Fremy, A. 79. 46.)

**Gold (auric) potassium sulphite**,

$\text{Au}_2(\text{SO}_3)_3$ ,  $5\text{K}_2\text{SO}_3 + 10\text{H}_2\text{O}$

(Rosenheim and Hertmann, Z. anorg. 1908, 59. 199.)

**Gold (auric) potassium sulphite ammonia**,

$\text{Au}_2(\text{SO}_3)_3$ ,  $3\text{K}_2\text{SO}_3$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$ .

As the corresponding  $\text{NH}_4$  salt. (Rosenheim and Hertmann, Z. anorg 1908, 59. 202.)

**Gold (aurous) sodium sulphite**,  $\text{Au}_2\text{SO}_3$ ,  $3\text{Na}_2\text{SO}_3 + 3\text{H}_2\text{O}$ .

Sol. in less than 1 pt.  $\text{H}_2\text{O}$ . Insol. in alcohol (Haase.)

$+5\text{H}_2\text{O}$ . (Himly.)

**Gold (auric) sodium sulphite**,

$\text{Au}_2(\text{SO}_3)_3$ ,  $5\text{Na}_2\text{SO}_3 + 28\text{H}_2\text{O}$

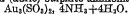
As K salt. (Rosenheim and Hertmann, anorg 1908, 59. 199.)

Gold (aurous) sulphite ammonia,  $3\text{Au}_2\text{O}$ ,  $4\text{SO}_2$ ,  $8\text{NH}_3 + 4\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  with decomp. Decomp. by acids

Sl sol. in cold, more easily in hot  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by boiling. (Hasse, *Zeit Ch* 1869. 535.)

Gold (auric) sulphite ammonia,



Ppt Decomp. in moist air and in neutral solution (Herzmann, *Z. anorg* 1908, 59. 198.)

Indium sulphite,  $2\text{In}_2\text{O}_3$ ,  $3\text{SO}_2 + 8\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$  (Bayer, A. 158. 372.)

Iridium sulphite,  $\text{Ir}_2(\text{SO}_3)_3 + 6\text{H}_2\text{O}$ .

Scarcely sol. in  $\text{H}_2\text{O}$ ; easily sol  $\text{HCl} + \text{Aq}$ . (Birnbbaum, A 186 179)

Iridyl sulphite,  $(\text{IrO})\text{SO}_3 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Birnbbaum)

Iridous potassium sulphite,  $\text{IrO}$ ,  $3\text{K}_2\text{O}$ ,  $5\text{SO}_2(?)$

Sl. sol. in  $\text{H}_2\text{O}$ , more sol. in  $\text{KOH} + \text{Aq}$ . Easily sol in  $\text{HCl} + \text{Aq}$  (Claus, *J pr.* 42. 359)

Iridous sulphite potassium chloride.

See Iridosulphite, potassium.

Iridium sulphite with  $\text{M}_2\text{SO}_3$ .

See Iridosulphite, M.

Iron (ferrous) sulphite,  $\text{FeSO}_3 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Very sl sol in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol in alcohol, but sol. therein in presence of  $\text{SO}_2$ . (Muspratt.)

Iron (ferric) sulphite,  $\text{Fe}_2\text{O}_3$ ,  $\text{SO}_2 + 6\text{H}_2\text{O}$ .

Very sl sol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Koene.)  $2\text{Fe}_2\text{O}_3$ ,  $3\text{SO}_2$  Deliquescent; decomp. by  $\text{H}_2\text{O}$  into  $\text{SO}_2$  and above comp  $3\text{Fe}_2\text{O}_3$ ,  $\text{SO}_2 + 7\text{H}_2\text{O}$  Ppt

Iron (ferroferric) potassium sulphite,  $\text{FeSO}_3$ ,  $(\text{FeO})_2\text{SO}_3$ ,  $2\text{K}_2\text{SO}_3$

Ppt. (Berglund)

Iron (ferric) potassium sulphite,  $\text{K}_2\text{O}$ ,  $\text{Fe}_2\text{O}_3$ ,  $3\text{SO}_2 + 2\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Koene, *Pogg.* 63. 453.)

$\text{Fe}_2\text{O}_3$ ,  $2\text{K}_2\text{O}$ ,  $3\text{SO}_2 + 5\text{H}_2\text{O}$ . Ppt. (Muepratt, *Phil. Mag* (3) 30. 414.)

Iron (ferric) potassium sulphite sulphate,  $\text{FeSO}_4\text{SO}_3\text{K}$ .

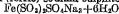
Sl. sol. in cold  $\text{H}_2\text{O}$ .

Sol. in 20%  $\text{HCl}$ ; decomp. on boiling. (Hofmann, *Z anorg.* 1897, 14. 286.)

$\text{Fe}(\text{SO}_3)_2\text{SO}_4\text{K}_2$  Almost insol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling with dil. acids. (Hofmann)

$\text{Fe}_2(\text{SO}_3)_2\text{SO}_4\text{K}_4 + 5\text{H}_2\text{O}$ . Insol in cold  $\text{H}_2\text{O}$ ; sol. in cold 20%  $\text{HCl} + \text{Aq}$ ; decomp. on boiling with  $\text{H}_2\text{O}$ . (Hofmann)

Iron (ferric) sodium sulphite sulphate,



Almost insol. in  $\text{H}_2\text{O}$

Decomp. by boiling with dil. acids. (Hofmann, *Z. anorg.* 1897, 14. 289.)

Iron (ferric) sodium hydrogen sulphite sulphate,  $\text{FeSO}_4(\text{SO}_3)_2\text{H}_2\text{Na}_2 + 2\text{H}_2\text{O}$ .

Only very sl. sol. in  $\text{H}_2\text{O}$ . (Hofmann)

Lanthanum sulphite,  $\text{La}_2(\text{SO}_3)_3 + 4\text{H}_2\text{O}$ .

Precipitate (Cleve)

Lead sulphite,  $\text{PbSO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids. Sl sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Röhrig, *J pr.* (2) 37. 233.)

Lithium sulphite,  $\text{Li}_2\text{SO}_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; precipitated from aqueous solution by abs alcohol. (Danson, *Chem. Soc.* 2. 205.) Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

$+ \text{H}_2\text{O}$  Sl. sol. in alcohol, and still less sol in ether (Röhrig, *J pr* (2) 37. 225.)  $+ 2\text{H}_2\text{O}$ . (Röhrig)

Lithium potassium sulphite,  $\text{LiKSO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Easily sol in  $\text{H}_2\text{O}$ . (Röhrig, *J pr* (2) 37. 251.)

Lithium sodium sulphite,  $6\text{Li}_2\text{SO}_3$ ,  $\text{Na}_2\text{SO}_3 + 8\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  (Röhrig)

Magnesium sulphite,  $\text{MgSO}_3 + 6\text{H}_2\text{O}$ .

Sol. in 20 pts. cold, and in less hot  $\text{H}_2\text{O}$ . (Fourcroy and Vauquelin.)

Sol. in 80 pts. cold, and in 120 pts. boiling  $\text{H}_2\text{O}$ . (Hager, *C. C.* 1875. 135.)

More easily sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol in liquid  $\text{NH}_3$ . (Franklin, *Am. Ch. J.* 1898, 20. 828.)

Precipitated from aqueous solution by alcohol

$+ 3\text{H}_2\text{O}$ . (Röhrig, *J pr.* (2) 37. 234.)

Manganous sulphite,  $\text{MnSO}_3 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , alcohol, or ether. Easily sol. in acids, also in  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Insol in acetone. (Naumann, *B.* 1904, 37. 4329)

$+ 2\frac{1}{2}\text{H}_2\text{O}$ . (Rammelsberg.)

$+ 3\text{H}_2\text{O}$ . Sol. in 10,000 pts. cold, and 5000 pts. hot  $\text{H}_2\text{O}$ ; more sol. in conc.  $\text{Mn}$  salts  $+ \text{Aq}$ , sol in 1000 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$ . 100 pts.  $\text{H}_2\text{SO}_4 + \text{Aq}$  dissolve 15-17 pts (Gorgeu, *C. R.* 96. 341)

Salt with  $2\frac{1}{2}\text{H}_2\text{O}$  is the only one which exists. (Röhrig, J. pr. (2) 37. 2)

**Manganous potassium sulphite,  $2\text{MnSO}_3 \cdot \text{K}_2\text{SO}_3$ .**

Insol in  $\text{H}_2\text{O}$ , even when boiling. (Gorgeu, C. R. 96. 376.)

$\text{MnSO}_3 \cdot \text{K}_2\text{SO}_3$  Sol. in  $\text{H}_2\text{O}$ . (Gorgeu.)

**Manganous sodium sulphite,  $\text{MnSO}_3 \cdot \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$ .**

Insol. in hot  $\text{H}_2\text{O}$ , but decomp. by cold  $\text{H}_2\text{O}$ . (Gorgeu.)

$4\text{MnSO}_3 \cdot \text{Na}_2\text{SO}_3$  Insol. in  $\text{H}_2\text{O}$ . (Gorgeu.)

**Mercuric sulphite,  $2\text{HgO} \cdot \text{SO}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ , alkali sulphites with subsequent decomp., and in  $\text{KCN} + \text{Aq}$  (de St-Gilles, A. ch. (3) 36. 80.)

$\text{HgSO}_3$ . Decomp. by cold  $\text{H}_2\text{O}$  (de St-Gilles)

Does not exist (Divers and Shimidzu, Chem. Soc. 49. 553)

$\text{HgO} \cdot 2\text{SO}_2 + \text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling (de St-Gilles) Exists only in aqueous solution. (Divers and Shimidzu.)

**Mercuriomercuric sulphite,  $\text{Hg}_2(\text{SO}_3)_2 + 2\text{H}_2\text{O} = \text{Hg}_2\text{SO}_3 \cdot \text{HgSO}_3$ .**

Very efflorescent. Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

$+4\text{H}_2\text{O}$  Very efflorescent.

**Hypomercurosic sulphite,  $\text{Hg}_4(\text{SO}_3)_3 + \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ , but easily decomp. on standing therewith. Almost absolutely insol in dil.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Divers and Shimidzu.)

**Mercuric oxysulphite,  $\text{Hg}(\text{SO}_2\text{OHgO})_2 \cdot \text{Hg} + \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Divers and Shimidzu.)

**Mercuric potassium sulphite, basic,  $\text{K}_2\text{O} \cdot 2\text{HgO} \cdot 2\text{SO}_3$ .**

(Barth, Z. phys. Ch. 1892, 9. 210.)

$\text{K}_2\text{O} \cdot 3\text{HgO} \cdot 3\text{SO}_3$  Insol. in  $\text{H}_2\text{O}$  Partly sol in  $\text{KOH} + \text{Aq}$ . (Barth)

**Mercuric potassium sulphite,  $\text{HgSO}_3 \cdot \text{K}_2\text{SO}_3 + \text{H}_2\text{O}$ .**

Sl sol. in cold  $\text{H}_2\text{O}$ . Decomp. on boiling (de St-Gilles, A. ch. (3) 36. 90.)

**Mercuric potassium sulphite mercuric chloride,  $\text{K}_2\text{Hg}(\text{SO}_3)_2 \cdot \text{HgCl}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Barth, Z. phys. Ch. 1892, 9. 206.)

**Mercuric silver sulphite,  $\text{HgSO}_3 \cdot \text{Ag}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .**

Decomp. rapidly, insol. in  $\text{H}_2\text{O}$ . (Barth, Z. phys. Ch. 9. 195.)

**Mercuric sodium sulphite,  $\text{HgSO}_3 \cdot \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (de St-Gilles.)

Sol. in 25 pts cold  $\text{H}_2\text{O}$ , and decomp. on heating (Divers and Shimidzu.)

$+2\text{H}_2\text{O} = \text{Na}_2(\text{SO}_3)_2 \cdot \text{Hg} + 2\text{H}_2\text{O}$ . (Barth, Z. phys. Ch. 9. 193.)

$2\text{HgSO}_3 \cdot \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$ . Much more sol. in  $\text{H}_2\text{O}$  than the above comp. especially on heating. (de St-Gilles)

Does not exist. (Divers and Shimidzu)

**Mercuric strontium sulphite,  $\text{HgSO}_3 \cdot \text{SrSO}_3 + 2\text{H}_2\text{O}$ .**

Ppt. (Barth.)

**Mercuric sulphite ammonium bromide,  $\text{HgSO}_3 \cdot \text{NH}_4\text{Br}$ .**

As  $\text{NH}_4\text{Cl}$  comp. (Barth, Z. phys. Ch. 1892, 9. 215.)

**Mercuric sulphite ammonium chloride,  $\text{HgSO}_3 \cdot \text{NH}_4\text{Cl}$ .**

As K salt. (Barth)

**Mercuric sulphite potassium chloride,  $\text{HgSO}_3 \cdot \text{KCl}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Barth.)

**Mercuric sulphite sodium chloride,  $\text{HgSO}_3 \cdot \text{NaCl} + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Barth.)

**Nickel sulphite, basic,  $2\text{NiSO}_3 \cdot \text{Ni}(\text{OH})_2 + 6\text{H}_2\text{O}$ .**

Ppt. (Seubert and Elten, Z. anorg. 1893, 4. 91.)

**Nickel sulphite,  $\text{NiSO}_3 + 4\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . with evolution of  $\text{SO}_2$  (Muspratt, A. 50. 259.)

$+6\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Rammelsberg, Pogg. 87. 391)

**Nickel sulphite ammonia,  $\text{NiSO}_3 \cdot 3\text{NH}_3 + 3\text{H}_2\text{O}$ .**

Sol. in little  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$  or heat (Rammelsberg, Pogg. 67. 245.)

**Osmious sulphite,  $\text{OsSO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$  without evolution of  $\text{SO}_2$ . Very slowly decomp. by  $\text{KOH} + \text{Aq}$  (Claus.)

**Osmious potassium sulphite,  $\text{OsSO}_3 \cdot 2\text{K}_2\text{SO}_3 \cdot 2\text{KHSO}_3 + 4\text{H}_2\text{O}$ .**

Nearly insol. in  $\text{H}_2\text{O}$ .

Osmious potassium sulphite chloride,  $\text{OsO}_2 \cdot 2\text{SO}_2 \cdot 8\text{KCl}$ .

Easily sol. in  $\text{H}_2\text{O}$ .

Palladium sodium sulphite,  $\text{PdSO}_3 \cdot 3\text{Na}_2\text{SO}_3 + 2\text{H}_2\text{O} = \text{Na}_2\text{Pd}(\text{SO}_3)_4 + 2\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . Sol. in  $\text{NaOH} + \text{Aq}$  or  $\text{H}_2\text{SO}_3 + \text{Aq}$ . (Wohler and Frerichs, A. 174. 199.)

Platinous sulphite,  $\text{PtO}_2 \cdot 2\text{SO}_2$ .

Easily sol. in  $\text{H}_2\text{O}$  or alcohol (Döbereiner, J. p. 16. 315).

Formula is  $\text{PtSO}_3$ . (Gmelin.)

$\text{PtSO}_3$ ,  $\text{H}_2\text{SO}_3$ . (Birnbäum, A. 139. 172.)

Platinic potassium sulphite,  $\text{PtO}_2 \cdot \text{SO}_3$ ,  $\text{K}_2\text{SO}_3 + \text{H}_2\text{O}$ .

Sol. in  $\text{KOH} + \text{Aq}$ . (Birnbäum, A. 139. 173.)

Platinic sodium sulphite,  $\text{PtO}_2 \cdot \text{SO}_3$ ,  $2\text{Na}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Birnbäum.)

Platinous sulphite with  $\text{M}_2\text{SO}_3$ .

See Platosulphite, M.

Platinum sulphite ammonium chloride.

See Chloroplatosulphite, ammonium.

Potassium sulphite,  $\text{K}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .

Somewhat deliquescent. Sol. in 1 pt. cold, and still less hot  $\text{H}_2\text{O}$ . (Fourcroy and Vauquelin, A. ch. 24. 254.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Very slightly soluble in alcohol. Insol. in ethyl acetate (Casaseca, C. R. 30. 821.)

Potassium hydrogen sulphite,  $\text{KHSO}_3$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in absolute alcohol.

Potassium pyrosulphite,  $\text{K}_2\text{S}_2\text{O}_5$ .

Slowly sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in alcohol; insol. in ether. (Muspratt, A. 60. 269.)

Potassium rhodium sulphite,  $3\text{K}_2\text{SO}_3$ ,

$\text{Rh}_2(\text{SO}_3)_2 + 6\text{H}_2\text{O}$ .

See Rhodosulphite, potassium.

Potassium ruthenium sulphite,

$\text{O}(\text{Ru}(\text{SO}_3)_4\text{K}_6)_2 + 2\text{H}_2\text{O}$ .

Ppt. (Miolati, C. C. 1901, I. 501.)

Potassium sodium sulphite,  $\text{KNaSO}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Spring, B. 7. 1161.)

+1, and  $2\text{H}_2\text{O}$ . (Schwicker, B. 22. 1731.)

Isomeric salts,  $\text{KSO}_3\text{Na}$  and  $\text{NaSO}_3\text{K}$ . (Barth, Z. phys. Ch. 9. 176.)

Potassium sodium hydrogen sulphite,  $\text{KNa}_2\text{H}(\text{SO}_3)_2 + 4\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ ; 100 pts  $\text{H}_2\text{O}$  dissolve 60 pts. salt at  $15^\circ$ . (Schwicker, B. 22. 1731.)

$\text{K}_2\text{NaH}(\text{SO}_3)_2 + 3\text{H}_2\text{O}$  (Schwicker.)

Potassium uranyl sulphite,  $\text{K}(\text{UO}_2)(\text{OH})\text{SO}_3$ .

Insol. in  $\text{H}_2\text{O}$ , but sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ . (Scheller.)

$\text{K}_2\text{O}$ ,  $2\text{UO}_3$ ,  $3\text{SO}_2$  (Kohlshütter, A. 1900, 311. 10 *et seq.*)

$\text{K}_2\text{O}$ ,  $4\text{UO}_3$ ,  $5\text{SO}_2$  (K.)

$\text{K}_2\text{O}$ ,  $3\text{UO}_3$ ,  $2\text{SO}_2$  (K.)

$\text{K}_2\text{O}$ ,  $\text{UO}_3$ ,  $2\text{SO}_2$  (K.)

Potassium vanadium sulphite.

See Vanadosulphite, potassium.

Potassium vanadyl sulphite,  $\text{K}_2\text{SO}_3$ ,  $\text{VO}_2\text{SO}_3 + 5\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. and can be recryst. therefrom. (Koppel and Behndt, B. 1901, 34. 3932.)

$\text{K}_2\text{O}$ ,  $3\text{VO}_3$ ,  $2\text{SO}_2$ . Sol. without decomp. in cold and hot  $\text{H}_2\text{O}$ .

Insol. in alcohol and ether (Koppel, Z. anorg. 1903, 35. 182.)

Potassium zinc sulphite,  $\text{K}_2\text{SO}_3$ ,  $3\text{ZnSO}_3 + 7\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Berglund, Acta Lund. 1872.)

Rhodium sulphite,  $\text{Rh}_2(\text{SO}_3)_2 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Claus.)

Rhodium sodium sulphite.

See Rhodosulphite, sodium.

Ruthenium sulphite,  $\text{Ru}_2(\text{SO}_3)_2$ .

Colloidal substance, sol. in a large quantity of  $\text{H}_2\text{O}$ . (Lucchesi, Gazz. ch. it. 1900, 30. (2) 71.)

Ruthenium sodium sulphite,  $\text{Na}_2\text{Ru}(\text{SO}_3)_2 + 2\text{H}_2\text{O}$ .

Ppt. (Miolati, C. C. 1901, I. 501.)

Samarium sulphite,  $\text{Sm}_2(\text{SO}_3)_2$ .

Amorphous precipitate. (Cleve.)

Scandium sulphite,  $\text{Sc}_2(\text{SO}_3)_2$ .

Insol. in cold  $\text{H}_2\text{O}$ . Sl. sol. in hot  $\text{H}_2\text{O}$ . Sol. in excess of sodium sulphite when heated (Crookes, Phil. Trans. 1910, 210. A. 363.)

+ $6\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$  with separation of  $\text{H}_2\text{SO}_3$ . (R. J. Meyer, Z. anorg. 1914, 86. 281.)

**Selenium sulphite,  $\text{SeSO}_3$ .**

Correct composition for "selenium sulphoxide." (Divers, Chem. Soc. 49. 583.)

**Silver sulphite,  $\text{Ag}_2\text{SO}_3$ .**

Very sl sol in cold  $\text{H}_2\text{O}$ . Decomp. on heating.

Solubility in  $\text{H}_2\text{O}$  is <1:20,000 (Bauhin, C. R. 1909, 149. 858.)

Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  and alkali sulphites +  $\text{Aq.}$  Insol. in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  Decomp. by strong acids, but not by acetic acid. (Berthier, A. ch. (3) 7. 82.)

Easily sol. in alkali thiosulphates +  $\text{Aq.}$  (Herschel.)

Cold  $\text{NaHSO}_3 + \text{Aq.}$  dissolves a considerable amount of  $\text{Ag}_2\text{SO}_3$ . (Rosenheim and Stenhausser, Z. anorg. 1900, 26. 78.)

Practically insol. in  $\text{HNO}_3 + \text{Aq.}$  or dil.  $\text{AgNO}_3 + \text{Aq.}$  also in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  (Divers, Chem. Soc. 49. 579.)

**Silver sodium sulphite,  $\text{Ag}_2\text{SO}_3$ ,  $\text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Svensson, B. 4. 714.)

**Sodium sulphite,  $\text{Na}_2\text{SO}_3$ .**

100 pts. dissolve at  $0^\circ$ , 14.1 pts.; at  $20^\circ$ , 25.8 pts., at  $40^\circ$ , 49.5 pts.  $\text{Na}_2\text{SO}_3$ . (Kremers, Pogg. 99. 50.) Maximum solubility is at  $33^\circ$ . (Mitscherlich.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{Na}_2\text{SO}_3$
60 4	28 29
59 8	28 29
59 8	28 65
59 8	28 75
37 0	28 01
37 0	28 07
47 0	28 19
47 0	28 07
55 6	28 21
84 0	28 26

The temp. at which  $\text{Na}_2\text{SO}_3 + 7\text{H}_2\text{O}$  changes into  $\text{Na}_2\text{SO}_3$  is about  $21.6^\circ$ .

(Hartley and Barrett, Chem. Soc. 1909, 95. 1183)

See also  $+7\text{H}_2\text{O}$ .

Sp. gr. of sat. solution at  $15^\circ = 1.21$ . (Greenish and Smith, Pharm. J. 1901, 66. 774.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in alcohol.

Insol. in ethyl acetate. (Casaseca, C. R. 30. 821.); methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370)

$+7\text{H}_2\text{O}$  Decomp slowly on air.

Sol in 4 pts  $\text{H}_2\text{O}$  at  $15^\circ$  with absorption of heat (Dumas), and in 1 pt. boiling  $\text{H}_2\text{O}$  (Fourcroy)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{Na}_2\text{SO}_3$
37 2	44.08
33 5	39 04
29 0	34 99
23 5	29 92
18.2	25 31
10 6	20 01
5 9	17 61
2 0	14 82
-1 9	13 09

Supersolubility curves have also been plotted for ice and  $\text{Na}_2\text{SO}_3 + 7\text{H}_2\text{O}$

(Hartley and Barrett, Chem. Soc. 1909, 95. 1181)

$+10\text{H}_2\text{O}$  Efflorescent. Somewhat less sol than above salt (Muspratt.)

**Sodium hydrogen sulphite,  $\text{NaHSO}_3$ .**

More difficultly sol in  $\text{H}_2\text{O}$  than  $\text{NaHCO}_3$ , and is precipitated by alcohol from aqueous solution (Muspratt)

Insol. in acetone. (Eidmann, C. C. 1899, II 1014; Naumann, B. 1904, 37. 4329) methyl acetate (Naumann, B. 1909, 42. 3790)

$+4\text{H}_2\text{O}$ . (Clark)

**Sodium pyrosulphite,  $\text{Na}_2\text{S}_2\text{O}_3$ .**

Decomp. gradually on the air

**Sodium uranyl sulphite,  $\text{Na}(\text{UO}_2)(\text{OH})\text{SO}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  than the K salt (Scheller)

$\text{Na}_2\text{O}$ ,  $2\text{UO}_3$ ,  $3\text{SO}_2$

$\text{Na}_2\text{O}$ ,  $3\text{UO}_3$ ,  $2\text{SO}_2$  (Kohlschütter, A. 1900, 311. 10 at seq)

**Sodium vanadyl sulphite,  $\text{Na}_2\text{O}$ ,  $2\text{SO}_3$ ,  $\text{VO}_2 + 5\text{H}_2\text{O}$** 

Sol. in  $\text{H}_2\text{O}$  with decomp.

$\text{Na}_2\text{O}$ ,  $2\text{SO}_3$ ,  $3\text{VO}_2 + 4\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$ ; decomp. on heating (Koppel, B. 1901, 34. 3933.)

**Sodium zinc sulphite,  $\text{Na}_2\text{SO}_3$ ,  $3\text{ZnSO}_3 + 7\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Berglund, Acta Lund, 1872.)

**Sodium sulphite silver chloride,  $3\text{Na}_2\text{SO}_3$ ,  $\text{AgCl} + 21\text{H}_2\text{O}$** 

Sol. in  $\text{H}_2\text{O}$ . (Svensson.)

**Strontium sulphite,  $\text{SrSO}_3$ .**

Precipitate. Almost insol in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ . (Muspratt)

Sol. in about 30,000 pts.  $\text{H}_2\text{O}$  at  $16-18^\circ$  (Antenrieth, Z anal 1898, 37. 293.)

Abundantly sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Röhrig)

**Tellurium sulphite,  $\text{TeSO}_3$ .**

Correct composition of "tellurium sulphoxide" (Divers, Chem. Soc 49. 583)

**Thallous sulphite,  $\text{Tl}_2\text{SO}_3$ .**

Sl. sol. in cold, easily in hot  $\text{H}_2\text{SO}_3 + \text{Aq}$ . (Röhrig, J. pr (2) 37. 229.)

100 pts.  $\text{H}_2\text{O}$  dissolve 3.34 pts. at  $15.5^\circ$ . Easily sol. in hot  $\text{H}_2\text{O}$ ; insol. in alcohol. (Seubert and Eiten, Z. anorg 2. 434)

**Thallous vanadyl sulphite,  $2\text{Tl}_2\text{SO}_3$ ,**

$\text{V}_2\text{O}_5\text{SO}_3 + 4\text{H}_2\text{O}$ .

(Gain, A. ch 1908, (8) 14. 278.)

$\text{Tl}_2\text{SO}_3, 3\text{V}_2\text{O}_5\text{SO}_3 + 8\text{H}_2\text{O}$  (Gain)

**Thorium sulphite,  $\text{Th}(\text{SO}_3)_2 + \text{H}_2\text{O}$ .**

Precipitate. (Cleve.)

**Tin (stannous) sulphite,  $5\text{SnO}, 2\text{SO}_2 + x\text{H}_2\text{O}$ .**

Ppt. Partly sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Röhrig, J. pr (2) 37. 249)

$+ 20\text{H}_2\text{O}$ . (Röhrig.)

$8\text{SnO}, 2\text{SO}_2 + 20\text{H}_2\text{O}$

$11\text{SnO}, 2\text{SO}_2 + 20\text{H}_2\text{O}$ . (Röhrig)

**Uranous sulphite, basic,  $\text{U}(\text{OH})_2\text{SO}_3 + \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. Sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ , but is soon decomp. (Rammelsberg)

**Uranyl sulphite, basic,  $3\text{UO}_2(\text{OH})_2$ ,**

$5(\text{UO}_2)\text{SO}_3 + 10\text{H}_2\text{O}$ .

(Seubert and Eiten, Z. anorg. 1893, 4. 80)

**Uranyl sulphite,  $(\text{UO}_2)_2\text{SO}_3 + 4\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$  or alcoholic solution of  $\text{SO}_2$  (Röhrig, J. pr (2) 37. 240)

**Vanadyl sulphite,  $3\text{VO}_2, 2\text{SO}_3 + 4\frac{1}{2}\text{H}_2\text{O}$ .**

Decomp. slowly on standing

Sol. in  $\text{H}_2\text{O}$  without apparent decomp (Koppel, Z. anorg. 1903, 35. 183.)

$2\text{V}_2\text{O}_5, 3\text{SO}_2 + 10\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ ; aq. sol decomp. on boiling giving off  $\text{SO}_2$  and forming  $\text{V}_2\text{O}_5, 2\text{H}_2\text{O}$ . (Gain, C. R. 1906, 143. 824.)

**Vanadyl zinc sulphite,  $\text{ZnO}, 3\text{VO}_2, 2\text{SO}_3$** 

Decomp. slowly in the air.

Sol. in  $\text{H}_2\text{O}$  without decomp. (Koppel, Z. anorg. 1903, 35. 183)

**Ytterbium sulphite,  $\text{Yb}_2(\text{SO}_3)_3 + 9\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Cleve, Z. anorg. 1902, 32. 143.)

**Yttrium sulphite,  $\text{Y}_2(\text{SO}_3)_3 + 3\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Zinc sulphite, basic,  $2\text{ZnSO}_3, 3\text{Zn}(\text{OH})_2$ .**

(Seubert, Arch. Pharm. 229. 321.)

$\text{ZnSO}_3, \text{Zn}(\text{OH})_2 + \text{H}_2\text{O}$ . (Seubert.)

**Zinc sulphite,  $\text{ZnSO}_3 + 2$ , and  $2\frac{1}{2}\text{H}_2\text{O}$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . 100 pts  $\text{H}_2\text{O}$  dissolve 0.16 pt  $\text{ZnSO}_3 + 2\text{H}_2\text{O}$  (Henston and Tieb-borne, Brit. Med. J. 1890. 1063)

Easily sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ . (Koene.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Insol. in alcohol.

Decomp. into basic salt by boiling  $\text{H}_2\text{O}$ . (Seubert, Arch. Pharm. 229. 1)

**Zinc sulphite ammonia,  $\text{ZnSO}_3, \text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rammelsberg, Pogg. 67. 255.)

**Zirconium sulphite.**

Insol. in  $\text{H}_2\text{O}$ . Somewhat sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ , from which it is pptd. on boiling. Sol. in  $(\text{NH}_4)_2\text{SO}_3 + \text{Aq}$ , from which Zr hydroxide is pptd. on boiling. (Berzelius)

$\text{Zr}(\text{SO}_3)_2 + 7\text{H}_2\text{O}$  Ppt. (Venable, J. Am. Chem. Soc. 1895, 17. 449.)

**Sulphuryl bromide,  $\text{SO}_2\text{Br}_2$ .**

(Odling, Chem Soc. 7. 2.)

Does not exist. (Sestini, Bull. Soc. 10. 226, Melsens, C. R. 76. 92; Michaelis.)

**Sulphuryl chloride,  $\text{SO}_2\text{Cl}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  and alcohol

Decomp. by moist air, water, or abs. alcohol; more rapidly by alkalies,  $\text{HCl}$ ,  $\text{SO}_2$ , etc. (Schiff, A. 102. 111)

$+ \text{H}_2\text{O}$ . Only sl. sol. in  $\text{H}_2\text{O}$  at  $0^\circ$  with slow decomp. (Baeyer, B. 1901, 34. 737.)

$+ 15\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$  at  $0^\circ$  and stable therein for several hours. (Baeyer.)

**Disulphuryl chloride (Pyrosulphuryl chloride),  $\text{S}_2\text{O}_2\text{Cl}_2$ .**

Decomp. slowly with  $\text{H}_2\text{O}$ . (Rose, Pogg 44. 291)

Sol. in  $\text{CCl}_4$  and  $\text{CHCl}_3$ ; miscible with liquid  $\text{SO}_2$ .

**Sulphuryl hydroxyl chloride,**

$\text{SO}_2\text{HCl} = \frac{\text{HO}}{\text{Cl}}\text{SO}_2$ .

Decomp. on moist air, and violently with  $\text{H}_2\text{O}$ . Not miscible with  $\text{CS}_2$ . Decomp. with alcohol.

**Sulphuryl titanium chloride,  $\text{SO}_3, \text{TiCl}_4 = \text{TiCl}_4\text{OSO}_2\text{Cl}$ .**

Slowly deliquescent (Clausnitzer, B. 11. 2011.)

**Disulphuryl chloride stannic oxychloride,**  
 $5\text{S}_2\text{O}_5\text{Cl}_2, 4\text{SnOCl}_2$ .Sol. in a little  $\text{H}_2\text{O}$ , but decomp. by more  $\text{H}_2\text{O}$ . (Rose, Pogg. 44. 320.)**Sulphuryl fluoride,  $\text{SO}_2\text{F}_2$ .**1 pt. is sol. in 10 pts.  $\text{H}_2\text{O}$  at  $9^\circ$ . 3 vol. are sol. in 1 vol. alcohol at  $9^\circ$ ; insol. in conc.  $\text{H}_2\text{SO}_4$  at  $66^\circ$ ; sol. in aq. solution of  $\text{KOH}$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{Ba}(\text{OH})_2$ , and in alcoholic solution of alkalies. (Moissan, C. R. 1901, 132. 377.)**Sulphuryl hydroxyl fluoride,  $\text{HSO}_4\text{F}$ .**Violently decomp. by  $\text{H}_2\text{O}$ . (Thorpe and Kirwan, Z. anorg. 3. 63.)**Sulphuryl peroxide,  $\text{SO}_4$ .**

See Sulphur heptoxide.

**Sulphydric acid.**

See Hydrogen Sulphide.

**Sulphydroxyl.**

See Sulphhydroxyl.

**Tantalalic acid,  $\text{H}_4\text{Ta}_2\text{O}_7$  (?).**Sol. in  $\text{HF}$  (Rose), and  $\text{KH}_2(\text{C}_2\text{O}_4)_2 + \text{Aq}$  (Gahn, Schw. J. 16. 437). At the instant of precipitation is sol. in various acids. (Rose.)**Aluminum tantalate.**Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)**Ammonium hexatantalate,  $(\text{NH}_4)_3\text{H}_7\text{Ta}_2\text{O}_{13} + \text{H}_2\text{O}$ .**Somewhat sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 102. 57.)**Barium hexatantalate,  $\text{Ba}_4\text{Ta}_6\text{O}_{28} + 6\text{H}_2\text{O}$ .**Sl sol. in  $\text{H}_2\text{O}$ . (Rose.)**Cæsium tantalate,  $4\text{Cs}_2\text{O}, 3\text{Ta}_2\text{O}_5 + 14\text{H}_2\text{O}$ .**Completely sol. in a small amount of hot  $\text{H}_2\text{O}$  (E. F. Smith, J. Am. Chem. Soc. 1908, 30. 1866.) $7\text{Cs}_2\text{O}, 6\text{Ta}_2\text{O}_5 + 38\text{H}_2\text{O}$ . Pptd. from its aqueous solution by alcohol. (Smith.)**Ferrous tantalate,  $\text{Fe}(\text{TaO}_3)_2$ .**Min. *Tantalite*. $5\text{FeO}, 4\text{Ta}_2\text{O}_5$ . Min. *Tapolite*.**Magnesium hexatantalate,  $\text{Mg}_4\text{Ta}_6\text{O}_{28} + 9\text{H}_2\text{O}$ .**

Ppt. (Rose, Pogg. 102. 61.)

 $4\text{MgO}, \text{Ta}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 81. 266.)**Mercurous tantalate,  $5\text{Hg}_2\text{O}, 4\text{Ta}_2\text{O}_5 + 5\text{H}_2\text{O}$ .**Decomp. by warm  $\text{HNO}_3 + \text{Aq}$  (1.21 sp. gr.) with separation of  $\text{Ta}_2\text{O}_5$ . (Rose, Pogg. 102. 64.)**Potassium tantalate,  $\text{KTaO}_4$ .**Insol. in  $\text{H}_2\text{O}$  Sol. in  $\text{KOH} + \text{Aq}$ . (Marignac, A. ch. (4) 9. 249.)**Potassium hexatantalate,  $\text{K}_4\text{Ta}_6\text{O}_{28} + 16\text{H}_2\text{O}$ .**Sol. without decomp. in moderately warm  $\text{H}_2\text{O}$ . Decomp. by boiling (Marignac, A. ch. (4) 9. 259.)**Rubidium tantalate,  $4\text{Rb}_2\text{O}, 3\text{Ta}_2\text{O}_5 + 14\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (E. F. Smith, J. Am. Chem. Soc. 1908, 30. 1668.)**Silver tantalate,  $4\text{Ag}_2\text{O}, 3\text{Ta}_2\text{O}_5$ .**Completely sol. in  $\text{NH}_4\text{OH} + \text{Aq}$   $\text{HNO}_3 + \text{Aq}$  dissolves  $\text{Ag}_2\text{O}$ , and  $\text{Ta}_2\text{O}_5$  separates out. (Rose, Pogg. 102. 64.)**Sodium tantalate,  $\text{NaTaO}_4$ .**Insol. in  $\text{H}_2\text{O}$ . (Rose.)**Sodium hexatantalate,  $\text{Na}_4\text{Ta}_6\text{O}_{28} + 25\text{H}_2\text{O}$ .**1 pt. salt dissolves in 493 pts.  $\text{H}_2\text{O}$  at  $13.5^\circ$ , and in 162 pts. at  $100^\circ$ . Very slightly sol. in alcohol Insol. in alkaline solutions. (Rose.)**Pertantalalic acid.**

See Pertantallic acid.

**Tantalum,  $\text{Ta}$ .**Not attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , aqua regia, or hot conc.  $\text{H}_2\text{SO}_4$ . Easily sol. in a mixture of  $\text{HNO}_3$  and  $\text{HF}$  (Berzelius, Pogg. 4. 6, Rose). Also sol. in  $\text{HF}$  alone (Berzelius.)Not attacked by alkali hydrates +  $\text{Aq}$ .Insol. in single acids and in aqua regia. Oxidized by a mixture of  $\text{HF}$  and aqua regia. (Moissan, C. R. 1902, 134. 211.)Pure  $\text{Ta}$  is insol. in boiling  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ , aqua regia or mixtures of these acids; slowly sol. in  $\text{HF} + \text{Aq}$ . (v. Bolton, Zeit. Elektrochem. 1905, 11. 45.)**Tantalum bromide,  $\text{TaBr}_5$ .**Decomp. by  $\text{H}_2\text{O}$ . (Rose.)**Tantalum dichloride,  $\text{TaCl}_5 + 2\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$  when freshly prepared. (Charbié, C. R. 1907, 144. 805.)**Tantalum pentachloride,  $\text{TaCl}_5$ .**Takes up  $\text{H}_2\text{O}$  from the air without deliquescing. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_4$ . Sol. in cold  $\text{HCl} + \text{Aq}$  to a cloudy liquid, which gelatinises after a time. Not completely sol. in boiling  $\text{HCl} + \text{Aq}$ , and the solution does not gelatinise by the subsequent addition of water, but all goes into solution. Partly sol. in  $\text{KOH} + \text{Aq}$ . Insol. in  $\text{K}_2\text{SO}_4 + \text{Aq}$ . Sol. in absolute alcohol.

**Tantalum pentafluoride, TaF<sub>5</sub>.**

Very hygroscopic; sol in H<sub>2</sub>O. (Ruff, B. 1909, 42, 494.)

**Tantalum fluoride with MF.**

See Fluotantalate, M.

**Tantalum hydroxide, Ta<sub>2</sub>O<sub>5</sub>, xH<sub>2</sub>O.**

See Tantalic acid.

**Tantalum nitride, TaN.**

Not sol. in any acids, except a mixture of HF and HNO<sub>3</sub>. (Rose, Pogg. 100, 146.)  
Ta<sub>2</sub>N<sub>4</sub>. (Joly, Bull. Soc. (2) 25, 506.)

**Tantalum dioxide, Ta<sub>2</sub>O<sub>5</sub>(?).**

Sol. in HF with evolution of hydrogen. (Hermann, J. pr. (2) 5, 69.)

**Tantalum tetroxide, Ta<sub>2</sub>O<sub>4</sub>.**

Not attacked by any acid, not even a mixture of HNO<sub>3</sub> and HF. (Berzelius, Pogg. 4, 20.)

Decomp. by HCl. (Smith, Z. anorg. 1894, 7, 98.)

**Tantalum pentoxide, Ta<sub>2</sub>O<sub>5</sub>.**

Insol. in any acid, even boiling H<sub>2</sub>SO<sub>4</sub> or in HF. (Berzelius.)

Sol. in fused KHSO<sub>4</sub>, 10 pts. being necessary to dissolve 1 pt. Ta<sub>2</sub>O<sub>5</sub>.

**Tantalum silicide, TaSi<sub>2</sub>.**

Insol. in most inorganic acids. Sol. in HF and in HF+HNO<sub>3</sub>.

Decomp. by fused alkali hydroxides. (Höngschmid, M. 1907, 28, 1027.)

**Tantalum sulphide, Ta<sub>2</sub>S<sub>4</sub>.**

Not attacked by HCl+Aq. Oxidised by boiling with HNO<sub>3</sub>+Aq, more rapidly with aqua regia. Attacked by H<sub>2</sub>SO<sub>4</sub> on heating. Not completely sol. in HF or a mixture of HF and HNO<sub>3</sub>.

**Telluretted hydrogen, TeH<sub>2</sub>.**

See Hydrogen telluride.

**Telluric acid, H<sub>2</sub>TeO<sub>4</sub>.**

Insol. in H<sub>2</sub>O, cold conc. HCl, hot HNO<sub>3</sub>, or boiling KOH+Aq, but when heated with H<sub>2</sub>O is gradually converted into H<sub>2</sub>TeO<sub>4</sub>+2H<sub>2</sub>O and dissolved.

+2H<sub>2</sub>O. Very slowly sol. in cold H<sub>2</sub>O, but sol. in hot H<sub>2</sub>O in every proportion. Insol. in absolute alcohol; sol. in dil alcohol according to the amount of H<sub>2</sub>O present. Sol. in acids and alkalis. Insol. in alcohol or ether.

Insol. in alcohol; sol. in NaOH+Aq. (Mylius, B. 1901, 34, 2216.)

Stable in the air.

Sol. in H<sub>2</sub>O; pptd by HNO<sub>3</sub>. (Staudenmaier, Z. anorg. 1895, 10, 191.)

**Solubility in H<sub>2</sub>O**

Solid phase	Temp.	% H <sub>2</sub> TeO <sub>4</sub>	Mols H <sub>2</sub> O to 1 mol H <sub>2</sub> TeO <sub>4</sub>	Mols H <sub>2</sub> TeO <sub>4</sub> to 100 mole H <sub>2</sub> O
H <sub>2</sub> TeO <sub>4</sub> +6H <sub>2</sub> O	0°	13.92	66.2	1.51
"	5°	17.84	49.2	2.03
"	10°	26.21	30.2	3.31
"	15°	32.79	21.9	4.55
H <sub>2</sub> TeO <sub>4</sub> .2H <sub>2</sub> O	10°	25.29	31.7	3.15
"	18°	28.90	26.2	3.82
"	30°	33.36	21.4	4.67
"	40°	36.38	18.8	5.33
"	60°	43.67	14.2	7.04
"	80°	51.55	10.07	9.93
"	100°	60.84	6.89	14.52

(Mylius, B. 1901, 34, 2211.)

+6H<sub>2</sub>O. Obtained from solutions at 0°. (Staudenmaier, Z. anorg. 1895, 10, 191.)

**Allotelluric acid, H<sub>2</sub>TeO<sub>4</sub>.**

Miscible with H<sub>2</sub>O.

Sol. in alcohol, pptd. by NaOH+Aq but sol. in excess. (Mylius, B. 1901, 34, 2218.)

**Tellurates.**

Neutral alkali salts are sol. in H<sub>2</sub>O; the acid salts are only sl. sol. therein, but dissolve in HCl+Aq.

**Aluminum tellurate.**

Ppt. Sol. in excess of aluminum salts+Aq. (Berzelius.)

**Ammonium tellurate, (NH<sub>4</sub>)<sub>2</sub>TeO<sub>4</sub>.**

Slowly but completely sol. in H<sub>2</sub>O. Sl. sol. in NH<sub>4</sub>OH+Aq or NH<sub>4</sub>Cl+Aq. Sl. sol. in alcohol. (Berzelius.)

(NH<sub>4</sub>)<sub>2</sub>O, 2TeO<sub>3</sub>. Sl. sol. in H<sub>2</sub>O, but more sol. than the corresponding K salt.

(NH<sub>4</sub>)<sub>2</sub>O, 4TeO<sub>3</sub>. Very sl. sol. in H<sub>2</sub>O. Insol. in alcohol. (Berzelius.)

**Barium tellurate, BaTeO<sub>4</sub>+3H<sub>2</sub>O.**

Sl. sol. in cold, more in boiling H<sub>2</sub>O. Easily sol. in HNO<sub>3</sub>+Aq. (Berzelius.)

BaH<sub>2</sub>(TeO<sub>4</sub>)<sub>2</sub>+2H<sub>2</sub>O. More sol. in H<sub>2</sub>O than BaTeO<sub>4</sub>. Decomp. by H<sub>2</sub>O. (Berzelius.)

BaO, 4TeO<sub>3</sub>. More sol. in H<sub>2</sub>O than either BaTeO<sub>4</sub> or BaH<sub>2</sub>(TeO<sub>4</sub>)<sub>2</sub>. (Berzelius.)

**Bismuth tellurate, Bi<sub>2</sub>TeO<sub>6</sub>+2H<sub>2</sub>O.**

Mn. Montanite. Sol. in HCl+Aq with evolution of Cl.

**Cadmium tellurate, CdTeO<sub>4</sub>.**

Ppt. Sol. in HCl+Aq. (Oppenheim.)

**Cæsium hydrogen tellurate, CsHTeO<sub>4</sub>+½H<sub>2</sub>O.**

1 pt. is sol. in 30 pts. H<sub>2</sub>O. (Norris, Am. Ch. J. 1901, 26, 321.)

**Calcium tellurate,  $\text{CaTeO}_4$ .**Ppt. Sol. in hot  $\text{H}_2\text{O}$ . (Berzelius)**Chromic tellurate,  $\text{Cr}_2(\text{TeO}_4)_3$ .**

Ppt. Sol. in excess of Ca salts + Aq

**Cobaltous tellurate.**

Ppt. (Berzelius.)

**Cupric tellurate,  $\text{CuTeO}_4$ .**

Ppt. (Berzelius)

 $\text{CuO}$ ,  $2\text{TeO}_3$ . Ppt. (B.) $\text{Cu}_2\text{TeO}_6$ . Insol in  $\text{H}_2\text{O}$ .Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{NH}_4\text{OH}$ ,  $\text{KCN}$  and acetic acid (Hutchins, J. Am. Chem. Soc. 1905, 27, 1181)**Glucinum tellurate,  $\text{GtTeO}_4$ .**Insol. in  $\text{H}_2\text{O}$ .**Iron (ferrous) tellurate,  $\text{FeTeO}_4$ .**Ppt. Min. *Ferrotellurate***Iron (ferric) tellurate,  $\text{Fe}_2(\text{TeO}_4)_3$ .**

Ppt. Sol. in ferric salts + Aq. (Berzelius)

**Lead tellurate, basic.**Not completely insol. in  $\text{H}_2\text{O}$ **Lead tellurate,  $\text{PbTeO}_4$ .**Somewhat sol in  $\text{H}_2\text{O}$  $\text{PbO}$ ,  $2\text{TeO}_3$ . More sol. than  $\text{PbTeO}_4$ . $\text{PbO}$ ,  $4\text{TeO}_3$ . Sl sol in  $\text{H}_2\text{O}$ . Sol in  $\text{HNO}_3$  + Aq, less sol in  $\text{HCl}$  + Aq. (Berzelius.)**Lithium tellurate,  $\text{Li}_4\text{TeO}_6 + x\text{H}_2\text{O}$ .**Sl sol in  $\text{H}_2\text{O}$  with decomp. (Mylius, B. 1901, 34, 2209.)**Magnesium tellurate,  $\text{MgTeO}_4$ .**Ppt. More sol. in  $\text{H}_2\text{O}$  than the Ba, Sr or Ca salts. $\text{MgTeO}_4$ . More sol. in  $\text{H}_2\text{O}$  than  $\text{MgTeO}_4$ .**Manganous tellurate.**

Ppt

**Mercurous tellurate, basic,  $3\text{Hg}_2\text{O}$ ,  $2\text{TeO}_3$ .**

Ppt (Hutchins, J. Am. Chem. Soc. 1905, 27, 1178)

**Mercurous tellurate,  $\text{Hg}_2\text{TeO}_4$ .**Ppt. Min. *Magnolite***Mercuric tellurate,  $\text{HgTeO}_4$ .**Ppt. Very easily decomp. by  $\text{H}_2\text{O}$  (Hutchins, J. Am. Chem. Soc. 1905, 27, 1179.) $+2\text{H}_2\text{O}$ . Slowly decomp by cold  $\text{H}_2\text{O}$ .Rapidly decomp by boiling  $\text{H}_2\text{O}$ . (Hutchins.) $\text{Hg}_2\text{TeO}_6$ . Insol. in  $\text{H}_2\text{O}$  Unchanged by boiling with  $\text{H}_2\text{O}$ Sol in  $\text{HNO}_3$ , but more readily sol in  $\text{HCl}$ . (Hutchins)**Mercuric tellurate.**

Ppt (Berzelius.)

**Mercurous hydrogen tellurate,  $\text{HgHTeO}_4 + 3\text{H}_2\text{O}$ .**Stable in the air if protected from the light  
Insol in  $\text{H}_2\text{O}$ . Decomp by boiling  $\text{H}_2\text{O}$  or by an excess of cold conc.  $\text{HNO}_3$  + Aq  
Sol in dil.  $\text{HNO}_3$  or dil. acetic acid (Hutchins, J. Am. Chem. Soc. 1905, 27, 1177.)**Nickel tellurate.**

Ppt.

**Potassium tellurate,  $\text{K}_2\text{TeO}_4 + 5\text{H}_2\text{O}$ .**Deliquesces. Sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$  containing  $\text{KOH}$ .100 g.  $\text{H}_2\text{O}$  dissolve at:

0°	20°	30°
8.82	27.53	50.42 g. $\text{K}_2\text{TeO}_4$ .

(Rosenheim and Weinheber, Z. anorg. 1911, 69, 264.)

Insol in alcohol. (Berzelius.)

 $\text{K}_2\text{O}$ ,  $2\text{TeO}_3$ . Insol in  $\text{H}_2\text{O}$ , acids, or alkalies. (B.) $\text{KHTeO}_4 + \frac{1}{2}\text{H}_2\text{O}$ . Sl sol. in cold, more sol in hot  $\text{H}_2\text{O}$  (Berzelius) $\text{K}_2\text{O}$ ,  $3\text{TeO}_3 + 5\text{H}_2\text{O}$ . Much more sol in hot than in cold  $\text{H}_2\text{O}$  (Hutchins, J. Am. Chem. Soc. 1905, 27, 1174.) $\text{K}_2\text{O}$ ,  $4\text{TeO}_3$ . Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$  or  $\text{HNO}_3$  + Aq. Sol by long heating with conc.  $\text{HNO}_3$  + Aq $\text{KHTeO}_4$ ,  $\text{H}_2\text{TeO}_4 + \frac{1}{2}\text{H}_2\text{O}$ . Sl sol in  $\text{H}_2\text{O}$ **Rubidium tellurate,  $\text{Rb}_2\text{TeO}_4 + 3\text{H}_2\text{O}$ .**Sol in about 10 pts.  $\text{H}_2\text{O}$  (Norris, Am. Ch. J. 1901, 26, 322.)**Rubidium hydrogen tellurate,  $\text{RbHTeO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .**Sol. in about 20 pts. cold  $\text{H}_2\text{O}$ . Sl. more sol in hot  $\text{H}_2\text{O}$ . (Norris, Am. Ch. J. 1901, 26, 320.)**Silver tellurate,  $3\text{Ag}_2\text{O}$ ,  $\text{TeO}_3$ .**Sol. in  $\text{NH}_4\text{OH}$  + Aq. $3\text{Ag}_2\text{O}$ ,  $2\text{TeO}_3$ . Insol. in boiling  $\text{H}_2\text{O}$ .  $+3\text{H}_2\text{O}$ . Ppt. Unchanged by cold  $\text{H}_2\text{O}$ .Gradually decomp. by boiling  $\text{H}_2\text{O}$ . (Hutchins, J. Am. Chem. Soc. 1905, 27, 1189) $\text{Ag}_2\text{TeO}_4$ . Decomp. by  $\text{H}_2\text{O}$  into  $3\text{Ag}_2\text{O}$ ,  $\text{TeO}_3$ . Sol. in  $\text{NH}_4\text{OH}$  + Aq. $+2\text{H}_2\text{O}$ . Insol. in hot and cold  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$ ,  $\text{KCN}$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ and  $\text{HCl}$  + Aq. Decomp. by conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  or acetic acid. (Hutchins, J. Am. Chem. Soc. 1905, 27, 1165.)

$\text{Ag}_2\text{TeO}_7$ . Ppt.  
 $\text{Ag}_2\text{O}$ ,  $4\text{TeO}_3$ . Ppt.  
 Could not be obtained. (Hutchins, J  
 Am Chem. Soc 1905, 27. 1168)

#### Sodium tellurate, $\text{Na}_2\text{TeO}_4 \cdot 2\text{H}_2\text{O}$ .

Very sl. sol. in hot or cold  $\text{H}_2\text{O}$ . When heated to drive off  $2\text{H}_2\text{O}$  becomes insol. in  $\text{H}_2\text{O}$ , but sol. in dil.  $\text{HNO}_3 + \text{Aq}$  (Berzelius.)  
 1 pt. is sol. in about 130 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ ;  
 50 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ .

$+4\text{H}_2\text{O}$ . 1 pt. is sol. in about 70 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ ; 40 pts.  $\text{H}_2\text{O}$  at  $50^\circ$ . (Mylus, B. 1901, 34. 2209.)

$\text{Na}_2\text{TeO}_4 + 4\text{H}_2\text{O} = \text{NaHTeO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .  
 Slowly but completely sol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  Insol. in alcohol (Berzelius.)

$\text{Na}_2\text{O}$ ,  $4\text{TeO}_3$ . Insol. in  $\text{H}_2\text{O}$ , acids, or alkalies, except by long boiling with  $\text{HNO}_3 + \text{Aq}$ .

$+x\text{H}_2\text{O}$  (a) Slowly sol. in  $\text{H}_2\text{O}$ . ( $\beta$ ) Insol. even in boiling  $\text{H}_2\text{O}$

$\text{Na}_4\text{TeO}_6 + 8\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  but with decomp (Mylus)

#### Strontium tellurates.

Resemble Ca salts.

#### Thallous tellurate, $\text{Te}_2\text{TeO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$  (Dennis, J Am Chem Soc 1898, 18. 975.)

#### Thorium tellurate.

Ppt. Insol. in excess of thorium salts  $+ \text{Aq}$

#### Uranium tellurate, $\text{U}_3(\text{TeO}_4)_2(?)$ .

Ppt Insol. in  $\text{H}_2\text{O}$  or  $\text{UO}_2(\text{NO}_3)_2 + \text{Aq}$ .

#### Yttrium tellurate.

Ppt Insol. in  $\text{H}_2\text{O}$  or Yt salts  $+ \text{Aq}$

#### Zinc tellurate, $\text{Zn}_3\text{TeO}_4$ .

Insol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and acetic acid. (Hutchins, J Am Chem Soc 1905, 27. 1181)

#### Zirconium tellurate.

Ppt (Berzelius.)

#### Tellurium, Te

Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$  Sl. sol in hot conc.  $\text{H}_2\text{SO}_4$ , but separates out on cooling. Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ . Easily oxidised by  $\text{HNO}_3$  or aqua regia. Sol. in boiling very conc.  $\text{KOH} + \text{Aq}$ , separating out again on cooling.

Not attacked by boiling conc.  $\text{HNO}_3 + \text{Aq}$ , according to Hartung-Schwartzkoff (Ann. Min. (4) 19. 345).

Sol. in warm conc.  $\text{KCN} + \text{Aq}$

Insol. in liq.  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

100 pts. methylene iodide dissolve 0.1 pt. Te at  $12^\circ$  (Retgers, Z anorg. 3. 343.)

$\frac{1}{2}$  com oleic acid dissolves 0.0014 g. Te in 6 days (Gates, J. phys. Ch. 1911, 15. 143)

A colloidal solution of Te in  $\text{H}_2\text{O}$  can be obtained. It exists in two modifications, a brown and a blue-gray. Both can be diluted with  $\text{H}_2\text{O}$  or concentrated by boiling without decomp. They are, however, decomp. by electrolytes, especially  $\text{NH}_4\text{Cl}$ . (Gutbier, Z. anorg. 1902, 32. 53.)

#### Tellurium dibromide, $\text{TeBr}_2$ .

Decomp on air or by  $\text{H}_2\text{O}$  (Rose, Pogg. 21. 443)

Conc tartaric acid dissolves partly without decomp. (Brauner, M 1891, 12. 34)

#### Tellurium tetrabromide, $\text{TeBr}_4$ .

Sol in a little, but decomp by much  $\text{H}_2\text{O}$ . Completely sol. in tartaric acid  $+ \text{Aq}$  (1.1). (Brauner, M. 1891, 12. 34.)

#### Tellurium hydrogen bromide, $\text{TeBr}_4$ , $\text{HBr} + 5\text{H}_2\text{O}$ .

Fumes in the air. Deliquescent. Stable in an atmos. of  $\text{HBr}$  (Metzner, C. R. 1897, 124. 1951.)

#### Tellurium dichloride, $\text{TeCl}_2$

Decomp on air, or by  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ . (Rose, Pogg. 21. 443)

#### Tellurium tetrachloride, $\text{TeCl}_4$ .

Extremely deliquescent. Decomp. by cold  $\text{H}_2\text{O}$ , with separation of oxychloride and tellurous acid. Sol. in hot  $\text{H}_2\text{O}$  with decomp. Sol. in dil.  $\text{HCl} + \text{Aq}$  without decomp. (Rose, Pogg. 21. 443)

Insol. in sulphur chloride and in  $\text{CS}_2$ . (Lenhei, J. Am. Chem. Soc 1902, 24. 188.)

#### Tellurium hydrogen chloride, $\text{TeCl}_4$ , $\text{HCl} + 5\text{H}_2\text{O}$ .

Easily decomp. (Metzner, C. R. 1897, 125. 24.)

#### Tellurium chloride with $\text{MCl}$ .

See Chlorotellurate, M.

#### Tellurium tetrachloride ammonia,

$\text{TeCl}_4 \cdot 3\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Metzner, C. R. 1897, 124. 33.)

$\text{TeCl}_4 \cdot 4\text{NH}_3$ . Not deliquescent. Decomp by  $\text{H}_2\text{O}$ . (Espenschied, J. pr. 80. 480.)

#### Tellurium tetrachloride sulphur trioxide,

$\text{TeCl}_4 \cdot \text{SO}_3$ .

Ppt. ((Prandtl, Z. anorg. 1909, 62. 247.)  
 $\text{TeCl}_4 \cdot 2\text{SO}_3$ . Decomp by moisture. Or heating at  $120^\circ$ , it gives  $\text{TeCl}_4 \cdot \text{SO}_3$ . (Prandtl

- Tellurium tetrafluoride,  $\text{TeF}_4$ .**  
(Metzner, C. R. 1897, 125. 25.)  
+  $\text{H}_2\text{O}$  (Hägbom, Bull. Soc. (2) 35. 60.)
- Tellurium hexafluoride,  $\text{TeF}_6$ .**  
Decomp. by  $\text{H}_2\text{O}$  slowly but completely.  
(Prideaux, Chem. Soc. 1908, 39. 322.)
- Tellurium zirconium fluoride,**  
See Fluozirconate, tellurium.
- Tellurium dioxide,  $\text{TeO}_2$ .**  
Insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 21. 443.)
- Tellurium tetraiodide,  $\text{TeI}_4$ .**  
Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$  or alcohol. Sol. in  $\text{HI}$ , but only sol. in  $\text{MI} + \text{Aq}$ . (Berzelius.)  
Data on solubility of  $\text{TeI}_4$  in  $\text{HI} + \text{I} + \text{Aq}$  are given by Menke (Z. anorg. 1912, 77. 283.)
- Tellurium hydrogen iodide,  $\text{TeI}_4$ ,  $\text{HI} + 8\text{H}_2\text{O}$ , and  $+9\text{H}_2\text{O}$ .**  
Deliquescent. (Metzner, A. ch. 1898, (7) 15. 203.)
- Tellurium nitride,**  
Two forms.  
a. Stable at ord. temp.  
b. Unstable at ord. temp.  
(Frantz Fischer, B. 1910, 43. 1472.)  
 $\text{TeN}$ . Not attacked by  $\text{H}_2\text{O}$  or dil. acetic acid.  
Insol. in liquid  $\text{NH}_3$ . Decomp. by  $\text{KOH} + \text{Aq}$ . (Metzner, A. ch. 1898, (7) 15. 203.)
- Tellurium monoxide,  $\text{TeO}$ .**  
Sl. sol. in cold dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily oxidised by  $\text{HNO}_3 + \text{Aq}$  or aqua regia. Decomp. immediately by boiling conc.  $\text{HCl} + \text{Aq}$ . Slowly decomp. by  $\text{KOH} + \text{Aq}$  (Divers and Shimosé, Chem. Soc. 35. 563.)
- Tellurium dioxide,  $\text{TeO}_2$ .**  
Very sl. sol. in  $\text{H}_2\text{O}$ . Sl. attacked by acids. Sl. sol. in  $\text{NH}_4\text{OH}$  or alkali carbonates  $+ \text{Aq}$ . Easily sol. in  $\text{NaOH}$  or  $\text{KOH} + \text{Aq}$ . Not sol. in less than 150,000 pts.  $\text{H}_2\text{O}$ . Easily sol. in warm dil.  $\text{HNO}_3 + \text{Aq}$ . Sol. in warm  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Klein and Morel, Bull. Soc. (2) 43. 203.)  
20%  $\text{H}_2\text{SO}_4 + \text{Aq}$ . dissolves on warming about 0.7%; 30%  $\text{H}_2\text{SO}_4 + \text{Aq}$ . about 0.86%; 50%  $\text{H}_2\text{SO}_4 + \text{Aq}$ . about 4.4%.  
These solutions are supersat. and  $\text{TeO}_2$  separates from the more dil. acids on standing. (Brauner, M. 1891, 12. 34.)  
Min. Tellurite.
- Tellurium dioxide hydrobromic acid,  $\text{TeO}_2$ ,  $3\text{HBr}$ .**  
(Ditte, C. R. 83. 336.)
- Tellurium dioxide hydrochloric acid,  $\text{TeO}_2$ ,  $2\text{HCl}$ .**  
(Ditte, C. R. 83. 336.)  
 $\text{TeO}_2$ ,  $3\text{HCl}$  (Ditte.)
- Tellurium trioxide,  $\text{TeO}_3$ .**  
Insol. in cold or hot  $\text{H}_2\text{O}$ , cold  $\text{HCl} + \text{Aq}$ , or cold or hot  $\text{HNO}_3 + \text{Aq}$ . Insol. in moderately conc.  $\text{KOH} + \text{Aq}$ , but, when the  $\text{KOH} + \text{Aq}$  is very conc., is sol. if boiling.
- Tellurium oxide,  $2\text{TeO}_2$ ,  $\text{TeO}_3$ .**  
"Tellurium tellurate."  
(Metzner, A. ch. 1898, (7) 15. 203.)
- Tellurium oxybromide.**  
Insol. in  $\text{H}_2\text{O}$ . (Ditte, A. ch. (5) 10. 82.)
- Tellurium oxybromide sulphur trioxide,  $\text{TeOBr}_2$ ,  $2\text{SO}_3$ .**  
Deliquescent. (Prandtl, Z. anorg. 1909, 62. 247.)
- Tellurium oxychloride,  $\text{TeOCl}_2$ .**  
Insol. in  $\text{H}_2\text{O}$ . (Ditte.)
- Tellurium oxyfluoride,  $\text{TeF}_4$ ,  $\text{TeO}_2 + 2\text{H}_2\text{O}$ .**  
Sol. in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$ .  
 $2\text{TeF}_4$ ,  $3\text{TeO}_2 + 6\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Metzner, C. R. 1897, 125. 25.)
- Tellurium sulphide,  $\text{TeS}$ .**  
Insol. in  $\text{CS}_2$ ; very unstable. (Snelling, J. Am. Chem. Soc. 1912, 34. 802.)
- Tellurium disulphide,  $\text{TeS}_2$ .**  
Insol. in  $\text{H}_2\text{O}$  or dil. acids. Sol. in alkali hydrates or sulphides  $+ \text{Aq}$ .  
 $\text{CS}_2$  dissolves out  $\text{S}$ , so that the substance is probably a mixture. (Becker, A. 180. 257.)
- Tellurium trisulphide,  $\text{TeS}_3$ .**  
Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{K}_2\text{S} + \text{Aq}$ .
- Tellurium sulphoxide,  $\text{TeSO}_3$ .**  
Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_4$ . (Weber, J. pr. (2) 25. 218.)  
Is tellurium sulphite. (Divers, Chem. Soc. 49. 583.)
- Tellurous acid,  $\text{H}_2\text{TeO}_3$ .**  
Appreciably sol. in  $\text{H}_2\text{O}$  and acids. Sol. in alkali hydrates or carbonates  $+ \text{Aq}$ .
- Tellurites.**  
The neutral and acid tellurites of the alkali metals are sol. in  $\text{H}_2\text{O}$ . Ba, Sr, Ca, and Mg tellurites are sl. sol., and the other salts insol. in  $\text{H}_2\text{O}$ . Most tellurites are sol. in  $\text{HCl} + \text{Aq}$ .

**Aluminum tellurite.**

Ppt. Insol. in Al salts + Aq. (Berzelius)

**Ammonium tellurite,  $(\text{NH}_4)\text{HTeO}_3$ ,  $\text{H}_3\text{TeO}_3$  +  $3\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by  $\text{NH}_4\text{Cl}$  + Aq or alcohol (Berzelius)

**Barium tellurite,  $\text{BaTeO}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$  when prepared in the moist way. (Berzelius.)

$\text{BaO}$ ,  $4\text{TeO}_3$

**Cadmium tellurite.**

Ppt. Sol. in  $\text{HNO}_3$ , and  $\text{HCl}$  + Aq. (Oppenheim)

**Calcium tellurite,  $\text{CaTeO}_3$ .**

Sl. sol. in cold, more sol. in hot  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{CaO}$ ,  $4\text{TeO}_3$

**Chromium tellurite.**

Ppt. Sol. in excess of chromic salts + Aq.

**Cobaltous tellurite.**

Ppt.

**Cupric tellurite.**

Insol. in  $\text{H}_2\text{O}$  (Berzelius.)

**Glucinum tellurite.**

Insol. in  $\text{H}_2\text{O}$ .

**Indium tellurite,  $\text{In}_2(\text{TeO}_3)_2$ ,  $2\text{In}(\text{OH})_3$ .**

Ppt. (Renz, Dissert. 1902.)

**Ferrous tellurite.**

Ppt.

**Ferric tellurite.**

Ppt.

**Lead tellurite,  $\text{PbTeO}_3$ .**

Ppt. Easily sol. in acids. (Berzelius)

**Lithium tellurite,  $\text{Li}_2\text{TeO}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{Li}_2\text{O}$ ,  $2\text{TeO}_3$ . Decomp. by cold  $\text{H}_2\text{O}$  into  $\text{Li}_2\text{TeO}_4$  and  $\text{Li}_2\text{O}$ ,  $4\text{TeO}_3$ . (B.)

$\text{Li}_2\text{O}$ ,  $4\text{TeO}_3$ . Sol. in hot, much less in cold  $\text{H}_2\text{O}$  (B.)

**Magnesium tellurite,  $\text{MgTeO}_3$ .**

Precipitate. Much more sol. in  $\text{H}_2\text{O}$  than the Ba, Sr, or Ca salt (Berzelius)

**Manganous tellurite.**

Ppt.

**Mercurous tellurite.**

Ppt.

**Mercuric tellurite.**

Ppt

**Nickel tellurite.**

Ppt.

**Potassium tellurite,  $\text{K}_2\text{TeO}_3$ .**

Not deliquescent. Slowly sol. in cold, more quickly in boiling  $\text{H}_2\text{O}$ . (Berzelius.)  $\text{K}_2\text{O}$ ,  $2\text{TeO}_3$ . Completely sol. in boiling  $\text{H}_2\text{O}$ , from which  $\text{K}_2\text{O}$ ,  $4\text{TeO}_3$  crystallises. (B.)  $\text{K}_2\text{O}$ ,  $4\text{TeO}_3$  +  $4\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$  into  $\text{K}_2\text{O}$ ,  $\text{TeO}_3$ , and  $\text{K}_2\text{O}$ ,  $2\text{TeO}_3$ , which dissolve, and  $\text{H}_2\text{TeO}_3$ , which is insol. (B.)

**Potassium hexatellurite,  $\text{K}_2\text{O}$ ,  $6\text{TeO}_3$  +  $2\text{H}_2\text{O}$ .**

Not decomp. by, but sl. sol. in  $\text{H}_2\text{O}$ . (Klein and Morel, C. R. 100, 1140.)

**Silver tellurite,  $\text{Ag}_2\text{TeO}_3$ .**

Ppt. Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Berzelius) The freshly pptd. salt is insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , acetic and tartaric acid; decomp. by  $\text{HCl}$ . (Lenher, J. Am. Chem. Soc. 1913, 35, 727.)

$\text{AgHTeO}_3$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  + Aq. (Rose, Pogg. 18, 60)

**Sodium tellurite,  $\text{Na}_2\text{TeO}_3$ .**

Slowly sol. in cold, more quickly in hot  $\text{H}_2\text{O}$ . Precipitated from aqueous solution by alcohol. (Berzelius)  $\text{Na}_2\text{O}$ ,  $2\text{TeO}_3$ . Decomp. by  $\text{H}_2\text{O}$  as K salt (B.)

$\text{Na}_2\text{O}$ ,  $4\text{TeO}_3$  +  $5\text{H}_2\text{O}$ . As above. (B.)

**Strontium tellurite,  $\text{SrTeO}_3$ .**

Resembles Ba salt.

$\text{SrH}_2\text{TeO}_6$ . Very sl. sol. in  $\text{H}_2\text{O}$ , more easily in  $\text{HNO}_3$  + Aq.

**Thorium tellurite.**

Precipitate. Insol. in  $\text{H}_2\text{O}$  or Th salts + Aq

**Stannous tellurite.**

Pptd. in presence of 60,000 pts  $\text{H}_2\text{O}$ . (Fischer.)

**Uranium tellurite,  $\text{U}_3(\text{TeO}_3)_8$ .**

Ppt. Insol. in U salts + Aq

**Yttrium tellurite.**

Precipitate.

**Zinc tellurite,  $\text{ZnTeO}_3$ .**

Ppt.

**Zirconium tellurite.**

Ppt.

**Terbium, Tb.**

Metal has not been isolated.

Has been decomp. into two or more elements by Krüss (Z. anorg. 4, 27)

**Terbium chloride,  $TbCl_3 \cdot 6H_2O$ .**

Sol. in  $H_2O$ , very hygroscopic; sol. in alcohol. (Urban, C. R. 1903, 146. 128)

**Terbium hydroxide.**

Sol. in dilute acids. Decomposes  $NH_4$  salts + Aq.

**Terbium oxide,  $Tb_2O_3$ .**

Sol. in dil. acids, even after ignition

**Terbium peroxide,  $Tb_2O_5$ .**

Sol. in  $HNO_3$  and in hot  $HCl$  (Urban, C. R. 1907, 146. 127)

**Tetramine chromium compounds.**

See—

Bromotetramine chromium compounds.

Chlorotetramine chromium compounds.

Iodotetramine chromium compounds.

**Tetramine cobaltic compounds,**

$Co(NH_4)_4X_6$ .

See—

Bromotetramine cobaltic compounds.

Carbonatotetramine cobaltic compounds.

Chlorotetramine cobaltic compounds.

Croceocobaltic compounds.

Fuscocobaltic compounds.

Flavocobaltic compounds.

Iodotetramine cobaltic compounds.

Nitratotetramine cobaltic compounds.

Praseocobaltic compounds.

Roseotetramine cobaltic compounds.

Sulphatotetramine cobaltic compounds.

See also under octamine cobaltic salts for many tetramine salts as yet unclassified.

**Tetramine cobaltic nitrite with  $MNO_2$ ,**

$Co_2(NH_4)_4(NO_2)_4, 2MNO_2$

See Diamine cobaltic nitrite.

**Tetrathionic acid,  $H_2S_4O_6$ .**

Known only in aqueous solution

Dil. solution can be boiled without decomp.

Conc. solution decomp. by boiling

Addition of  $H_2SO_4$  or  $HCl$  makes solution more stable. (Fordos and Gélis, C. R. 15. 920.)

**Tetrathionates.**

Tetrathionates are all easily sol. in  $H_2O$ , but insol. in alcohol

**Barium tetrathionate,  $BaS_4O_6 \cdot 2H_2O$ .**

Very sol. in  $H_2O$ , but precipitated by addition of alcohol

**Cadmium tetrathionate.**

Deliquescent. Solution in  $H_2O$  gradually decomposes. (Kessler, Pogg. 74. 249.)

**Cæsium tetrathionate,  $Cs_2S_4O_6$ .**

(J. Meyer, B. 1907, 40. 1361.)

**Cuprous tetrathionate,  $Cu_2S_4O_6$ .**

Decomp. by  $H_2O$  (Chancel and Diacon, C. R. 1863, 56. 711.)

**Cupric tetrathionate,  $CuS_4O_6$ .**

Sol. in  $H_2O$

Decomp. by long boiling. (Curtius and Henkel, J. pr. 1888, (2) 37. 148.)

**Lead tetrathionate,  $PbS_4O_6 \cdot 2H_2O$ .**

Sol. in  $H_2O$

**Manganous hydrogen tetrathionate,**

$MnH_2(S_4O_6)_2$ .

Deliquescent. Very sol. in  $H_2O$  and alcohol (Curtius and Henkel, J. pr. (2) 37. 148)

**Nickel tetrathionate ammonia,  $NiS_4O_6, 6NH_3$ .**

Ppt. Decomp. by  $H_2O$ . Insol. in alcohol. (Ephraim, B. 1913, 46. 3109.)

**Potassium tetrathionate,  $K_2S_4O_6$ .**

Soluble in  $H_2O$ . Insol. in alcohol.

Difficultly sol. in  $H_2O$  (Kessler, Pogg. 1847, 74. 254)

**Rubidium tetrathionate,  $Rb_2S_4O_6$ .**

Not hygroscopic (J. Meyer, B. 1907, 40. 1356.)

**Sodium tetrathionate,  $Na_2S_4O_6$ .**

Sol. in  $H_2O$ . Precipitated therefrom by a great excess of alcohol. (Kessler, J. pr. 95. 13.)

+  $2H_2O$ . (Berthelot, A. ch. (6) 17. 450.)

**Strontium tetrathionate,  $SrS_4O_6 \cdot 6H_2O$ .**

Sol. in  $H_2O$ . (Kessler, Pogg. 74. 255.)

More sol. in  $H_2O$  than Ba salt.

**Zinc tetrathionate.**

Sol. in  $H_2O$ . (Fordos and Gélis.)

**Zinc hydrogen tetrathionate,  $ZnH_2(S_4O_6)_2$ .**

Extremely sol. in  $H_2O$  and alcohol. (Curtius and Henkel, J. pr. (2) 37. 147)

**Zinc tetrathionate ammonia,  $ZnS_4O_6, 3NH_3$ .**

Ppt. (Ephraim, B. 1915, 48. 641.)

**Thallic acid.****Potassium thallate.**

Known only in aqueous solution. (Carstanjen, J. pr. 101. 55.)

Does not exist. (Lepsius, Chem. Ztg. 1890, 1327)

**Thallium, Tl.**

Not attacked by pure  $H_2O$ . Easily sol. in dil.  $H_2SO_4$  or  $HNO_3$  + Aq. Difficultly sol. in  $HCl$  + Aq. Absolute alcohol dissolves considerable quantity in a short time, also methyl alcohol, and acetic ether (Böttger).  
Not easily attacked by  $HF$  + Aq (Kuhlmann.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20, 830.)

$\frac{1}{2}$  ccm oleic acid dissolves 0.0424 g. Tl in 6 days (Gates, J. phys. Chem. 1911, 15, 143.)

**Thallium arsenide,  $TlAs$ .**

Decomp. by  $H_2SO_4$ . (Carstanjen.)

**Thallous azoimide,  $TlN_3$ .**

Sl. sol. in  $H_2O$ .

0.1712 pt. is sol. in 100 pts.  $H_2O$  at  $0^\circ$ , 0.1965 pt. is sol. in 100 pts.  $H_2O$  at  $5^\circ$ ;

0.3 pt. is sol. in 100 pts.  $H_2O$  at  $16^\circ$ .

Insol. in abs. alcohol and ether.

(Curtius, J. pr. 1898, (2) 53, 284.)

**Thallothallic azoimide,  $TlN_3$ ,  $TlN_3$ .**

Explosive. Decomp. by hot  $H_2O$  and by acids (Dennis, J. Am. Chem. Soc. 1896, 18, 973.)

**Thallous bromide,  $TlBr$ .**

Nearly insol. in cold, sl. sol. in boiling  $H_2O$ . (Willm, Bull. Soc. (2) 2, 89.)

1 l.  $H_2O$  dissolves 0.00869 g. mol.  $TlBr$  at  $68.5^\circ$ . (Noyes, Z. phys. Ch. 6, 248.)

Sl. sol. in  $H_2O$ .  $0.45 \times 10^{-3}$  g. is dissolved in a liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46, 603.)

1 l.  $H_2O$  dissolves 420 mg.  $TlBr$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50, 356.)

238 mg.  $TlBr$  are contained in 1 l. sat. solution at  $0.13^\circ$ ; 289 mg. at  $8.37^\circ$ ; 423 mg. at  $18^\circ$ ; 579 mg. at  $25.68^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64, 169.)

Solubility of  $TlBr$  in  $Tl(NO_3)$  + Aq at  $68.5^\circ$ .

g. mole per l.		g. mole per l.	
$TlNO_3$	$TlBr$	$TlNO_3$	$TlBr$
0	0.00869	0	2.469
0.0163	0.00410	4.336	1.164
0.0294	0.00289	7.820	0.821
0.0955	0.00148	25.400	0.420

(Noyes, Z. phys. Ch. 1890, 6, 248.)

Insol. in acetone (Naumann, B. 1904, 37, 4329); pyridine (Naumann, B. 1904, 37, 4610); acetone (Eidmann, C. C. 1899, II, 1014).

**Thallic bromide,  $TlBr_3$ .**

Deliquescent. Easily sol. in  $H_2O$  and alcohol. (Willm.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790.)

+  $H_2O$ . Very unstable. Sol. in  $H_2O$ ,

alcohol and ether (Meyer, Z. anorg. 1900, 24, 353.)

+  $4H_2O$ . Very sol. in  $H_2O$ . (Thomas, C. R. 1902, 134, 546.)

**Thallothallic bromide,  $TlBr$ ,  $TlBr_3$ .**

Decomp. by  $H_2O$ . (Meyer, Z. anorg. 1900, 24, 354.)

$3TlBr$ ,  $TlBr_3$ . Decomp. by  $H_2O$  into  $TlBr$  and  $TlBr_3$ .

**Thallic hydrogen bromide,  $TlBr_3$ ,  $HBr$ .**

Very sol. in  $H_2O$ . (Thomas, C. R. 1902, 134, 546.)

**Thallic bromide ammonia,  $TlBr_3$ ,  $3NH_3$ .**

Decomp. by  $H_2O$ .

**Thallium bromochloride,  $TlClBr$ .**

Decomp. by  $H_2O$  (Thomas, C. R. 1901, 132, 1489.)

$TlClBr_3$  +  $4H_2O$ . Ppt.

$TlCl_2Br$  +  $4H_2O$ . Ppt. Decomp. by  $H_2O$  (Thomas, C. R. 1902, 134, 546.)

$Tl_2Cl_2Br_4$ . Decomp. by  $H_2O$ ,  $H_2SO_4$  or  $HNO_3$ . (Thomas, C. R. 1900, 131, 894; C. R. 1901, 132, 1489.)

$Tl_4Cl_2Br_8$ . Sol. in  $H_2O$ . (Thomas, C. R. 1901, 132, 82.)

$TlClBr_3$ ,  $3TlCl$ . Cryst. from  $H_2O$  containing  $HNO_3$ . (Cushmann, Am. Ch. J. 1900, 24, 222.)

$TlCl$ ,  $3TlBr$ . Sol. in  $H_2O$  without decomp. (Cushmann.)

$TlBr_3$ ,  $3TlCl$ . Decomp. by  $H_2O$ . (Cushmann.)

$TlBr_3$ ,  $TlCl$ . Sol. in  $H_2O$  with decomp. (Cushmann.)

$TlCl_2$ ,  $2TlBr$ ,  $TlCl$ . Sol. in  $H_2O$ . (Meyer, Z. anorg. 1900, 24, 355-360.)

$TlBr_3$ ,  $2TlCl$ ,  $TlBr$ . Ppt. Decomp. by  $H_2O$  (Meyer.)

$(TlCl_2, TlCl)$ ,  $2(TlBr_3, TlBr)$ . Ppt. (Meyer.)

$2(TlCl_2, TlCl)$ ,  $(TlBr_3, TlBr)$ . Ppt. Decomp. by hot  $H_2O$  (Meyer.)

**Thallium bromofluoride,  $TlFBr_2$ .**

Decomp. in moist air.

Sol. in abs. alcohol (Gewecke, A. 1909, 366, 233.)

**Thallium bromofluoride ammonia,**

$TlFBr_3$ ,  $4NH_3$ .

Decomp. by moisture.

Difficultly sol. in abs. alcohol. (Gewecke, A. 1909, 366, 234.)

**Thallic chloride,  $TlCl$ .**

Solubility in pts.  $H_2O$  at  $t^\circ$ , according to H = Heberberg; C = Crookes; L = Lamy.

$0^\circ$	$15^\circ$	$18^\circ$	$16.5^\circ$
504	283.4	377	359 pts. $H_2O$ ,
H	C	H	H
$100^\circ$	$100^\circ$	$100^\circ$	
about 50	52.5	63 pts. $H_2O$ .	
L	C	H	

1 l.  $\text{H}_2\text{O}$  dissolves 0.0161 g. mol.  $\text{TlCl}$  at  $25^\circ$ . (Noyes, Z. phys. Ch. 6. 249.)

$3.26 \times 10^{-3}$  grams are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46, 603.)

1 l.  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves 0.01606 g. mol.  $\text{TlCl}$  (Geffcken, Z. phys. Ch. 1904, 49, 296)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

100 cc. sat. solution contain at:

$t^\circ$	$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$	$40^\circ$	$50^\circ$
g. $\text{TlCl}$	0.17	0.24	0.34	0.46	0.60	0.80

$t^\circ$	$60^\circ$	$70^\circ$	$80^\circ$	$90^\circ$	$99^\circ$	$3^\circ$
g. $\text{TlCl}$	1.02	1.29	1.60	1.97	2.41	

(Berkeley, Trans. Roy. Soc. 1904, 203, A, 208.)

1 l.  $\text{H}_2\text{O}$  dissolves 3.040  $\text{TlCl}$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50, 356.)

2.27 g. are dissolved in 1 l. of sat. solution at  $9.54^\circ$ , 3.05 g. at  $17.7^\circ$ ; 3.97 g. at  $25.78^\circ$ .

(Kohlrausch, Z. phys. Ch. 1908, 64, 168.)

0.01629 mol. is sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Hill, J. Am. Chem. Soc. 1910, 32, 1385.)

0.01607 g. equiv. is sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Bray and Winninghoff, J. Am. Chem. Soc. 1911, 33, 1665.)

Much less sol. in  $\text{H}_2\text{O}$  containing  $\text{HCl}$  or  $\text{HNO}_3$ .

Solubility in  $\text{HCl} + \text{Aq}$  at  $25^\circ$ . 1 l. dissolves g. mol.  $\text{TlCl}$ .

g. $\text{HCl}$ added	$\text{TlCl}$	g. $\text{HCl}$ added	$\text{TlCl}$
0	0.01610	0.1468	0.00316
0.0283	0.00836	1.000	0.00200
0.0560	0.00565		

(Noyes, Z. phys. Ch. 6. 249.)

Solubility in  $\text{HCl} + \text{Aq}$ . at  $25^\circ$ .

Concentration of $\text{HCl}$ , equivalents per liter	Solubility of $\text{TlCl}$ , equivalents per liter
0	0.01612
0.025	0.00869
0.05	0.00585
0.10	0.00384
0.20	0.00254

(Noyes, Z. phys. Ch. 1892, 9, 614)

Solubility in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$

Normality $\text{HNO}_3$	Sp. gr. of the solution	g. $\text{TlCl}$ dissolved per l.
0.000	0.996	3.952
0.4977	1.0184	5.937
1.0046	1.0359	6.833
2.0452	1.0705	8.143
4.017	1.1362	9.926

(Hill and Simmons, Z. phys. Ch. 1909, 67, 606.)

Neatly insol. in  $\text{NH}_4\text{OH} + \text{Aq}$

More sol. in  $\text{K}_2\text{CO}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . 3.86 g.  $\text{TlCl}$  are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . 21.84 g.  $\text{TlCl}$  are sol. in 1 l.  $5\text{N} - \text{K}_2\text{CO}_3 + \text{Aq}$  at  $25^\circ$ . (Spencer and Le Pla, C. C. 1908, 11, 198.)

Solubility in  $\text{KNO}_3 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{KNO}_3$ , miliequivalents per l.	Solubility of $\text{TlCl}$ , miliequivalents per l.
10	16.07
20	17.16
50	18.26
100	19.61
300	23.13
1000	30.72

(Bray and Winninghoff, J. Am. Chem. Soc. 1911, 33, 1670.)

Solubility in  $\text{K}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{K}_2\text{SO}_4$ , miliequivalents per l.	Solubility of $\text{TlCl}$ , miliequivalents per l.
10	16.07
20	17.79
50	19.42
100	21.37
300	26.00
1000	34.16

(Bray and Winninghoff, J. Am. Chem. Soc. 1911, 33, 1670.)

Solubility in  $\text{Ti}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{Ti}_2\text{SO}_4$ , miliequivalents per l.	Solubility of $\text{TlCl}$ , miliequivalents per l.
10	16.07
20	10.34
50	6.77
100	4.68

(Bray and Winninghoff, J. Am. Chem. Soc. 1911, 33, 1670.)

Solubility of  $\text{TlCl}$  in salts +  $\text{Aq}$  at  $25^\circ$ .

Salt	Concentration of salt g. equiv. per l.	$\text{TlCl}$ dissolved g. equiv. per l.
$\text{NH}_4\text{Cl}$	0.025	0.00872
	0.05	0.00593
	0.2	0.00271
$\text{CaCl}_2$	0.025	0.00899
	0.05	0.00524
	0.10	0.00417
	0.20	0.00234

Solubility of  $\text{TiCl}_3$  in salts + Aq at  $25^\circ$ .—  
*Continued*

Salt	Concentration of salt g. equiv. per l.	$\text{TiCl}_3$ dissolved g. equiv. per l.
$\text{CdCl}_2$	0.025	0.01040
	0.05	0.0078
	0.10	0.00578
	0.20	0.00425
$\text{CuCl}_2$	0.025	0.00905
	0.05	0.00614
	0.10	0.00422
	0.20	0.00291
$\text{MgCl}_2$	0.025	0.00904
	0.05	0.00618
	0.10	0.00413
	0.20	0.00275
$\text{MnCl}_2$	0.025	0.00898
	0.05	0.00617
	0.10	0.00412
	0.20	0.00286
$\text{KCl}$	0.025	0.00872
	0.05	0.00593
	0.1	0.00399
	0.2	0.00265
$\text{NaCl}$	0.025	0.00869
	0.05	0.00592
	0.10	0.00395
	0.20	0.00271
$\text{ZnCl}_2$	0.025	0.00899
	0.05	0.00627
	0.10	0.00412
	0.20	0.00281
$\text{TiClO}_2$	0.025	0.00897
$\text{TiNO}_2$	0.025	0.00883
	0.05	0.00626
	0.10	0.00423

(Noyes, Z. phys. Ch. 1892, 9, 609.)

Solubility of  $\text{TiCl}_3$  in salts + Aq at  $25^\circ$ .

Salt	Mols $\text{TiCl}_3$ sol. in 1 liter of				
	0.5-N solution	N solution	2-N solution	3-N solution	4-N solution
$\text{NH}_4\text{NO}_3$	0.02587	0.03121	0.03990		
$\text{KNO}_3$	0.02599	0.03077	0.03904		
$\text{NaNO}_3$	0.02594	0.03054	0.03851	0.04544	0.05128
$\text{LiNO}_3$	0.02542	0.03035	0.03785	0.04438	
$\text{KClO}_3$	0.02370				
$\text{NaClO}_3$	0.02320	0.02587	0.03090	0.03303	0.03850

(Geffcken, Z. phys. Ch. 1904, 49, 295.)

Insol. in alcohol. Easily sol. in hot  $\text{HgCl}_2$  + Aq. (Carstanjen.)Solubility of  $\text{TiCl}_3$  in  $\text{HCl} \cdot \text{H}_2\text{O}_2$  + Aq at  $25^\circ$ .  
(g. equiv. per l.)

Acid	$\text{TiCl}_3$
0.000	0.01629
0.5134	0.01580
1.013	0.01495
2.016	0.0132
4.180	0.0099
8.130	0.0054
11.49	0.0026
14.31	0.0012
16.01	0.0005

(Hill, J. Am. Chem. Soc. 1910, 32, 1189.)

Insol. in pyridine. (Naumann, B. 1904, 37, 4610); acetone. (Naumann, B. 1904, 37, 4329.)

Thallic chloride,  $\text{TiCl}_3$ .*Anhydrous.*Easily sol. in  $\text{H}_2\text{O}$  and in most ord. solvents.

In contact with moist air, it rapidly becomes hydrated (Thomas, C. R. 1902, 135, 1053.)

Difficultly sol. in methyl acetate (Naumann, B. 1909, 42, 3790.)

Very sol. in acetone (Renz, B. 1902, 35, 1110.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37, 4328.)

+  $\text{H}_2\text{O}$ . Deliquescent, and very easily sol. in  $\text{H}_2\text{O}$ . (Werther.)Deliquescent, and very easily sol. in  $\text{H}_2\text{O}$ . (Werther.)+  $4\text{H}_2\text{O}$ . 86.2 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ . Sp. gr. of sat. aq. solution at  $17^\circ = 1.85$ . (Thomas, C. R. 1902, 135, 1052.)

Very hygroscopic. (Meyer, Z. anorg. 1900, 24, 336.)

Very sol. in alcohol and ether. (Meyer, Z. anorg. 1900, 24, 338.)

+  $7\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent. (Werther.)Thallothallic chloride,  $3\text{TiCl}_3 \cdot \text{TiCl}_3$ .1 pt. dissolves in pts.  $\text{H}_2\text{O}$  at  $t^\circ$ , according to C=Crookes, H=Hebberling; L=Lamy.

15°	17°	100°	100°
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380.1	346	52.9	20-25 pts. $\text{H}_2\text{O}$ .
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C	H	C	L
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Sl. decomp. by dissolving. (Lamy.)

Thallic hydrogen chloride,  $\text{TiCl}_3 \cdot \text{HCl}$  +  $3\text{H}_2\text{O}$ .

Very hygroscopic.

Decomp. by  $\text{H}_2\text{O}$ . (Meyer, Z. anorg. 1900, 24, 337.)Thallium tungsten chloride,  $\text{Ti}_2\text{W}_7\text{Cl}_8$ .Nearly insol. in  $\text{H}_2\text{O}$ .Sol. in a hot mixture of equal pts.  $\text{H}_2\text{O}$  and conc.  $\text{HCl}$ .

Sl. sol. in conc HCl.  
Nearly insol. in most organic solvents.  
(Olsson, B 1913, 46. 575.)

**Thallic zinc chloride,  $2\text{TiCl}_3, \text{ZnCl}_2 + 6\text{H}_2\text{O}$ .**

Can be cryst from  $\text{H}_2\text{O}$  (Gewecke, A. 1909, 366. 224.)

**Thallic chloride ammonia,  $\text{TiCl}_3, 3\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in HCl + Aq (Willm.)

**Thallium chlorofluoride,  $\text{TlFCl}_2$ .**

Very hygroscopic.  
Decomp. by moist air.  
Easily sol in abs alcohol (Gewecke, A. 1909, 366. 230.)  
+  $3\text{H}_2\text{O}$ . Not hygroscopic.  
Decomp. by  $\text{H}_2\text{O}$ , alcohol and ether (Gewecke.)

**Thallium chlorofluoride ammonia,  $\text{TlFCl}_2, 4\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ .  
Difficultly sol in abs. alcohol and in ether (Gewecke, A. 1909, 366. 232.)

**Thallium chlorofluoride potassium chloride,  $2\text{TlFCl}_2, \text{KCl}$ .**

Ppt. (Gewecke, A. 1909, 366. 231.)

**Thalious fluoride,  $\text{TlF}$ .**

Sol. in  $1\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and in much less hot  $\text{H}_2\text{O}$ . Difficultly sol in alcohol. (Buchner, W. A. B. 52. 2. 644.)  
+  $\frac{1}{2}\text{H}_2\text{O}$  Deliquescent. (Willm.)

**Thallic fluoride,  $\text{TlF}_3$ .**

Insol. in  $\text{H}_2\text{O}$  and cold HCl + Aq (Willm.)  
Cannot be obtained in pure state (Gewecke, A. 1909, 366. 218.)

**Thalious hydrogen fluoride,  $\text{TlF}, \text{HF}$ .**

Sol. in 1 pt.  $\text{H}_2\text{O}$ . (Buchner.)

**Thalious tungstyl fluoride,**

See Fluoxytungstate, thalious.

**Thalious vanadium fluoride.**

See Fluovanadate, thalious.

**Thalious vanadyl fluoride.**

See Fluoxyvanadate, thalious.

**Thalious hydroxide,  $\text{TlOH}$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol.

Solubility of  $\text{TlOH}$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	g equiv. $\text{TlOH}$ per l	Sp gr $15^\circ/4^\circ$
0	1.151	1.231
18.5	1.551	1.317
19.5	1.582	1.322
29	1.803	1.342
23.1	1.861	1.377
33.1	1.967	1.400
36	2.075	1.417
40	2.240	1.446
44.5	2.442	
54.1	2.940	
59.4	3.281	
64.6	3.601	
78.5	4.673	
90.0	5.705	
99.2	6.708	

(Bahr, Z. anorg 1911, 71. 87.)

The solubility of  $\text{Ti}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at these temperatures is the same as that of  $\text{TlOH}$ .  
+  $\text{H}_2\text{O}$  (Willm, Bull. Soc (2) 5. 354.)

**Thallic hydroxide,  $\text{Ti}_2\text{O}_3, \text{H}_2\text{O} = \text{TlO}(\text{OH})$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol in dil. acids and ammonium salts + Aq. Insol in caustic alkali solutions

$\text{Ti}(\text{OH})_3$  Easily sol. in dil. HCl or  $\text{H}_2\text{SO}_4$  + Aq. (Carnegie, C. N. 60. 113.)

**Thalious iodide,  $\text{TlI}$ .**

Very sl. sol. in  $\text{H}_2\text{O}$

1 pt  $\text{TlI}$  is sol in pts.  $\text{H}_2\text{O}$  at  $t^\circ$ . C=according to Crookes; H=according to Hebbeling; L=according to Lamy; W=according to Werther

35°	15°	16°	16-17°	19.4°
20,000	4450	16,000	11,676	14,654 pts. $\text{H}_2\text{O}$ .
W	C	L	H	W
20°	23.4°	45°	100°	100°
11,954	10,482	5407	842	804 pts. $\text{H}_2\text{O}$ .
W	W	W	C	H

Sol. in 17,000 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Long, Z. anal. 30. 342.)

Sat. solution at  $20.15^\circ$  contains 63.6 mg. or  $1.92 \times 10^{-4}$  g. mol  $\text{TlI}$  per l (Böttger, Z. phys. Ch. 1903, 46. 603.)

1 l.  $\text{H}_2\text{O}$  dissolves 56 mg.  $\text{TlI}$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

36.2 mg are dissolved in 1 l. of sat. solution at  $9.90^\circ$ ; 56 mg. at  $18.1^\circ$ ; 84.7 mg. at  $26^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 1.76 \times 10^{-4}$  mol per litre. (Spencer, Z. phys. Ch. 1912, 80. 708.)

Not decomp. by dil  $\text{H}_2\text{SO}_4$ , HCl, or alkalis + Aq. Decomp. by hot dil  $\text{HNO}_3$  + Aq, and cold conc  $\text{HNO}_3$ . Sol in aqua regia.

Also less sol in acetic acid than in  $\text{H}_2\text{O}$ . (Carstanjen.)

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Werther.) Not wholly insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , and solubility is increased by presence of  $(\text{NH}_4)_2\text{SO}_4$  or  $\text{NH}_4\text{Cl}$  (Baubigny, C. R. 113 544)

Sol in 13,000 pts  $\text{NH}_4\text{OH} + \text{Aq}$  ( $6\frac{1}{2}\%$  or  $2\frac{1}{4}\%$   $\text{NH}_3$ ). Sol. in 17,000 pts  $\text{NH}_4\text{OH} + \text{Aq}$  ( $1\frac{1}{4}\%$   $\text{NH}_3$ ). (Long.)

Insol in dil  $\text{KI} + \text{Aq}$  (1%  $\text{KI}$ ) (Baubigny)

Much more insol in  $\text{KI} + \text{Aq}$  than in  $\text{H}_2\text{O}$ ; 1 pt dissolves in 75,000 pts dil.  $\text{KI} + \text{Aq}$  (Lamy)

Nearly insol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , and absolutely insol therein in presence of  $\text{Pb}$  salts (Werner, C. N. 53. 51.)

Sol in 56,336 pts. 85% alcohol at  $13^\circ$  (Werther.) Sol. in 18,934 pts. 98% alcohol at  $19^\circ$ . (Hebborn.)

When  $\text{TlI}$  is shaken with alcohol of  $78^\circ\text{B}$  (1 vol.  $\text{H}_2\text{O} + 3$  vols. 98% alcohol) at  $22^\circ$ , and let stand with  $\text{TlI}$  for 24 hours, and then evaporated to  $\frac{1}{2}$  vol., there is shown no ppt by  $\text{NH}_4\text{SH} + \text{Aq}$  (Baubigny)

Sol. in 260,000 pts. 90% alcohol, and 37,000 pts 50% alcohol at  $20^\circ$ . (Long.)

Insol in methylene iodide (Retgers, Z anorg. 3. 343)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C., 1899, II. 1014.)

Insol. in pyridine. (Naumann, B. 1904, 37. 4501.)

#### Thallic iodide, $\text{TlI}_3$ .

Sol. in alcohol.  
Decomp. slowly in the air. (Wells, Z anorg 1884, 6. 813)

Sol. in ether

#### Thallothallic iodide, $\text{Tl}_3\text{I}_4 = 5\text{TlI}, \text{TlI}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 6. 82.)

#### Thallium nitride.

Very unstable. (Franz Fischer, B. 1901, 43. 1470.)

#### Thallous oxide, $\text{Tl}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ .

See Thallous hydroxide.

#### Thallic oxide, $\text{Tl}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Not attacked by cold  $\text{H}_2\text{SO}_4$ . Sol. in hot  $\text{H}_2\text{SO}_4$ . Sol. in cold  $\text{HCl} + \text{Aq}$ .

Insol. in alkalis +  $\text{Aq}$ . (Werther, J. pr. 91. 385)

#### Black modification.

Less sol. in dil. acids than the brown modification. Solution is accompanied by a slight reduction to thallous salt.

More sol. in 10%  $\text{HCl}$  than in 10%  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ .

More sol. in conc. than in dil. acids. (Rabe, Z. anorg 1906, 48. 431.)

#### Brown modification

Easily sol. in dil. mineral acids on warming, with slight reduction to thallous salt.

More sol. in conc. acid, (Rabe.)

#### Thallium dioxide, $\text{Tl}_2\text{O}_2$ .

Insol. in  $\text{H}_2\text{O}$  (Picconi, Gazz. ch. it. 17. 450.)

#### Thallic oxide ammonia, $\text{Tl}_2\text{O}_3, 6\text{NH}_3$ .

Decomp. by much  $\text{H}_2\text{O}$ . Insol. in alcohol. (Carstanjen)

#### Thallic oxyfluoride, $\text{TlOF}$ .

Insol. in  $\text{H}_2\text{O}$ . Slowly decomp. by boiling with  $\text{H}_2\text{O}$ .

Sol. in mineral acids. Almost insol. in  $\text{HF}$ . (Gewecke, A. 1909, 386. 226.)

#### Thallium phosphide (?)

Ppt. (Crookes)

#### Thallous selenide, $\text{Tl}_2\text{Se}$ .

Insol. in  $\text{H}_2\text{O}$ . Scarcely attacked by cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but dissolves when heated. (Carstanjen)

#### Thallothallic selenide.

Not attacked by cold conc. or boiling dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  Conc.  $\text{H}_2\text{SO}_4$  decomposes. (Carstanjen)

#### Thallous sulphide, $\text{Tl}_2\text{S}$ .

Insol. in  $\text{H}_2\text{O}$ ,  $(\text{NH}_4)_2\text{S} + \text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{KCN} + \text{Aq}$ , and in alkali carbonates, and hydrates +  $\text{Aq}$ . Difficultly sol. in a solution of oxalic acid or acetic acid. (Crookes.) Easily sol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Difficultly sol. in  $\text{HCl} + \text{Aq}$ . (Willm.)

Sol. in  $\text{H}_2\text{O}$ .

$0.21 \times 10^{-4}$  g. is dissolved in 1 l. sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

#### Thallic sulphide, $\text{Tl}_2\text{S}_3$ .

Insol. in  $\text{H}_2\text{O}$  Insol. in cold, sol. in warm dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  without separation of  $\text{S}$ . Sol. in other dilute acids with separation of  $\text{S}$ . (Carstanjen.)

#### Thallium pentasulphide, $\text{Tl}_2\text{S}_5$ .

Ppt. (Hofmann, B. 1903, 36. 3092.)

#### Thallothallic sulphide, $5\text{Tl}_2\text{S}, 3\text{Tl}_2\text{S}_3$ .

Very slowly decomp. by cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$

$\text{Tl}_2\text{S}, \text{Tl}_2\text{S}_3$ . (Carstanjen.)

$\text{Tl}_2\text{S}, 2\text{Tl}_2\text{S}_3$ . Decomp. by dil. acids. (Schneider, J. pr. (2) 10. 55.)

#### Thallium telluride, $\text{Tl}_2\text{Te}$ .

(Fabre, C. R. 105. 073.)

**Thio-**

For compounds with prefix thio-, see also under sulpho-.

**Thioantimonic acid.**

See Sulphantimonic acid.

**Thioarsenic acid.**

See Sulpharsenic acid.

**Thiomolybdic acid.**

See Sulphomolybdic acid.

**Thionamic acid,  $\text{NH}_2\text{SO}_2 = \text{NH}_2\text{SO}(\text{OH})$ .**

Very deliquescent, and sol in  $\text{H}_2\text{O}$ .

$\text{H}_2\text{O}$  solution decomp gradually. (Rose, Pogg. 33. 275; 42. 425.)

**Ammonium thionamate,  $\text{NH}_2\text{SO}(\text{ONH}_2)$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ ; easily decomp. when in solution. (Rose.)

Very sol. in alcohol with decomp. Sl. sol. in dry ether. (Drivers and Ogawa, C. C. 1900, I. 1259.)

**Dithionic acid.**

See Dithionic acid.

**Trithionic acid.**

See Trithionic acid.

**Tetrathionic acid.**

See Tetrathionic acid.

**Pentathionic acid.**

See Pentathionic acid.

**Thionyl bromide,  $\text{SOBr}_2$ .**

Unstable.

Decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 1896, 122. 322.)

**Thionyl bromochloride,  $\text{SOClBr}$ .**

Decomp. slowly in the cold, rapidly at  $115^\circ$ .

Decomp. by  $\text{H}_2\text{O}$ . (Besson C. R. 1896, 122. 321.)

**Thionyl chloride,  $\text{SOCl}_2$ .**

Sol. in  $\text{CHCl}_3$  and  $\text{C}_6\text{H}_6$ . (Oddo, Gazz. ch. it. 1899, 29. (2) 318.)

**Thionyl fluoride,  $\text{SOF}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in  $\text{AsCl}_3$ ,  $\text{C}_6\text{H}_6$ , ether and oil of turpentine. (Moissan, C. R. 1900, 130. 1439.)

**Thiophosphamic acid;  $\text{H}_2\text{PNH}_2\text{O}_2\text{S}$  (?).**

Known only in its salts. (Gladstone and Holmes, Chem. Soc. (2) 3. 1.)

**Cadmium thiophosphamate,  $\text{CdPNH}_2\text{O}_2\text{S}$ .**

Sol. in dil. acids, and  $\text{NH}_4\text{OH} + \text{Aq.}$  (G. and H.)

**Lead —,  $\text{PbPNH}_2\text{O}_2\text{S}$ .**

Ppt. Sol. in dil.  $\text{HNO}_3 + \text{Aq.}$  (Gladstone and Holmes, Chem. Soc. (2) 3. 1.)

**Thiophosphodiamic acid,  $\text{H}_2\text{PN}_2\text{H}_4\text{OS}$ .**

Known only in solution, which soon decomposes. (G. and H.)

**Cadmium thiophosphodiamate,  $\text{Cd}(\text{PN}_2\text{H}_4\text{OS})_2$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids, and  $\text{NH}_4\text{OH} + \text{Aq.}$  (G. and H.)

**Cupric —,  $\text{Cu}(\text{PN}_2\text{H}_4\text{OS})_2$ .**

Insol. in  $\text{H}_2\text{O}$ , dil.  $\text{HCl}$ , or  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in  $\text{KCN} + \text{Aq.}$  (Gladstone and Holmes, Chem. Soc. (2) 3. 1.)

**Lead —,  $\text{Pb}(\text{PN}_2\text{H}_4\text{OS})_2$ .**

Insol. in  $\text{H}_2\text{O}$  Sol. in dil.  $\text{HNO}_3 + \text{Aq.}$

**Nickel —,  $\text{Ni}(\text{PN}_2\text{H}_4\text{OS})_2$ .**

Sol. in dil. acids, and  $\text{NH}_4\text{OH} + \text{Aq.}$  (Gladstone and Holmes, Chem. Soc. (2) 3. 1.)

**Zinc —,  $\text{Zn}(\text{PN}_2\text{H}_4\text{OS})_2$ .**

Ppt. Sol. in dil. acids, and  $\text{NH}_4\text{OH} + \text{Aq.}$  (Gladstone and Holmes)

**Thiophosphonitride,  $\text{PSN}$ .**

Not decomp. by cold  $\text{H}_2\text{O}$ . Slowly decomp. by boiling  $\text{H}_2\text{O}$  Easily decomp. by boiling dil  $\text{HCl}$ . (Stock, B. 1906, 39. 1974.)

**Thiophosphoric acid,  $\text{H}_2\text{PSO}_3 = \text{PS}(\text{OH})_2$ .**

Known only in its salts.

**Ammonium magnesium thiophosphate,  $\text{NH}_4\text{MgPSO}_3 + 9\text{H}_2\text{O}$** 

Sl. sol. in cold  $\text{H}_2\text{O}$ . (Kubierschky, J. pr. (2) 31. 100.)

**Barium —,  $\text{Ba}_3(\text{PSO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$ . (Wurtz, A. ch. (3) 20. 473.)

**Cobalt —.**

Insol. in  $\text{H}_2\text{O}$ , but partially decomp. when boiled therewith. (Wurtz.)

**Cupric —.**

Insol. in  $\text{H}_2\text{O}$ ; very easily decomp. (Wurtz.)

**Ferric —.**

Insol. in  $\text{H}_2\text{O}$ . (Wurtz.)

**Magnesium —,  $\text{Mg}_2(\text{PSO}_3)_2 + 20\text{H}_2\text{O}$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ . (Kubierschky, J. pr. (2) 31. 99.)

**Nickel thiophosphate.**

Insol. in  $H_2O$ , but decomp. when boiled therewith. (Wurtz.)

**Potassium —,  $K_2PSO_4$ .**

Very sol. in  $H_2O$ . Known only in aqueous solution. (Wurtz.)

**Sodium —,  $Na_2PSO_4 + 12H_2O$ .**

Easily sol. in boiling  $H_2O$ . Cryst. out on cooling. (Wurtz, A. ch. (3) 20. 472.)

Insol. in alcohol.

**Strontium —.**

Insol. in  $H_2O$ . (Wurtz.)

**Dithiometaphosphoric acid.****Ammonium dithiometaphosphate,  $NH_4PS_2O$** 

Decomp. by  $H_2O$ . (Stock, B. 1906, 39. 1990.)

**Monothioorthophosphoric acid.****Monoammonium monothioorthophosphate,  $O=P(SNH_4)(OH)_2$ .**

Sol. in  $H_2O$ .

Insol. in alcohol. (Stock, B. 1906, 39. 1990.)

**Triammonium monothioorthophosphate,  $SNH_4PO(OH)_2$** 

(Stock.)

**Dithioorthophosphoric acid.****Ammonium dithiophosphate,  $(NH_4)_2PS_2O_4 + 2H_2O$ .**

Sl. efflorescent. Sol. in  $H_2O$ . (Kubierschky, J. pr. (2) 31. 93.)

**Ammonium magnesium —,  $NH_4MgPS_2O_4 + 6H_2O$** 

Sl. sol. in cold,  $H_2O$ . (Kubierschky.)

**Barium —,  $Ba_3(PS_2O)_2 + 8H_2O$ .**

Precipitate. (Kubierschky, J. pr. (2) 31. 103.)

+18 $H_2O$ . As the trithio compound. (Ephraim, B. 1910, 43. 287.)

**Calcium —.**

Very easily decomposed. (Kubierschky.)

**Sodium —,  $Na_3PS_2O_4 + 11H_2O$ .**

Very sol. in  $H_2O$ . (Kubierschky, J. pr. (2) 31. 93.)

**Trithioorthophosphoric acid.****Ammonium trithioorthophosphate,  $(NH_4)_3PS_3O + H_2O$ .**

(Stock, B. 1906, 39. 1985.)

**Barium trithioorthophosphate,  $Ba_2(PS_3O)_2 + 20H_2O$ .**

Decomp. by  $H_2O$  and dil. acids.

Sol. in conc.  $HNO_3$ , with oxidation of the sulphur to  $H_2SO_4$ . (Ephraim, B. 1910, 43. 286.)

**Magnesium —,  $Mg_3(PS_3O)_2 + 20H_2O$ .**

Decomp. by  $H_2O$  and dil. acids. (Ephraim.)

**Thiophosphorous acid.****Ammonium thiophosphite (?),  $(NH_4)_2P_2S_2O_4 + 3H_2O$ .**

Sol. in  $H_2O$ . (Lemoine, C. R. 98. 45.) +6 $H_2O$ .

**Sodium thiophosphite (?),  $Na_4P_2S_2O_4 + 5H_2O = P_2O_5, 2Na_2S + 5H_2O$ .**

Sol. in  $H_2O$ . (Lemoine, C. R. 98. 45.)  
 $Na_4P_2S_2O_4 + 4H_2O = P_2O_5, 3Na_2O, 2H_2S + 2H_2O$ . Sol. in  $H_2O$ . (Lemoine, l. c.)

**Thiophosphoryl triamide,  $PS(NH_2)_3$ .**

Rapidly decomp. by  $H_2O$ . Scarcely sol. in alcohol, ether, or  $CS_2$ . (Chevriér, C. R. 66. 748.)

**Metathiophosphoryl bromide,  $PS_2Br$ .**

Decomp. by  $H_2O$ . Insol. in ether. (Michaelis, A. 164. 9.)

**Orthothiophosphoryl bromide,  $PSBr_2$ .**

Slowly decomp. by cold, rapidly by hot  $H_2O$  but volatile with only partial decomp. with steam. Easily sol. in ether,  $CS_2$ ,  $PCl_3$ ,  $PBr_3$ . Decomp. by cold alcohol. Forms hydrate  $PSBr_2 + H_2O$ . (Michaelis, A. 164. 9.)

**Pyrothiophosphoryl bromide,  $P_2S_2Br_4$ .**

Decomp. by  $H_2O$  and alcohol. Sol. in  $CS_2$  and ether. (Michaelis.)

**Thiophosphoryl phosphorus bromide,  $PSBr_3, PBr_4$ .**

Decomp. by  $H_2O$  into  $PSBr_2$ . (Michaelis.)

**Thiophosphoryl dibromochloride,  $PSClBr_2$ .**

Decomp. by  $H_2O$  and alkalis.  
Fumes in the air. (Besson, C. R. 1896, 122. 1059.)

**Thiophosphoryl bromodichloride,  $PSCl_2Br$ .**

Decomp. by  $H_2O$  and alkalis. Reacts violently with  $HNO_3$ . (Besson, C. R. 1896, 120. 1058.)

**Thiophosphoryl chloride,  $PSCl_3$ .**

Very slowly decomp. by  $H_2O$ , and may be distilled with steam without much decomp. Decomp. by alcohol. Miscible with  $CS_2$ . (Baudrimont, J. pr. 87. 301.)

Sol. in  $CCl_4$  and  $C_6H_6$ . (Oddo, Gazz. ch. it. 1899, 29. (2) 318.)

Thiophosphoryl pentachloride,  $\text{PS}_2\text{Cl}_5$  (?).

Decomp. by  $\text{H}_2\text{O}$ . Sol. in alkalis with residue of S. Attacked violently by  $\text{HNO}_3$ , alcohol, ether, oil of turpentine. Miscible with  $\text{CS}_2$ . (Gladstone, Chem. Soc. 3. 5.)

Thiophosphoryl fluoride,  $\text{PSF}_3$ .

Slowly sol. in  $\text{H}_2\text{O}$  with decomp. Sl. sol. in ether.

Insol. in  $\text{H}_2\text{SO}_4$ ,  $\text{CS}_2$ , or benzene. (Thorpe and Rodger, Chem. Soc. 55. 306.)

More sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ .

Thiophosphoryl iodide,  $\text{PSI}_3$ .

Very sol. in  $\text{CS}_2$ . Unstable when heated. Fumes in the air. (Besson, C. R. 1896, 122. 1201.)

Thiosulphuric (formerly Hyposulphurous) acid,  $\text{H}_2\text{S}_2\text{O}_3$ .

Known only in aqueous solution, which is extremely unstable, and decomposes very quickly after its formation. The time before decomposition is exactly proportional to the ratio of the weight of  $\text{H}_2\text{O}$  to the weight of  $\text{H}_2\text{S}_2\text{O}_3$  present; i. e., if one solution contains twice as much  $\text{H}_2\text{O}$  for a given amt. of  $\text{H}_2\text{S}_2\text{O}_3$  as a second solution, the first solution will decompose in twice the length of time. The length of time is about 20 secs. at  $10^\circ$ , and 2 secs. at  $50^\circ$  for conc. solutions, to 120 secs. at  $10^\circ$  and 12 secs. at  $50^\circ$  for very dilute solutions. (See Landolt (B. 18. 2958) for further figures; also Winkelmann (B. 18. 406).)

Thiosulphates.

The thiosulphates of the alkalis and of Ca and Sr are easily sol. in  $\text{H}_2\text{O}$ ; Ba and Sr salts are sl. sol. and the other salts insol. The salts of the metals dissolve in alkali thiosulphates + Aq. All are insol. in alcohol.

Double Salts of Thiosulphuric acid. It is impossible to determine whether substances of this class are true chem. individuals. Many described by Svensson and others are doubtless isomorphic mixtures, whose comp. depends on the temp. and conc. of the solution in which pptd. (Rosenheim, Z. anorg. 1900, 25. 72.)

Ammonium thiosulphate,  $(\text{NH}_4)_2\text{S}_2\text{O}_3$ .

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$ . Not deliquescent. (Fock and Klüss, B. 1889, 22. 3099.)

Crystallises with  $\frac{1}{2}\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 56. 298.) Anhydrous. (Arppe, A. 96. 113.)

Insol. in alcohol. (Arppe.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Ammonium cadmium thiosulphate,  $3(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{CdS}_2\text{O}_3 + 3\text{H}_2\text{O}$

Can be recryst. from warm  $\text{H}_2\text{O}$  (Fock and Klüss, B. 23. 1758.)

+  $\text{H}_2\text{O}$  (F. and K.)  
 $(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{CdS}_2\text{O}_3$  (F. and K.)

Ammonium cuprous thiosulphate,

$(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$

Less sol. in  $\text{H}_2\text{O}$  than  $2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 91.)

$2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rosenheim and Steinhäuser.)

Ammonium cuprous thiosulphate cuprous iodide,  $7(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3, 8\text{CuI} + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Brun, C. R. 1892, 114. 668.) Could not be obtained (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 107.)

Ammonium cuprous sodium thiosulphate ammonia,  $3\text{Cu}_2\text{S}_2\text{O}_3, 4\text{Na}_2\text{S}_2\text{O}_3, (\text{NH}_4)_2\text{S}_2\text{O}_3, 6\text{NH}_3$ .

Ppt. When dry is fairly stable in the air. Partially decomp. by  $\text{H}_2\text{O}$ .

Sol. in dil.  $\text{H}_2\text{SO}_4$  or acetic acid. (Shunn, J. Am. Chem. Soc. 1904, 26. 948.)

Ammonium lead thiosulphate,  $2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 3\text{H}_2\text{O}$ .

Easily and completely sol. in cold  $\text{H}_2\text{O}$ , but deposits  $\text{PbS}_2\text{O}_3$  by standing or warming. (Rammelsberg, Pogg. 56. 312.)

Ammonium magnesium thiosulphate,  $(\text{NH}_4)_2\text{Mg}(\text{S}_2\text{O}_3)_2 + 6\text{H}_2\text{O}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Kessler, Pogg. 74. 283.)

Not deliquescent. (Fock and Klüss, B. 23. 540.)

Ammonium mercuric thiosulphate,  $4(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{HgS}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by alcohol. Extremely easily decomp. (Rammelsberg, Pogg. 56. 318.)

Ammonium potassium thiosulphate,  $\text{NH}_4\text{KS}_2\text{O}_3$ .

Sol. in  $\text{H}_2\text{O}$  (Fock and Klüss, B. 23. 536.)

Ammonium silver thiosulphate,  $2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Somewhat sol. in alcohol. (Herschel, Edinb. Phil. J. 1. 398.)

$(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + x\text{H}_2\text{O}$  Nearly insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , from which it is reprecip. by an acid. (Herschel.)

**Ammonium zinc thiosulphate,**  
 $(\text{NH}_4)_2\text{S}_2\text{O}_3 \cdot \text{ZnS}_2\text{O}_3 + \text{H}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$ . (Rosenheim and Davidsohn, Z anorg. 1904, 41. 238)

**Ammonium thiosulphate ammonium cuprous bromide,**  $\text{CuBr} \cdot \text{NH}_4\text{Br} \cdot 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ .

Sol in  $\text{H}_2\text{O}$  (Rosenheim, Z anorg. 1900, 25. 107.)

The double salts of ammonium thiosulphate with silver and copper haloids are true chemical compounds and may be recryst. from  $\text{H}_2\text{O}$  without decomp. (Rosenheim, Z. anorg. 1900, 25. 100.)

**Ammonium thiosulphate ammonium silver bromide,**  $\text{AgBr} \cdot \text{NH}_4\text{Br} \cdot 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ .

Sol in  $\text{H}_2\text{O}$ . (Rosenheim)

**Ammonium thiosulphate ammonium cuprous chloride,**  $\text{CuCl} \cdot \text{NH}_4\text{Cl} \cdot 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ .

Sol in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rosenheim.)

**Ammonium thiosulphate ammonium silver chloride,**  $\text{AgCl} \cdot \text{NH}_4\text{Cl} \cdot 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ .

Sol. in cold  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ .

Decomp. by boiling with  $\text{H}_2\text{O}$  and by dil. acids (Rosenheim)

**Ammonium thiosulphate ammonium cuprous cyanide.**

Composition not constant (Rosenheim.)

**Ammonium thiosulphate ammonium silver cyanide.**

Composition not constant (Rosenheim)

**Ammonium thiosulphate ammonium cuprous iodide,**  $\text{CuI} \cdot \text{NH}_4\text{I} \cdot 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ .

Sol in  $\text{H}_2\text{O}$ . (Rosenheim.)

**Ammonium thiosulphate ammonium cuprous iodide,**  $4(\text{NH}_4)_2\text{S}_2\text{O}_3 \cdot \text{NH}_4\text{I} \cdot \text{CuI}$ .

Very sol. in  $\text{H}_2\text{O}$  Decomp. by boiling. (Brun, C R. 1892, 114. 668.)

**Ammonium thiosulphate ammonium silver iodide,**  $\text{AgI} \cdot \text{NH}_4\text{I} \cdot 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ .

Sol. in  $\text{H}_2\text{O}$  (Rosenheim.)

**Ammonium thiosulphate ammonium cuprous sulphocyanide,**  $\text{CuSCN} \cdot \text{NH}_4\text{SCN} \cdot 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ .

Sol. in  $\text{H}_2\text{O}$  (Rosenheim.)

**Ammonium thiosulphate ammonium silver sulphocyanide,**  $\text{AgSCN} \cdot \text{NH}_4\text{SCN} \cdot 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ .

Sol. in  $\text{H}_2\text{O}$  (Rosenheim.)

**Ammonium thiosulphate cuprous iodide,**  
 $(\text{NH}_4)_2\text{S}_2\text{O}_3 \cdot 2\text{CuI} + \text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ . (Brun, C. R. 1892, 114. 668.)

Could not be obtained (Rosenheim and Stenhausser)

**Barium thiosulphate,**  $\text{BaS}_2\text{O}_3 + \text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 21. 437.)

Insol in alcohol.

1 pt cannot be dissolved in 2000 pts.  $\text{H}_2\text{O}$ .

Sol. in dil  $\text{HCl} + \text{Aq}$  without decomposition.

(Herschel, 1819.)

Pptd from  $\text{BaS}_2\text{O}_3 + \text{Aq}$  by dil. alcohol. (Sobrero and Selmi, A. ch. (3) 28. 211.)

Insol in acetone (Naumann, B. 1904, 47. 4329)

**Barium bismuth thiosulphate,**  $\text{Ba}_4\text{Bi}(\text{S}_2\text{O}_3)_4$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Hauser, Z. anorg. 1903, 35. 9)

**Barium cadmium thiosulphate,**  $2\text{BaS}_2\text{O}_3 \cdot \text{CdS}_2\text{O}_3 + 8\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Fock and Klüss, B. 23. 1761.)

$3\text{BaS}_2\text{O}_3 \cdot \text{CdS}_2\text{O}_3 + 8\text{H}_2\text{O}$  Sl. sol. in  $\text{H}_2\text{O}$ .

**Barium cuprous thiosulphate.**

Easily sol. in hot, difficultly sol. in cold  $\text{H}_2\text{O}$  (Cohen, Chem. Soc. 51. 38)

$2\text{BaS}_2\text{O}_3 \cdot \text{Cu}_2\text{S}_2\text{O}_3 + 7\text{H}_2\text{O}$  Nearly insol. in  $\text{H}_2\text{O}$  (Vortmann, M. 9. 165)

**Barium gold thiosulphate.**

Sl. sol. in  $\text{H}_2\text{O}$ . Insol in alcohol. (Fordos and Gélus.)

**Barium lead thiosulphate.**

Difficultly sol in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 66. 313)

**Barium thiosulphate chloride,**  $\text{BaS}_2\text{O}_3 \cdot \text{BaCl}_2 + 2\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Fock and Klüss, B. 23. 3001.)

**Bismuth caesium thiosulphate,**  $\text{Cs}_3\text{Bi}(\text{S}_2\text{O}_3)_3$ .

Sol. in  $\text{H}_2\text{O}$ .

Insol. in alcohol. (Hauser, Z. anorg. 1903, 35. 8)

**Bismuth potassium thiosulphate,**  $\text{K}_3\text{Bi}(\text{S}_2\text{O}_3)_3 \cdot \frac{1}{2}\text{H}_2\text{O}$ .

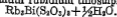
Solubility in  $\text{H}_2\text{O}$ .

100 cc of the sat. solution contain 3.5 g. at  $2^\circ$ , 7.0 g. at  $18^\circ$ . At  $18^\circ$  the solution decomposes.

More sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  than in pure  $\text{H}_2\text{O}$

Insol. in alcohol (Hauser, Z. anorg. 1903, 35. 5)

$+ \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ . Insol in alcohol. (Carnot, C R. 83. 390.)

**Bismuth rubidium thiosulphate,**Sol. in  $\text{H}_2\text{O}$ .

Insol. in acid alcohol (Hauser, Z. anorg. 1903, 35. 7.)  
 +  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Hauser, Z. anorg. 1903, 35. 8.)

**Bismuth sodium thiosulphate,**

Very sol. in  $\text{H}_2\text{O}$ , and also in alcohol. (Carnot, C. R. 83. 338.)

$\text{Na}_2\text{Bi}(\text{S}_2\text{O}_3)_2$ . Decomp. by  $\text{H}_2\text{O}$ . Easily sol. in 50% alcohol. (Hauser, Z. anorg. 1903, 35. 3.)

**Cadmium thiosulphate,  $\text{CdS}_2\text{O}_3 + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Vortmann and Padberg, B. 22. 2638)

**Cadmium potassium thiosulphate,  $3\text{CdS}_2\text{O}_3, 5\text{K}_2\text{S}_2\text{O}_8$ .**

Cannot be recryst without decomp (Fock and Klüss, B. 23. 1753.)

$\text{CdS}_2\text{O}_3, 3\text{K}_2\text{S}_2\text{O}_8 + 2\text{H}_2\text{O}$ . Can be crystallised from  $\text{H}_2\text{O}$  without decomp (F. and K.)

**Cadmium sodium thiosulphate,  $\text{CdS}_2\text{O}_3, 3\text{Na}_2\text{S}_2\text{O}_8 + 16\text{H}_2\text{O}$ .**

Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Jochem, C. C. 1885, 642)

+  $9\text{H}_2\text{O}$ . (Vortmann and Padberg, B. 22. 2639.)

+  $3\text{H}_2\text{O}$ . Deliquescent (Fock and Klüss, B. 23. 1757)

$2\text{CdS}_2\text{O}_3, \text{Na}_2\text{S}_2\text{O}_8 + 7\text{H}_2\text{O}$  (V. and P.)  
 $3\text{CdS}_2\text{O}_3, \text{Na}_2\text{S}_2\text{O}_8 + 9\text{H}_2\text{O}$  (V. and P.)

**Cadmium strontium thiosulphate,  $\text{CdS}_2\text{O}_3, 3\text{SrS}_2\text{O}_8 + 10\text{H}_2\text{O}$ .**

(Fock and Klüss, B. 23. 1763)

**Cæsium thiosulphate,  $\text{Cs}_2\text{S}_2\text{O}_3$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Chabré, C. R. 1901, 133. 297.)

+  $2\text{H}_2\text{O}$ . Very hygroscopic. (J. Meyer, B. 1907, 40. 1360.)

**Cæsium cuprous thiosulphate,  $\text{Cs}_2\text{S}_2\text{O}_3$ ,**

Easily sol. in  $\text{H}_2\text{O}$  with decomp. (J. Meyer, B. 1907, 40. 1361.)

**Cæsium lead thiosulphate,  $\text{Cs}_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 2\text{H}_2\text{O}$ .**

Not hygroscopic.

$2\text{Cs}_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 3\text{H}_2\text{O}$ . Hygroscopic. (J. Meyer.)

**Cæsium magnesium thiosulphate,  $\text{Cs}_2\text{S}_2\text{O}_3, \text{MgS}_2\text{O}_3 + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Meyer.)

**Cæsium silver thiosulphate,  $2\text{Cs}_2\text{S}_2\text{O}_3,$** 

Not hygroscopic

Decomp by hot  $\text{H}_2\text{O}$  (J. Meyer)

**Calcium thiosulphate,  $\text{CaS}_2\text{O}_3 + 6\text{H}_2\text{O}$ .**

Sol. in 1 pt  $\text{H}_2\text{O}$  at  $3^\circ$ .

Aqueous solution saturated at  $10^\circ$  has sp. gr. 1.300. Solution with sp. gr. 1.11437 at  $15.5^\circ$  contains 0.2081 of its weight in  $\text{CaS}_2\text{O}_3$ .

Decomp on heating. Insol. in alcohol (sp. gr. 0.8234). (Herschel, A. ch. 14. 355.)  
 100 g. sat. solution contains 29.4 g.  $\text{CaS}_2\text{O}_3$  at  $9^\circ$ , and 34.7 g.  $\text{CaS}_2\text{O}_3$  at  $25^\circ$ . (Kremann and Rodemund, M. 1914, 35. 1065.)

**Solubility of  $\text{CaS}_2\text{O}_3 + \text{Na}_2\text{SO}_3$  in  $\text{H}_2\text{O}$** 

$^\circ$	$\text{Na}_2\text{S}_2\text{O}_3$	$\text{CaS}_2\text{O}_3$	Solid phase
9	0	29.4	$\text{CaS}_2\text{O}_3, 6\text{H}_2\text{O}$
	11.04	22.64	" + $\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$
	25.21	15.84	
	31.01	7.70	
25	0	34.7	$\text{CaS}_2\text{O}_3, 6\text{H}_2\text{O}$
	9.24	29.69	"
	15.67	21.41	
	18.34	25.18	
	28.24	21.14	" + $\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$
	30.19	20.33	
	31.24	18.43	
	35.04	11.61	

(Kremann and Rodemund, M. 1914, 35. 1065.)

**Calcium lead thiosulphate,  $2\text{CaS}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 4\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rammelsberg.)

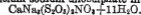
**Calcium potassium thiosulphate,  $\text{CaS}_2\text{O}_3, 3\text{K}_2\text{S}_2\text{O}_8 + 5\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  (Fock and Klüss, B. 24. 3016.)

**Calcium silver thiosulphate,  $2\text{CaS}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + x\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ ; less sol. in alcohol.

$\text{CaS}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + x\text{H}_2\text{O}$  Sl. sol. in  $\text{H}_2\text{O}$ , abundantly in  $\text{NH}_4\text{OH} + \text{Aq}$  (Herschel, 1819.)

**Calcium sodium thiosulphate nitrate,**

(Kremann and Rodemund, M. 1914, 35. 1065.)

**Cobaltous thiosulphate,  $\text{CoS}_2\text{O}_3 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Cobaltous sodium thiosulphate,  $2\text{CoS}_2\text{O}_3, 5\text{Na}_2\text{S}_2\text{O}_8 + 25\text{H}_2\text{O}$ .**

Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Jochem.)

Could not be obtained by Vortmann and Padberg.

$\text{CoS}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3 + 15\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Vortmann and Padberg, B. 22. 2641)

**Cuprous thiosulphate**,  $\text{Cu}_2\text{O}$ ,  $3\text{S}_2\text{O}_3 + 2\text{H}_2\text{O} = \text{Cu}_2\text{H}_4(\text{S}_2\text{O}_3)_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Abundantly sol. in  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq.,  $\text{NH}_4\text{Cl}$  + Aq.,  $\text{NH}_4\text{OH}$  + Aq., or  $(\text{NH}_4)_2\text{CO}_3$  + Aq. Sol. in  $\text{HCl}$  or  $\text{HNO}_3$  + Aq. (v. Hauer, W. A. B. 13. 443)

**Cuprous hydrazine thiosulphate**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $(\text{N}_2\text{H}_4)_2\text{H}_4\text{S}_2\text{O}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH}$  + Aq. and in dil. acids. (Ferrattini, C. C. 1912, I. 1281.)

**Cupric lead thiosulphate**,  $\text{Pb}(\text{CuS}_2\text{O}_3)_2 + 3\text{H}_2\text{O}$ . (?)

Very sol. in  $\text{H}_2\text{O}$  and quickly decomp. (Gerard, C. C. 1904, I. 253)

**Cuprous mercurous thiosulphate**,  $5\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{Hg}_2\text{S}_2\text{O}_3$ .

Insol. or sl. sol. in cold, decomp. by boiling  $\text{H}_2\text{O}$ .  $\text{HNO}_3$  + Aq. dissolves out Cu. (Rammelsberg, Pogg. 56. 319)

**Cuprous potassium thiosulphate**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{K}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; decomp. on heating with pptn. of  $\text{CuS}$ . Easily sol. in  $\text{K}_2\text{S}_2\text{O}_3$  + Aq. (Rammelsberg, Pogg. 56. 321.)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{K}_2\text{S}_2\text{O}_3$ . Very sol. in cold  $\text{H}_2\text{O}$ ; insol. in  $\text{K}_2\text{S}_2\text{O}_3$  + Aq. (Cohen, Chem. Soc. 51. 39)

+  $3\text{H}_2\text{O}$ . Scarcely sol. in cold, sol. with sl. decomp. in hot  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  + Aq. with evolution of  $\text{SO}_2$ .

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{K}_2\text{S}_2\text{O}_3 + 3\text{H}_2\text{O}$  More sol. in  $\text{H}_2\text{O}$  than  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{K}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$  Solution is not decomp. by boiling. Sol. in excess of  $\text{NH}_4\text{OH}$  + Aq. (Rammelsberg.)

**Cuprous rubidium thiosulphate**,  $\text{Rb}_2\text{S}_2\text{O}_3$ ,  $\text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Ppt. (J. Meyer, B. 1907, 40. 1357)  $2\text{Rb}_2\text{S}_2\text{O}_3$ ,  $\text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ . Ppt. (J. Meyer.)

$3\text{Rb}_2\text{S}_2\text{O}_3$ ,  $\text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ . Ppt. (J. Meyer.)

**Cuprous silver sodium thiosulphate ammonia**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Ag}_2\text{S}_2\text{O}_3$ ,  $5\text{Na}_2\text{S}_2\text{O}_3$ ,  $6\text{NH}_3$ .

Ppt. Becomes dark when exposed to light. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Shunn, J. Am. Chem. Soc. 1904, 26. 949.)

**Cuprous sodium thiosulphate**,  $2\text{Cu}_2\text{S}_2\text{O}_3$ ,  $7\text{Na}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Ppt. from aqueous solution by alcohol. (Jochem, C. C. 1885. 642.)

+  $12\text{H}_2\text{O}$ . Sol. in very dil.  $\text{HCl}$  + Aq. (Jochem)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ , insol. in alcohol. (Rammelsberg.)

+  $6\text{H}_2\text{O}$  (Jochem)

$3\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3 + 8\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{C}$  (Vortmann)

+  $5\text{H}_2\text{O}$ . (Lenz, A. 40. 99.) Formula according to Jochem is—

$5\text{Cu}_2\text{S}_2\text{O}_3$ ,  $4\text{Na}_2\text{S}_2\text{O}_3 + 8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol. in  $\text{HCl}$  + Aq. without evolution of  $\text{SO}_2$ , also in dil.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$  + Aq. Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Jochem.)

+  $6\text{H}_2\text{O}$ . As above. (Jochem.)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq. (Russell, Ch. Ztg. 9. 233.)

+  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and alcohol

Decomp. by dil. acids. (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 84.)

+  $2\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol. (Bhaduri, Z. anorg. 1898, 17. 1.)

+  $2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Vortmann, M. 1883, 9. 188.)

$3\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$ . (Gerard, C. C. 1904, I. 253.)

+  $5\text{H}_2\text{O}$ . Sol. in 352 pts.  $\text{H}_2\text{O}$ . (Russell, Ch. Z. 1885, 9. 223)

100 cc. 5%  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq. dissolve 12.28 g.

" " 7.5% " " 17.46 g.

" " 10% " " 22.54 g.

(Russell, Ch. Z. 1885, 9. 223.)

$4\text{Cu}_2\text{S}_2\text{O}_3$ ,  $8\text{Na}_2\text{S}_2\text{O}_3 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and alcohol.

Decomp. by dil. acids (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 84.)

+  $6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol. (Bhaduri, Z. anorg. 1898, 17. 1.)

$7\text{Cu}_2\text{S}_2\text{O}_3$ ,  $5\text{Na}_2\text{S}_2\text{O}_3 + 16\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  and by alcohol (Bhaduri, Z. anorg. 1898, 17. 1.)

It is impossible to determine whether any of these compds. are complex or double salts.

As a class they are not easily sol. and decomp. in solution. They may therefore be mixtures

whose comp. depended upon the temp. and conc. of the solution in which they were pptd. (Rosenheim, Z. anorg. 1900, 25. 81)

**Cuprocupric sodium thiosulphate ammonia**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{CuS}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$ ,  $4\text{NH}_3$ .

Insol. in, but decomp. by hot  $\text{H}_2\text{O}$ . Sol. in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq. Sol. in  $\text{NH}_4\text{OH}$  + Aq. or  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq. (Schutte, C. R. 42. 1267)

**Cuprous sodium thiosulphate cuprous chloride**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$ ,  $2\text{CuCl}$ .

(Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 86.)

**Cupric sodium thiosulphate cupric sulphide**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{CuS} + 4\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq. and  $\text{NH}_4\text{OH}$  + Aq; insol. in alcohol. (Lenz, A. 40. 99.)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $2\text{CuS}$  Sol. in  $\text{H}_2\text{O}$  or dil.  $\text{HCl}$  + Aq. (Kessel, B. 11. 1585.)

**Cuprous sodium thiosulphate sodium chloride**,  $3\text{Cu}_2\text{S}_2\text{O}_3, 2\text{Na}_2\text{S}_2\text{O}_3, 4\text{NaCl}+8\text{H}_2\text{O}$ .

Sol in  $\text{Na}_2\text{S}_2\text{O}_3+\text{Aq}$ . (Siewert, *Zeit ges Naturwiss.* 26. 486.)  
Ppt. (Bhaduri, *Z. anorg.* 1898, 17. 3.)

**Cupric thiosulphate ammonia**,  $\text{CuS}_2\text{O}_3, 4\text{NH}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 21.79 pts at  $25^\circ$  (Pudachies, *Dissert*).

**Cuprocupric thiosulphate ammonium chloride**,  $\text{Cu}_2\text{O}, \text{CuO}, 38\text{S}_2\text{O}_3, 2\text{NH}_4\text{Cl}$ .

Sol in  $\text{HNO}_3+\text{Aq}$  with separation of S (v. Hauer, *W A B* 13. 447.)

**Glucinum thiosulphate**,  $\text{GlS}_2\text{O}_3+11\text{H}_2\text{O}$ .

(Faktor, *C C.* 1901, II 878)

**Gold (aurous) hydrogen thiosulphate**,  $\text{Au}_2\text{S}_2\text{O}_3, 3\text{H}_2\text{S}_2\text{O}_3$ .

Known only in solution. (Fordos and Géhu, *A. ch.* (3) 13. 394.)

**Gold (aurous) sodium thiosulphate**,  $\text{Au}_2\text{S}_2\text{O}_3, 3\text{Na}_2\text{S}_2\text{O}_3+4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; solution decomp. on heating. Insol in absolute, al. sol. in dil. alcohol. (Fordos and Géhu)

$\text{Au}_2\text{S}_2\text{O}_3, 6\text{Na}_2\text{S}_2\text{O}_3+10\text{H}_2\text{O}$  Very sol. in  $\text{H}_2\text{O}$ , but decomp by boiling (Jochum, *C C.* 1885. 642.)

**Iron (ferrous) thiosulphate**,  $\text{FeS}_2\text{O}_3+5\text{H}_2\text{O}$ .

Deliquescent. Very sol in  $\text{H}_2\text{O}$  or alcohol. (Koene, *Pogg.* 63. 241.)

**Iron (ferrous) sodium thiosulphate**,  $\text{FeS}_2\text{O}_3, 3\text{Na}_2\text{S}_2\text{O}_3+8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ , and easily decomp (Vortmann and Padberg, *B* 22. 2641)

**Lead thiosulphate**,  $\text{PbS}_2\text{O}_3$ .

Sol. in 3266 pts.  $\text{H}_2\text{O}$ . Sol in alkali thiosulphates +Aq (Rammelsberg, *Pogg.* 56. 308.)

**Lead lithium thiosulphate**,  $\text{PbS}_2\text{O}_3, \text{Li}_2\text{S}_2\text{O}_3$ .

Very hygroscopic.

Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{PbS}$ . (J. Meyer, *B.* 1907, 40. 1355)

**Lead potassium thiosulphate**,  $\text{PbS}_2\text{O}_3, 3\text{K}_2\text{S}_2\text{O}_3+2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with partial separation of  $\text{PbS}_2\text{O}_3$ . Sol. in  $\text{K}_2\text{S}_2\text{O}_3+\text{Aq}$ . (Rammelsberg, *Pogg.* 56. 310.)

**Lead rubidium thiosulphate**,  $2\text{Rb}_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3+2\text{H}_2\text{O}$ .

Difficultly sol. in cold  $\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (J. Meyer, *B.* 1907, 40. 1358.)

**Lead sodium thiosulphate**,  $\text{PbS}_2\text{O}_3, 2\text{Na}_2\text{S}_2\text{O}_3$ .

Sl sol in  $\text{H}_2\text{O}$ . Very easily sol in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2$  and  $\text{Na}_2\text{S}_2\text{O}_3+\text{Aq}$  (Lenz, *A* 40. 98)

Insol in alcohol

$2\text{PbS}_2\text{O}_3, 5\text{Na}_2\text{S}_2\text{O}_3+60\text{H}_2\text{O}$ . Easily decomp. (Jochum, *C C.* 1885. 642.)

$\text{PbS}_2\text{O}_3, 3\text{Na}_2\text{S}_2\text{O}_3+12\text{H}_2\text{O}$  Decomp in boiling aqueous solution. (Vortmann and Padberg, *B* 22. 2637)

**Lead strontium thiosulphate**.

Sol. in  $\text{H}_2\text{O}$  Precipitated as a syrup by alcohol. (Rammelsberg.)

**Lithium thiosulphate**,  $\text{Li}_2\text{S}_2\text{O}_3+3\text{H}_2\text{O}$ .

Very deliquescent, and sol in  $\text{H}_2\text{O}$  and absolute alcohol. (Fock and Klüss, *B.* 22. 3099.)

**Lithium silver thiosulphate**,  $\text{Li}_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3+4\text{H}_2\text{O}$ .

Hygroscopic.

Decomp by boiling  $\text{H}_2\text{O}$  and by acids. (Meyer and Eggeling, *B.* 1907, 40. 1355)

**Magnesium thiosulphate**,  $\text{MgS}_2\text{O}_3+6\text{H}_2\text{O}$ .

Very easily sol in  $\text{H}_2\text{O}$  Precipitated from conc. solution by alcohol. (Rammelsberg, *Pogg.* 56. 303.)

**Magnesium potassium thiosulphate**,

$\text{MgK}_2(\text{S}_2\text{O}_3)_2+6\text{H}_2\text{O}$ .

Deliquescent, and sol. in  $\text{H}_2\text{O}$  Less sol. than  $\text{K}_2\text{S}_2\text{O}_3$  (Rammelsberg, *Pogg.* 56. 304.)

Not deliquescent (Fock and Klüss, *B.* 23. 539)

**Magnesium rubidium thiosulphate**,  $\text{MgS}_2\text{O}_3, \text{Rb}_2\text{S}_2\text{O}_3+6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Meyer, *B.* 1907, 40. 1358)

**Manganous thiosulphate**,  $\text{MnS}_2\text{O}_3$ .

Sol in  $\text{H}_2\text{O}$ , from which it is pptd. by alcohol (Rammelsberg, *Pogg.* 56. 305.)

+ $5\text{H}_2\text{O}$ . Decomp very easily. (Vortmann and Padberg, *B.* 322. 2641.)

**Manganous sodium thiosulphate**,  $\text{MnS}_2\text{O}_3, 2\text{Na}_2\text{S}_2\text{O}_3+16\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  Insol or but sl sol in alcohol. (Jochum, *C C.* 1885. 642)

**Mercuric potassium thiosulphate**,  $3\text{HgS}_2\text{O}_3, 5\text{K}_2\text{S}_2\text{O}_3$ .

Sol in 10 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and  $\frac{1}{2}$  pt at  $100^\circ$  Aqueous solution decomp on standing or heating

Insol. in alcohol (Kirchhoff, *Scher J.* 2. 30.)

$\text{HgS}_2\text{O}_3, 3\text{K}_2\text{S}_2\text{O}_3+3\text{H}_2\text{O}$  (Fock and Klüss, *B.* 24. 1353.)

$\text{HgS}_2\text{O}_3, 5\text{K}_2\text{S}_2\text{O}_3+\text{H}_2\text{O}$ . (F. and K)

**Nickel thiosulphate,  $\text{NiS}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ .**

Permanent. Sol. in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 56. 306)

**Nickel sodium thiosulphate,  $2\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{Na}_2\text{S}_2\text{O}_3 \cdot 25\text{H}_2\text{O}$ .**

Efflorescent Sol in  $\text{H}_2\text{O}$ . (Jochum)

**Nickel thiosulphate ammonia,  $\text{NiS}_2\text{O}_3 \cdot 4\text{NH}_3 \cdot 6\text{H}_2\text{O}$ .**

Decomp. on air Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rammelsberg, Pogg. 56. 306)

$\text{NiS}_2\text{O}_3 \cdot 5\text{NH}_3 + \text{H}_2\text{O}$ . (Ephraim, B 1913, 46. 3108.)

$\text{NiS}_2\text{O}_3 \cdot 6\text{NH}_3 + 3\text{H}_2\text{O}$  (Voitmann and Padberg, B. 22. 2641.)

**Platinous sodium thiosulphate.**

See Plathiosulphate, sodium.

**Potassium thiosulphate,  $\text{K}_2\text{S}_2\text{O}_3 \cdot 1/3, 1, 1\frac{1}{2}\text{H}_2\text{O}$ , and  $2\text{H}_2\text{O}$ .**

Very deliquescent Very sol. in  $\text{H}_2\text{O}$  with absorption of heat Solution is stable on the air. Insol in alcohol

100 pts.  $\text{H}_2\text{O}$  dissolve pts  $\text{K}_2\text{S}_2\text{O}_3$  at  $t^\circ$ .

$t^\circ$	Pts $\text{K}_2\text{S}_2\text{O}_3$	Solid phase
0	96.1	$\text{K}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
17	150.5	$3\text{K}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
20	155.4	"
25	165.0	"
30	175.7	"
35	202.4	$3\text{K}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O} + \text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
40	204.7	$\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
45	208.7	"
50	215.2	"
55	227.7	"
60	238.3	"
56.1	234.5	$\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O} + 3\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
65	245.8	$3\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
70	255.2	"
75	268.0	"
78.3	292.0	$3\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O} + \text{K}_2\text{S}_2\text{O}_3$
80	293.1	$\text{K}_2\text{S}_2\text{O}_3$
85	298.5	"
90	312.0	"

(Inohiko Io, Mem Coll Sc Kyoto, 1911, 3. 212.)

Sol. in dil.  $\text{HCl} \cdot \text{H}_2\text{O} + \text{Aq}$  without decomp (Mathieu-Plessy, C. R. 101. 59)

Insol in ethyl acetate (Casasaca, C. R. 80. 821.)

**Potassium silver thiosulphate,  $2\text{K}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3$ .**

Sol. in  $\text{H}_2\text{O}$  (Cohen.)  
 $\text{K}_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3$ . Sl sol. in  $\text{H}_2\text{O}$  (Herschel.)

$3\text{K}_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$  Rather sl. sol. in  $\text{H}_2\text{O}$ . (Rosenheim and Sternhäuser, Z. anorg. 1900, 25. 76)

Sl. sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

**Potassium silver thiosulphate ammonia,  $\text{KAgS}_2\text{O}_3 \cdot 2\text{NH}_3$ .**

Very sl sol in  $\text{H}_2\text{O}$ . Easily sol in hot  $\text{NH}_4\text{OH} + \text{Aq}$ . (Schwieker, B. 22. 1735)  
 $5\text{K}_2\text{S}_2\text{O}_3, 3\text{Ag}_2\text{S}_2\text{O}_3, \text{NH}_3$  Difficultly sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in hot  $\text{NH}_4\text{OH} + \text{Aq}$  with partial decomp. (J. Meyer, B. 1907, 40. 1359.)

**Potassium sodium thiosulphate.**

(a)  $\text{KNaS}_2\text{O}_3 + 2\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 213.7 pts salt at  $15^\circ$ . (Schwieker, B. 22. 1733)

(b)  $\text{NaKS}_2\text{O}_3 + 2\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 205.3 pts salt at  $15^\circ$  (Schwieker.)

**Potassium strontium thiosulphate,  $\text{K}_2\text{S}_2\text{O}_3 \cdot \text{SrS}_2\text{O}_3 + 5\text{H}_2\text{O}$ .**

Sol in  $\text{H}_2\text{O}$ . (Fock and Kluss, B. 24. 3017.)

**Potassium zinc thiosulphate,  $\text{K}_2\text{S}_2\text{O}_3 \cdot \text{ZnS}_2\text{O}_3 + \text{H}_2\text{O}$ .**

Very sol in  $\text{H}_2\text{O}$ . (Rosenheim and Davidsohn, Z. anorg. 1904, 41. 238)

**Potassium thiosulphate sodium chloride,  $\text{K}_2\text{S}_2\text{O}_3 \cdot \text{NaCl}$ .**

Sol in  $\text{H}_2\text{O}$  (Pape, Pogg. 139. 238.)

**Rubidium thiosulphate,  $\text{Rb}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .**

Very hygroscopic; easily sol. in  $\text{H}_2\text{O}$  (J. Meyer, B. 1907, 40. 1356)

**Rubidium silver thiosulphate,  $2\text{Rb}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .**

Ppt Not hygroscopic. Difficultly sol. in cold  $\text{H}_2\text{O}$ . Decomp. by warm  $\text{H}_2\text{O}$ . (J. Meyer.)

**Rubidium silver thiosulphate ammonia,  $\text{Rb}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3 \cdot \text{NH}_3$ .**

Ppt (J. Meyer.)  
 $3\text{Rb}_2\text{S}_2\text{O}_3, 4\text{Ag}_2\text{S}_2\text{O}_3, \text{NH}_3$ . Ppt Decomp. in the air. (J. Meyer.)

**Samarium thiosulphate.**

(Cleve)

**Scandium thiosulphate, basic,  $\text{Sc}(\text{OH})\text{S}_2\text{O}_3$ .**

Ppt. (R. J. Meyer, Z. anorg. 1914, 86. 282.)

**Silver thiosulphate,  $\text{Ag}_2\text{S}_2\text{O}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH}$  or alkali thiosulphates +  $\text{Aq}$ . (Herschel, Edinb. Phil. J. 1. 26)

**Silver sodium thiosulphate,  $\text{Ag}_2\text{S}_2\text{O}_3 \cdot \text{Na}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$ .**

Sl sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  to form—

$\text{Ag}_2\text{S}_2\text{O}_3, 2\text{Na}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$  Easily sol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ , somewhat sol. in al-

cohol, especially if warm or dilute (Lenz, A. 40. 94.)

$\text{Ag}_2\text{S}_2\text{O}_3 \cdot 6\text{Na}_2\text{S}_2\text{O}_3 + 21\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ . (Jochum, C. C. 1885. 642.)

Silver sodium thiosulphate acetylde acetylene,  $2\text{Na}_2\text{S}_2\text{O}_3 \cdot 7\text{Ag}_2\text{S}_2\text{O}_3 \cdot 18\text{Ag}_2\text{C}_2\text{S}_2 \cdot 32\text{C}_2\text{H}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Insol in alkalis. (Bhaduri, Z anorg 1913, 79. 356.)

$7\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{Ag}_2\text{S}_2\text{O}_3 \cdot 86\text{Ag}_2\text{C}_2\text{S}_2 \cdot 13\text{C}_2\text{H}_2$ . (Bhaduri.)

Silver sodium thiosulphate ammonia,

$\text{NaAgS}_2\text{O}_3 \cdot \text{NH}_3$ .

Very unstable (Schwicker, B. 22. 1736.)

Silver strontium thiosulphate,  $\text{Ag}_2\text{S}_2\text{O}_3 \cdot \text{SrS}_2\text{O}_3$ .

Nearly insol. in  $\text{H}_2\text{O}$  Very sl. sol. in  $\text{SrS}_2\text{O}_3 + \text{Aq}$ , easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Herschel.)

Sodium thiosulphate,  $\text{Na}_2\text{S}_2\text{O}_3$  and +1, 2 and  $5\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve.

At  $18^\circ$ , 65 pts.  $\text{Na}_2\text{S}_2\text{O}_3$ .

"  $20^\circ$ , 69 " "

"  $25^\circ$ , 75 " "

"  $30^\circ$ , 82 " "

"  $35^\circ$ , 89 " "

"  $40^\circ$ , 98 " "

"  $45^\circ$ , 109 " "

"  $47^\circ$ , 114 " "

(Mulder.)

100 pts.  $\text{H}_2\text{O}$  dissolve at  $0^\circ$ , 47.6 pts.  $\text{Na}_2\text{S}_2\text{O}_3$ ; at  $20^\circ$ , 69.5 pts.; at  $40^\circ$ , 104 pts.; at  $60^\circ$ , 192.3 pts. (Kremers, Pogg. 99. 50.)

100 pts  $\text{H}_2\text{O}$  dissolve 171 pts. cryst. (= 108.9 pts. anhydrous) salt at  $19.5^\circ$  to form a solution of 1.3875 sp. gr. (Schiff, A. 113. 350.)

By supersaturation 100 pts.  $\text{H}_2\text{O}$  may dissolve 217.4 pts.  $\text{Na}_2\text{S}_2\text{O}_3$  at  $0^\circ$ . (Kremers)

Solubility in  $\text{H}_2\text{O}$

$t^\circ$	% $\text{Na}_2\text{S}_2\text{O}_3$	Solid phase
0	34.43	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
10	37.89	"
20	41.17	"
30	45.86	"
40	50.65	"
45	54.49	"
50	62.92	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
60	67.39	"
72	70.39	"
80.5	71.33	"
90.5	71.76	"
100	72.68	"

(Taylor, Proc. Edinburgh Soc. 1898, 22. 49.)

Solubility of anhydrous  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g.	
	Solution	$\text{H}_2\text{O}$
40	67.40	206.70
45	67.60	208.60
50	67.76	210.20
55	68.15	214.00
60	68.48	217.30
65	68.80	220.50
70	69.05	223.10
75	69.35	226.30
80	69.80	231.80

(Young and Burke, J. Am. Chem. Soc. 1906, 28. 327.)

The solubility of the hydrates of  $\text{Na}_2\text{S}_2\text{O}_3$  are exceedingly complicated. There are five groups of hydrates, (I) primary, (II) secondary, (III) tertiary, (IV) quaternary, and (V), quintary, and transitions occur between members of the same and different groups.  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$  (I) is the commercial thiosulphate. The relations and solubility of the various hydrates is shown in the following table.

Solubility of  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

I. Primary hydrates.

$t^\circ$	g. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g.		Solid phase
	Solution	$\text{H}_2\text{O}$	
0	33.40	50.15	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ (I)
5	35.33	54.64	"
10	37.37	59.69	"
15	39.11	64.22	"
20	41.20	70.07	"
25	43.15	75.90	"
30	45.19	82.45	"
35	47.71	91.24	"
40	50.83	105.37	"
45	55.33	123.87	"
48 17	. .	. . .	" + $\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ (I)
0	52.73	111.60	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ (I)
5	53.45	114.90	"
10	53.94	117.10	"
20	55.15	122.68	"
25	56.03	127.43	"
30	57.13	133.27	"
40	59.38	146.20	"
45	60.73	154.70	"
50	62.28	165.11	"
55	63.85	176.60	"
60	65.68	191.30	"
65	68.04	212.90	"
66.5	. .	. . .	" + $\text{Na}_2\text{S}_2\text{O}_3$

Solubility of  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .—  
*Continued.*

## II. Secondary hydrates.

$t^\circ$	g. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g.		Solid phase
	Solu- tion	$\text{H}_2\text{O}$	
0	41.96	72.30	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}(\text{II})$
5	43.56	77.17	"
10	45.25	82.65	"
15	47.27	89.36	"
20	49.38	97.55	"
25	52.15	108.98	"
30	56.57	130.26	"
30 22	..	..	" $\text{Na}_2\text{S}_2\text{O}_3 \cdot 4\text{H}_2\text{O}(\text{II})$
33 5	58.59	141.48	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 4\text{H}_2\text{O}(\text{II})$
36 2	60.51	153.23	"
38 6	62.80	168.82	"
40 65	..	..	" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{II})$
0	60.47	153.00	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{II})$
5	60.74	154.70	"
10	61.04	156.70	"
15	61.57	160.20	"
20	62.11	163.90	"
25	62.73	168.30	"
30	63.56	174.40	"
35	64.32	180.20	"
40	65.22	187.60	"
45	66.02	194.30	"
50	66.82	201.40	"
55	67.90	211.50	"
56 5	..	..	" $+\text{Na}_2\text{S}_2\text{O}_3$

## III. Tertiary hydrates.

0	46.14	85.67	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ (III and IV)
5	48.44	93.95	"
10	51.66	106.80	"
13	54.96	122.00	"
14.35	..	..	" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{IV})$
14.3	..	..	" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{III})$
0	57.42	134.80	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{3}{2}\text{H}_2\text{O}(\text{III})$
5	57.84	137.20	"
10	58.28	139.70	"
15	58.80	142.70	"
20	59.28	145.60	"
25	60.18	151.10	"
30	60.78	155.00	"
35	61.57	160.20	"
40	62.60	167.40	"
45	63.97	177.50	"
47.5	64.68	183.00	"
48.5	..	..	" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{III})$
47 5	64.78	183.90	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{III})$
50	65.30	188.20	"
52.5	65.89	193.20	"
55	66.45	198.10	"
60	68.07	213.10	"
61	..	..	" $+\text{Na}_2\text{S}_2\text{O}_3$

Solubility of  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .—  
*Continued.*

## IV. Quaternary hydrate.

$t^\circ$	g. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g.		Solid phase
	Solu- tion	$\text{H}_2\text{O}$	
0	57.63	136.00	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{IV})$
5	58.08	138.60	"
10	58.49	140.90	"
15	59.00	143.90	"
20	59.57	147.30	"
25	50.35	152.30	"
30	61.03	156.60	"
35	61.94	162.80	"
40	62.95	169.90	"
45	64.22	179.50	"
50	65.45	189.50	"
55	67.07	203.70	"
58	..	..	" $+\text{Na}_2\text{S}_2\text{O}_3$

## V. Quintary hydrates.

0	57.63	136.00	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}(\text{V})$
5	58.23	139.40	"
10	59.05	144.20	"
15	60.02	150.10	"
20	61.02	156.50	"
25	62.30	165.30	"
30	63.50	174.40	"
35	65.27	188.00	"
27 5	..	..	" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{V})$
30	63.34	172.80	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{V})$
35	64.07	178.40	"
40	64.75	183.70	"
45	65.58	190.50	"
50	66.58	199.20	"
55	67.59	208.50	"
43	..	..	" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{V})$
25	64.21	179.40	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{V})$
35	64.60	182.50	"
40	64.99	185.60	"
45	65.61	190.82	"
50	66.02	194.30	"
55	66.57	199.10	"
60	67.40	206.70	"
65	68.24	214.90	"
70	69.06	..	"
70	..	..	" $\text{Na}_2\text{S}_2\text{O}_3$

(Young and Burke, J. Am. Chem. Soc. 1906, 28, 321.)

Heat is absorbed by dissolving in  $\text{H}_2\text{O}$ .  
110 pts.  $\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O} + 100$  pts.  $\text{H}_2\text{O}$   
lower temp. from  $10.7^\circ$  to  $8^\circ$ . (Rüdorff, B 2, 68.) $+\frac{1}{2}\text{H}_2\text{O}$ . (Young and Burke, J. Am. Chem. Soc. 1906, 28, 321.) $+\text{H}_2\text{O}$ . $+\frac{1}{2}\text{H}_2\text{O}$ . (Young and Burke.) $+\frac{1}{2}\text{H}_2\text{O}$ . (Young and Burke.)

+2H<sub>2</sub>O.  
+4H<sub>2</sub>O. M.-pt. 41.60°. (Young and Burke)  
+5H<sub>2</sub>O. M.-pt. 45° (Kopp); 48° (Kremers), 50° (Mulder); 48.5° (Hilden, Chem. Soc. 45. 409); 47.9° (Taylor, Proc. Edinburgh, Soc. 1898, 22. 249); 48.09° (Richards and Churchill, Z. phys. Ch. 1899, 28. 314); 48.45° (Young and Burke, J. Am. Chem. Soc. 1906, 28. 324)

Labile modification melts at 32°. (Paimentier and Amat, C. R. 98. 735.)

Sp. gr of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq at 19°.

% = %Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + 5H<sub>2</sub>O

%	Sp gr	%	Sp gr	%	Sp gr.
1	1.0052	18	1.0975	35	1.1986
2	1.0105	19	1.1031	36	1.2048
3	1.0158	20	1.1087	37	1.2110
4	1.0211	21	1.1145	38	1.2172
5	1.0264	22	1.1204	39	1.2234
6	1.0317	23	1.1263	40	1.2297
7	1.0370	24	1.1322	41	1.2362
8	1.0423	25	1.1381	42	1.2427
9	1.0476	26	1.1440	43	1.2492
10	1.0529	27	1.1499	44	1.2558
11	1.0584	28	1.1558	45	1.2624
12	1.0639	29	1.1617	46	1.2690
13	1.0695	30	1.1676	47	1.2756
14	1.0751	31	1.1738	48	1.2822
15	1.0807	32	1.1800	49	1.2888
16	1.0863	33	1.1862	50	1.2954
17	1.0919	34	1.1924		

(Schiff, A. 113. 118.)

B.-pt. of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq. P = pts. Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> to 100 pts. H<sub>2</sub>O.

B-pt	P	B-pt	P	B-pt	P
101°	14	110°	104	119°	201
102°	27	111	113	120	214 5
103	39	112	122	121	229
104	49 5	113	131.5	122	244
105	59	114	141.5	123	262
106	68	115	152	124	283
107	77	116	164	125	311
108	86	117	175.75	126	348
109	95	118	188		

(Gerlach, Z. anal. 26. 436.)

Moderately sol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20. 829.)

100 pts. absolute ethyl alcohol dissolve at room temperature 2.5 mg Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>. (Böttker, Z. phys. Ch. 1897, 22. 410.)

100 pts absolute ethyl alcohol dissolve at room temperature 3.4 mg Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + 5H<sub>2</sub>O. (Böttker, Z. phys Ch 1897, 22. 510)

Sol. in oil of turpentine (Edison, Am Chemist, 7. 127). Insol. therein (Techn. J B. 27. 1003).

Insol. in ethyl acetate (Casaseca, C. R. 30. 821)

**Sodium thalious thiosulphate**, 3Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, 2Tl<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + 10H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Werther)  
+8H<sub>2</sub>O (Jochum)  
2Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, Tl<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + 8H<sub>2</sub>O (Vortmann and Padberg, B. 22. 2638)

**Sodium zinc thiosulphate**, Na<sub>2</sub>S<sub>4</sub>O<sub>6</sub>, 2ZnS<sub>2</sub>O<sub>3</sub> + 23H<sub>2</sub>O.

Sol in H<sub>2</sub>O (Jochum, C. C. 1885. 642)  
3Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, 2ZnS<sub>2</sub>O<sub>3</sub> + 10H<sub>2</sub>O. Deliquescent. (Vortmann and Padberg, B. 22. 2640.)

**Sodium thiosulphate mercuric iodide**, 2Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, HgI<sub>2</sub>.

Decomp by H<sub>2</sub>O and by alcohol. (Eder and Uhm, M. 1882, 3. 197)

**Strontium thiosulphate**, SrS<sub>2</sub>O<sub>3</sub> + 5H<sub>2</sub>O.

Permanent. Sol in 6 pts. cold H<sub>2</sub>O (Gay-Lussac), in 4 pts H<sub>2</sub>O at 13°, and 1.75 pts. boiling H<sub>2</sub>O (Herschel, 1819)

1 g is sol. in 3.7 cc. H<sub>2</sub>O at room temp. (Antenrieth, Z. anal. 1898, 37. 293.)

Gradually efflorescent. Insol in alcohol. (Herschel)

**Thalious thiosulphate**.

Ppt. Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O. (Crookes.)

Easily sol. in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq (Jochum.)

**Tin thiosulphate (?)**.

Sol. in H<sub>2</sub>O.

**Uranyl thiosulphate**, (UO<sub>2</sub>)S<sub>2</sub>O<sub>3</sub>.

Ppt. (Faktor, C. C. 1901, II. 878.)

**Zinc thiosulphate**, ZnS<sub>2</sub>O<sub>3</sub> + xH<sub>2</sub>O.

Very deliquescent, and very sol. in H<sub>2</sub>O and alcohol. (Rammelsberg)

**Zinc thiosulphate ammonia**, ZnS<sub>2</sub>O<sub>3</sub>, 2NH<sub>3</sub>.

Decomp by H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH + Aq, from which it is pptd. by alcohol (Rammelsberg, Pogg. 56. 62.)

**Thiothiazyl bromide**, N<sub>2</sub>S<sub>4</sub>Br.

Decomp. H<sub>2</sub>O and alkalis.

Stable in the air (Muthmann, B. 1897, 30. 630.)

**Thiodithiazyl dichloride**, S<sub>2</sub>N<sub>2</sub>Cl<sub>2</sub>.

See Nitrogen sulphochloride.

**Thiothiazyl chloride**, S<sub>2</sub>N<sub>2</sub>Cl.

See Nitrogen sulphochloride.

**Thiothiazyl iodide**, N<sub>2</sub>S<sub>4</sub>I.

Decomp spontaneously in the air. Very unstable. (Muthmann, B. 1897, 30. 631)

**Thiothiazyl nitrate,  $S_4N_4NO_3$ .**

Sol in  $H_2O$  with decomp Sol in  $HNO_3 + Aq.$  (Demargay, C. R. 91. 1066)  
Sol. in cold  $H_2O$  with decomp  
Completely insol in organic solvents, as  $CS_2$ ,  $CHCl_3$ , acetone, and acetic ether. (Muthmann and Seitter, B. 1897, 30. 629.)

**Thiothiazyl sulphate  $(S_4N_4)HSO_4$ .**

Stable on air Sol in  $H_2O$  with decomp (Demargay, C. R. 91 854. 1066.)

**Thiothiazyl sulphocyanide,  $N_4S_4CNS$ .**

Stable in the air.  
Sol in benzene and chloroform. (Muthmann and Seitter, B. 1897, 30. 631.)

**Dithioetetrathiazyl dichloride,  $S_8N_4Cl_2$ .**

See Nitrogen sulphochloride.

**Thorium, Th.**

Not oxidised by boiling  $H_2O$   
Quickly sol (Chydenus, Pogg 119. 43), very slowly sol. by long boiling (Berzelius, Pogg. 16. 385) in  $HNO_3 + Aq.$  Insol. in cold, easily sol. in warm dil.  $H_2SO_4 + Aq.$  Slowly sol. in cold, rapidly in hot  $HCl + Aq.$  Easily oxidised by aqua regia. Insol. in  $KOH + Aq.$  or  $HF + Aq.$   
Sl. sol in dil.  $H_2SO_4 + Aq.$ ; decomp. by conc.  $H_2SO_4$ . Very sl. sol in dil., and less in conc.  $HNO_3 + Aq.$  Easily sol. in conc.  $HCl + Aq.$  and aqua regia. (Nilson, B. 15. 2521.)

**Thorium B.**

Somewhat sol in hot  $H_2O$ , which dissolves 70% in an hour. More rapidly sol. in dil. acids or hot  $KI + Aq.$  Somewhat sol. in organic solvents. Insol. in  $CS_2$  and in methylene iodide (Hogley, Phil. Mag. 1913, (6) 25. 331.)

**Thorium C.**

Somewhat sol in hot  $H_2O$ . More rapidly sol. in hot  $KI + Aq.$  and in dil. acids. More sol. in organic solvents than thorium B. 20% sol. in  $CS_2$  or methylene iodide in 10 minutes (Hogley, Phil. Mag. 1913, (6) 25. 331.)

**Thorium tetraboride,  $ThB_4$ .**

Sol. in cold conc.  $HNO_3$  and  $HCl$  and in hot conc.  $H_2SO_4$ . (Jassonneux, C. R. 1905, 141. 192.)

**Thorium hexaboride,  $ThB_6$ .**

Sol. in hot dil. or conc.  $HNO_3$ ; insol in  $H_2SO_4$ ,  $HCl$ ,  $HF$  and aq. alkalis. (Jassonneux, C. R. 1905, 141. 193.)

**Thorium dibromide,  $ThBr_2$ .**

Sol. in  $H_2O$  with partial decomp (Troost and Ouvrard, A. ch. (6) 17. 227.)

**Thorium tetrabromide,  $ThBr_4$ .**

Sol in  $H_2O$ . (Berzelius.)  
Very hygroscopic, and sol. in  $H_2O$  with partial decomp (Troost and Ouvrard, A. ch. (6) 17. 229.)  
Sl. sol. in organic solvents (Matthews, J. Am. Chem. Soc. 1898, 20. 840.)  
 $+7H_2O$ . Sol. in alcohol. (Rosenheim, B. 1900, 33. 979.)  
 $+8H_2O$ . Very sol. in alcohol and  $H_2O$ . Insol. in chloroform and light petroleum (Lesmsky, Z. anorg. 1897, 15. 82.)

**Thorium tetrabromide ammonia,  $ThBr_4 \cdot 3NH_3$ .**

Insol. in organic solvents. (Matthews, J. Am. Chem. Soc. 1898, 20. 840.)

**Thorium carbide,  $ThC_2$ .**

Almost insol. in conc. acids; decomp. by  $H_2O$  and by dil. acids (Moissan, C. R. 1896, 122. 577.)

**Thorium tetrachloride,  $ThCl_4$ .**

Anhydrous Extremely deliquescent, and sol. in  $H_2O$  with evolution of heat. Sol. in alcohol.  
Sol. in ether (Matthews, J. Am. Chem. Soc. 1898, 20. 824.)  
 $+7H_2O$ . Deliquesces in the air. Very sol. in  $H_2O$  and alcohol. Insol. in ether. (Krüss, Z. anorg. 1897, 14. 368.)  
 $+8H_2O$ . Hygroscopic. Easily sol. in  $H_2O$  and absolute alcohol. Not pptd. from solution in alcohol by ether.  
 $+9H_2O$ . As above (Rosenheim, Z. anorg. 1903, 35. 426.)

**Thorium tetrachloride ammonia,  $ThCl_4 \cdot 6NH_3$ .**

Insol. in ether. Decomp. by  $H_2O$ .  
 $ThCl_4 \cdot 8NH_3$ . Fumes in moist air. Decomp. by  $H_2O$  (Matthews, J. Am. Chem. Soc. 1898, 20. 824.)  
The compds. of  $ThCl_4$  with  $NH_3$  are of the type  $ThCl_4 \cdot nNH_3$ , and may be classified into three groups  
(1)  $n=4, 6, 7, 12, 18$ . Compds. are decomp. by  $H_2O$   
(2)  $n=4, 6, 7$  Compds. are not decomp. by  $H_2O$   
(3)  $n=6, 7, 12, 18$  The first two compds. of this series are identical with the last two of group (2).  
 $ThCl_4 \cdot 4NH_3$  of group (2) is the only one in the whole series stable above  $120^\circ$ . (Chauvenet, C. R. 1910, 151. 387.)

**Thorium fluoride,  $ThF_4 \cdot 4H_2O$ .**

Insol. in  $H_2O$  or  $HF + Aq.$

**Thorium hydride,  $ThH_2$ .**

Decomp. by dil.  $HCl + Aq.$  (Winkler, B. 24. 873.)

**Thorium hydroxide,  $\text{Th}(\text{OH})_4$ .**

Insol in  $\text{H}_2\text{O}$ .

Sol in acids, except oxalic, molybdic, and hydrofluoric acids

Insol in alkali hydroxides, but easily sol in alkali carbonates + Aq. More sol in  $\text{NH}_4\text{OH} + (\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  than in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  alone. (Berzelius.) Not pptd. in presence of tartaric and citric acids (Chydenius, Pogg 119. 43.)

$4\text{ThO}_2, \text{H}_2\text{O}$ . Insol. in water and acids at boiling temp.

**Thorium hydroxybromide,  $\text{Th}(\text{OH})_2\text{Br}_2 + 11\text{H}_2\text{O}$ .**

Sol. in alcohol. (Rosenheim, B 1900, 33. 979.)

**Thorium hydroxychloride;  $(\text{OH})\text{ThCl}_2 + 11\text{H}_2\text{O}$ .**

Sol. in alcohol. (Rosenheim, B. 1900, 33. 978.)

$\text{Th}(\text{OH})_2\text{Cl}_2 + 5\text{H}_2\text{O}$ . Slowly takes up  $\text{H}_2\text{O}$  from the air.

Sol. in  $\text{H}_2\text{O}$  without decomp

Sol in alcohol. Pptd from solution in alcohol by ether (Rosenheim, Z. anorg 1903, 35. 425)

+  $8\text{H}_2\text{O}$ . Hydrosopic, sol. in alcohol (Rosenheim, B 1900, 33. 978)

**Thorium hydroxyiodide,  $\text{Th}(\text{OH})\text{I}_2 + 10\text{H}_2\text{O}$** 

Evolves iodine in the light (Rosenheim, Z. anorg 1903, 35. 430.)

**Thorium iodide.**

Sol. in  $\text{H}_2\text{O}$ .

**Thorium nitride,  $\text{Th}_3\text{N}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Matignon, C. R 1901, 132. 37.)

**Thorium oxide,  $\text{ThO}_2$ .**

When ignited is insol. in  $\text{HCl}$  and  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{H}_2\text{SO}_4$  by heating to boiling and subsequent addition of  $\text{H}_2\text{O}$ . Insol in alkali hydrates or carbonates + Aq

**Thorium metoxide,  $\text{Th}_2\text{O}_3 + \text{H}_2\text{O}$ .**

Sl. sol. in  $\text{HCl}$ . (Locke, Z. anorg 1894, 7. 348.)

+  $2\text{H}_2\text{O}$ . Loses 1  $\text{H}_2\text{O}$  at  $100^\circ$ . Sol in  $\text{H}_2\text{O}$ ; insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  (Locke.)

**Metathorium oxide.**

Sol. in  $\text{H}_2\text{O}$  after having been treated with conc.  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ , even if previously ignited.

$\text{ThO}_2, x\text{Th}(\text{OH})_4$ . Compare  $\text{Th}_2\text{O}_3$ . (Locke) (Stevens, Z. anorg. 1901, 27. 42.)

**Thorium peroxide,  $\text{Th}_2\text{O}_4$ .**

Precipitate. (Cleve, C. R. 100. 605.)

**Thorium oxychloride.**

Decomp. by  $\text{H}_2\text{O}$  into  $\text{ThCl}_4$  and  $\text{ThO}_2$ .

$\text{ThOCl}_2$ . Sol in  $\text{H}_2\text{O}$ .

Insol in abs alcohol (Matignon, A. ch. 1907, (8) 10. 133)

+  $3\text{H}_2\text{O}$ .

+  $5\text{H}_2\text{O}$ . (Matignon, A. ch. 1907, (8) 10. 135)

**Metathorium oxychloride,  $\text{ThO}_2, x\text{ThCl}_4$ .**

Hydrosopic; sol in  $\text{H}_2\text{O}$ ; insol in abs. alcohol. (Stevens, Z. anorg. 1901, 27. 47.)

**Thorium oxyfluoride,  $\text{ThOF}_2$ .**

Insol. in  $\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{SO}_4$  with decomp. (Chauvenet, C. R. 1908, 146. 974)

**Thorium oxysulphide,  $\text{ThS}_2, 2\text{ThO}_2$ .**

(Chydenius)

**Thorium phosphide.**

Insol. in  $\text{H}_2\text{O}$  (Berzelius)

**Thorium silicide,  $\text{ThSi}_2$ .**

Sol. in aq. min. acids; insol. in aq. alkalies

Decomp. by fusion with  $\text{NaOH}$  or  $\text{KOH}$  (Höngschmid, C. R. 1906, 142. 158.)

**Thorium sulphide,  $\text{ThS}_2$ .**

Insol in warm  $\text{H}_2\text{SO}_4$ . Very slightly attacked by  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ . Sol. in hot aqua regia (Berzelius)

**Thoromolybdic acid.****Ammonium thoromolybdate,**

$(\text{NH}_4)_3\text{Th}(\text{Mo}_2\text{O}_7)_2 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Barbieri, C. A. 1913. 3724.)

$(\text{NH}_4)_2\text{H}_2\text{Th}(\text{Mo}_2\text{O}_7)_2 + 11\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids (Barbieri.)

**Silver thoromolybdate,  $\text{Ag}_3\text{Th}(\text{Mo}_2\text{O}_7)_2$ .**

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{HNO}_3 + \text{Aq}$ , but nearly insol. in presence of  $\text{AgNO}_3$ . (Barbieri)

**Sodium thoromolybdate,  $\text{Na}_3\text{Th}(\text{Mo}_2\text{O}_7)_2 + 15\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Barbieri.)

$\text{Na}_2\text{H}_2\text{Th}(\text{Mo}_2\text{O}_7)_2 + 17\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Barbieri.)

**Thulium, Tm.****Thulium chloride,  $\text{Tm}_2\text{Cl}_3 + 14\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$  and in alcohol (James, J. Am. Chem. Soc. 1911, 33. 1342.)

**Thulium hydroxide.**

Easily sol. in dil. acids. (James, J. Am. Chem. Soc. 1911, 33. 1342.)

**Thulium oxide,  $Tm_2O_3$** 

Slowly sol. in hot conc. acids. (James, J. Am. Chem. Soc. 1911, **33**, 1342.)

**Tin, Sn.**

Insol. in  $H_2O$ . Tin is not attacked by distilled  $H_2O$  when air is passed through it for a week.

Slowly sol. in dil. cold  $HCl + \Delta$ , but rapidly sol. if hot and conc. Slowly sol. in hot dil.  $H_2SO_4 + \Delta$ , but decomp. by hot conc.  $H_2SO_4$ .

Readily sol. in cold aqua regia. Attacked violently by conc.  $HNO_3 + \Delta$  with pptn. of  $SnO_2$ . Completely sol. in dil. cold  $HNO_3 + \Delta$  (1 pt.  $HNO_3$ : 1 pt.  $H_2O$ ) at 22°. (Hay, C. N. **22**, 298.) Not attacked by pure conc.  $HNO_3 + \Delta$  of 1.512–1.419 sp. gr., but violently attacked by less conc. acid. Also attacked by most conc. acid if it contains  $NO_2$ . (Millon, A. ch. (3) **6**, 95.)

If Sn is placed in dil.  $HNO_3 + \Delta$  of 1.15 sp. gr. it is sol. dissolved, but soon pptd. again as  $SnO_2$ . If a small amt. of  $NH_4Cl$  is added, the Sn remains permanently in solution,  $HCl + \Delta$  has a similar action. (Ordway, Am. J. Sci. (2) **23**, 220.) Easily sol. in the cold in mixture of 1 vol.  $H_2SO_4$ , 2 vols.  $HNO_3$ , and 3 vols.  $H_2O$ . (Basset, C. N. **53**, 172.)

$HNO_3 + \Delta$  containing less than 12%  $HNO_2$  attacks Sn and forms a stannous salt, which decomposes, giving a turbid solution.  $HNO_3 + \Delta$  (12–45%  $HNO_2$ ) completely dissolves Sn, but solution becomes turbid on standing.  $HNO_3 + \Delta$  containing more than 45%  $HNO_2$  does not dissolve Sn, but forms a white substance, which is sol. in  $H_2O$  if over 70% acid is used, this solution soon becomes turbid. (Montemartini, Gazz. ch. it. **22**, 384.)

Sn dissolves in  $HNO_3 + \Delta$  at low temps. (0–21°). When very dil.  $HNO_3 + \Delta$  (14%  $HNO_2$ ) is used, the amount of stannous salt formed decreases only slightly with increase of temp. while with 30–40% acid it falls to zero at 21°. (Walker, J. Soc. Chem. Ind. 1893, 845.)

In presence of Fe, Cr or Al,  $HNO_3 + \Delta$  acts on Sn to form soluble products, from which conc.  $HNO_3$  ppt. all Sn as metastannic acid. (van Leent, C. C. 1899, I. 101.)

Much more sol. in acids when small quantities of metallic salts have been added. This is most noticeable when  $PtCl_4$  or tartar emetic is added to  $HCl + \Delta$ .  $HCl + \Delta$  with tartar emetic exerts 11 times, and with  $PtCl_4$ , 13 times the action exhibited by pure acid. (Millon, C. R. **21**, 37.)

Sol. in 2N  $HClO_4 + \Delta$ . (Hendrixson, J. Am. Chem. Soc. 1904, **26**, 755.)

Pyrosulphuric acid dissolves Sn on warming. (Divers, Chem. Soc. 1885, **47**, 639.)

Hot telluric acid attacks Sn. (Hutchins, J. Am. Chem. Soc. 1905, **27**, 1183.)

Sn is attacked by 17%  $HN_3 + \Delta$ . (Curtius and Russom, J. pr. 1898, (2) **58**, 299.)

Sol. in a solution of Na in liquid  $NH_3$ .

(Kraus, J. Am. Chem. Soc. 1907, **29**, 1562.)

Insol. in liquid  $NH_3$ . (Core, Am. Ch. J. 1898, **20**, 830.)

Sol. in boiling alum +  $\Delta$  (1 pt. alum to 4 pts.  $H_2O$ ).

Sol. in  $KHSO_4$ ,  $NH_4Cl$  (1.4), and  $K_2C_2H_3O_6 + \Delta$ . Sol. in  $K_2C_2H_3O_6 + \Delta$ , but not attacked by  $MgSO_4$ ,  $K_2SO_4$ ,  $KNO_3$ , or  $Na_2SO_4 + \Delta$ . (Cludius, J. pr. **9**, 161.)

Sol. in alkalis +  $\Delta$ .

Attacked easily by conc.  $NaCl$ ,  $KCl$ , or  $NH_4NO_3 + \Delta$ ; not attacked by  $NH_4Cl + \Delta$ . (Hallock, Am. Ch. J. **6**, 52.)

Sol. in  $Fe(NO_3)_3 + \Delta$  in presence of  $HNO_3$ , +  $\Delta$  in proportion of 1 atom Sn to 1 atom Fe. (Lopez and Storeh, W. A. B. **98**, 2b, 268.)

Solubility in dil. saline solutions

100 cem  $H_2O$  containing 0.5 g.  $NaCl$  or  $KCl$  dissolve 6 mg. Sn from 11.8 sq. cm. in one week when air without  $CO_2$  is passed through the solution, but none at all when the air contains  $CO_2$ .

100 cem  $H_2O$  containing 1 g.  $NH_4Cl$  dissolve 5 mg. Sn under above conditions without  $CO_2$ , and none with  $CO_2$ .

With 1 g.  $MgCl_2$ , 1 mg. Sn was dissolved without  $CO_2$ , and none with  $CO_2$ .

With 1 g.  $K_2SO_4$ , 2 mg. Sn were dissolved without  $CO_2$ , and none with  $CO_2$ .

With 1 g.  $KNO_3$ , 3 mg. Sn were dissolved without  $CO_2$ , and 1 mg. with  $CO_2$ .

With 1 g.  $Na_2CO_3$ , 7 mg. Sn were dissolved without  $CO_2$ .

With 1 g.  $NaOH$ , 220 mg. Sn were dissolved without  $CO_2$ .

$CaO, H_2 + \Delta$  did not dissolve. (Wagner, Dmgl. **221**, 280.)

Not attacked by sugar +  $\Delta$ . (Klein, C. R. **102**, 1170.)

$\frac{1}{2}$  cem oleic acid dissolves 0.0134 g. Sn in 6 days. (Gates, J. phys. Chem. 1911, **15**, 143.)

**Tin antimonide,  $SnSb$ .**

(Stead, J. Soc. Chem. Ind. 1897, **16**, 205.)

**Tin arsenide,  $Sn_3As_2$ .**

(Stead, J. Soc. Chem. Ind. 1897, **16**, 206.)

**Tin (stannous) bromide,  $SnBr_2$** 

Sol. in  $H_2O$

Sol. in pyridine. (Naumann, B. 1904, **37**, 4609.)

Mol. weight determined in pyridine and ethyl sulphide. (Werner, Z. anorg. 1897, **15**, 23.)

**Tin (stannic) bromide, basic,  $SrBr_2OH + 3H_2O$ .**

Sol. in  $H_2O$ . Decomp. in aq. solution when warmed.

Sol. in ether, methyl alcohol, ethyl alcohol, acetone, acetic acid and esters of organic acids. Nearly insol. in benzene, ligroin and  $CHCl_3$ . (Pfeffer, Z. anorg. 1914, **87**, 242.)

**Tin (stannic) bromide,  $\text{SnBr}_4$ .**

Deliquescent. Sol in  $\text{H}_2\text{O}$  without evolution of heat. (Balard)

Decomp. by  $\text{H}_2\text{O}$  much more quickly than  $\text{SnCl}_4$  (Lorenz, Z. anorg. 1895, 9, 378.)

Easily sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29, 374.);  $\text{PCl}_3$ ,  $\text{PBr}_3$  and  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25, 217.)

Sol in acetone. (Naumann, B. 1904, 37, 4328.)

+4 $\text{H}_2\text{O}$  (Preis and Raymann, C. C. 1882, 773)

**Stannic hydrogen bromide,  $\text{SnBr}_4 \cdot 2\text{HBr}$ .**

See Bromostannic acid.

**Stannic bromide with MBr.**

See Bromostannate, M.

**Tin (stannic) bromochloride,  $\text{SnClBr}_3$ .**

Fumes in moist air; decomp by  $\text{H}_2\text{O}$ . (Besson, C. R. 1897, 124, 685)

$\text{SnCl}_2\text{Br}_2$  Fumes in moist air. Decomp by  $\text{H}_2\text{O}$ . (Besson.)

$\text{SnCl}_3\text{Br}$  Fumes in moist air. Decomp. by  $\text{H}_2\text{O}$  (Besson.)

**Tin (stannic) bromotelluride,  $\text{SnBr}_3\text{Te}$ .**

Sol in cold  $\text{H}_2\text{O}$ . Decomp. in aq. solution at 80°.

$\text{SnBr}_3\text{I}$ .

$\text{SnBr}_3\text{I}_2$ . (Lenormand, C. C. 1899, II, 521, J. Pharm. 1899, 10, 114)

**Tin (stannous) chloride,  $\text{SnCl}_2$ , and +2 $\text{H}_2\text{O}$** 

Not deliquescent. 100 pts.  $\text{H}_2\text{O}$  dissolve 83.9 pts.  $\text{SnCl}_2$  at 0° (Engel, A. ch. (6) 17, 347) 100 pts.  $\text{H}_2\text{O}$  dissolve 269.8 pts.  $\text{SnCl}_2$  at 15°, and sat. solution has sp. gr. 1.827 (Michel and Krafft, A. ch. (3) 41, 478.) Sol. in a certain amount of  $\text{H}_2\text{O}$  without decomp., but more  $\text{H}_2\text{O}$  causes pptn. of  $\text{SnO}$ ,  $\text{SnCl}_4$ .

$\text{SnCl}_2 + \text{Aq}$  absorbs O from air

Melts in crystal  $\text{H}_2\text{O}$  at 46°. (Ordway)

Sat. solution boils at 121.7°.

Sp. gr. of  $\text{SnCl}_2 + \text{Aq}$  at 15° containing:

5 10 15 20 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ ,  
1.0331 1.0684 1.1050 1.1442

25 30 35 40 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ ,  
1.1855 1.2300 1.2779 1.3298

45 50 55 60 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ ,  
1.3850 1.4451 1.5106 1.5823

65 70 75 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ .  
1.6598 1.7452 1.8399

(Gerlach, Dingl. 186, 131.)

Solubility of  $\text{SnCl}_2$  in  $\text{HCl} + \text{Aq.}$   $\frac{\text{SnCl}_2}{2} =$

$\frac{1}{2}$  molecules  $\text{SnCl}_2$  in milligrammes in 10 cc solution,  $\text{HCl} =$  molecules  $\text{HCl}$  in milligrammes in ditto,  $\text{H}_2\text{O} =$  amt.  $\text{H}_2\text{O}$  present in grammes.

$\frac{\text{SnCl}_2}{2}$	HCl	Sum of equiv	Sp. gr. of solution	$\text{H}_2\text{O}$
74	0	74	1.532	8 33
66 7	6 6	73 3	1.489	8 35
63 75	13 54	77 29	1.472	8 198
68 4	24 8	93 2	1.524	7.869
81 2	34 9	116 1	1.625	7.305
94 2	40 0	134 2	1.724	6.880
117 6	44	161.6	1.883	6.108
147.6	49 4	197 0	2.114	5.387
156.4	66	222 4	2.190	4.715
157	78	235	2.199	4.309

(Engel, A. ch. (6) 17, 347.)

Solubility is thus diminished by  $\text{HCl} + \text{Aq.}$ , while there are less than 8-10 mols.  $\text{HCl}$  for 1 mol.  $\text{SnCl}_2$ . When that limit is passed the solubility rapidly increases. (Engel.)

Sol. in very dil.  $\text{HCl}$  or tartaric acid +  $\text{Aq.}$  Sol. in  $\text{KOH} + \text{Aq.}$  Sol. in conc.  $\text{SnOCl}_2 + \text{Aq.}$  (Gerlach.) Sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$

Anhydrous  $\text{SnCl}_2$  is partially sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 830.)

Sol. in absolute alcohol. Insol in oil of turpentine.

11 41 pts.  $\text{SnCl}_2$  are sol. in 100 pts. ether at 0°.

11.38 pts.  $\text{SnCl}_2$  are sol. in 100 pts. ether at 16°.

11.38 pts.  $\text{SnCl}_2$  are sol. in 100 pts. ether at 35.5°. (Laszczyński, B. 1894, 27, 2286.)

Anhydrous  $\text{SnCl}_2$  is sol. in ether. (de Jong, Z. anal. 1902, 41, 596.)

1 g. anhydrous  $\text{SnCl}_2$  is sol. in 1.8 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 1.6. (Naumann, B. 1904, 37, 4336.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II, 1014)

Anhydrous  $\text{SnCl}_2$  is sol. in methyl acetate to the extent of 15.7% (Schröder and Steiner, J. pr. 1909, (2) 79, 63.)

31.20 pts.  $\text{SnCl}_2 + 2\text{H}_2\text{O}$  are sol. in 100 pts. ethyl acetate at -2°.

35.53 pts.  $\text{SnCl}_2 + 2\text{H}_2\text{O}$  are sol. in 100 pts. ethyl acetate at +22°

73.44 pts.  $\text{SnCl}_2 + 2\text{H}_2\text{O}$  are sol. in 100 pts. ethyl acetate at 82°. (Laszczyński, B. 1894, 27, 2286.)

1 pt. anhydrous  $\text{SnCl}_2$  is sol. in 22.40 pts. ethyl acetate at 18°. D18°/4° = 0.9215. (Naumann, B. 1910, 43, 319.)

Insol in ethyl amine (Shinn, J. phys. Ch. 1907, 11, 538); pyridine (Naumann, B. 1904, 37, 4600); benzonitrile (Naumann, B. 1914, 47, 1369)

Insol. in  $\text{CS}_2$ . (Aretowski, Z. anorg. 1894, 6, 257.)  
Sol in urethane (Castoro, Z. anorg. 1899, 20, 61.)  
Mol weight determined in pyridine and ethyl sulphide. (Werner, Z. anorg. 1897, 15, 22.)

**Tin (stannic) chloride, basic,  $\text{SnCl}_4\text{OH} + 3\text{H}_2\text{O}$ .**

Hygroscopic.

Sol. in  $\text{H}_2\text{O}$ .

Sol in ether, alcohol, acetone, acetic acid.  
Nearly insol. in ligrom and benzene (Pfeuffer Z. anorg. 1914, 87, 241.)

**Tin (stannic) chloride,  $\text{SnCl}_4$ .**

(a) *Ordinary modification.*—Deliquescent. Sol. in  $\text{H}_2\text{O}$ . On diluting  $\text{SnCl}_4 + \text{Aq}$  and boiling,  $\text{SnO}_2$  separates out.  $\text{SnCl}_4 + \text{Aq}$  is not pptd by  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ ;  $\text{H}_3\text{PO}_4 + \text{Aq}$  ppts. in a few days, and  $\text{H}_4\text{AsO}_4 + \text{Aq}$  in a short time. No ppt is formed by  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{KCl}$ ,  $\text{NaCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{KNO}_3$ , etc. +  $\text{Aq}$ .

Sp. gr. of  $\text{SnCl}_4 + \text{Aq}$  at  $15^\circ$ .

% $\text{SnCl}_4$ + $5\text{H}_2\text{O}$	Sp. gr.	% $\text{SnCl}_4$ + $5\text{H}_2\text{O}$	Sp. gr.	% $\text{SnCl}_4$ + $5\text{H}_2\text{O}$	Sp. gr.
2	1.012	34	1.226	66	1.538
4	1.024	36	1.242	68	1.563
6	1.036	38	1.259	70	1.587
8	1.048	40	1.276	72	1.614
10	1.059	42	1.293	74	1.641
12	1.072	44	1.310	76	1.669
14	1.084	46	1.329	78	1.698
16	1.097	48	1.347	80	1.727
18	1.110	50	1.366	82	1.759
20	1.124	52	1.386	84	1.791
22	1.137	54	1.406	86	1.824
24	1.151	56	1.426	88	1.859
26	1.165	58	1.447	90	1.894
28	1.180	60	1.468	92	1.932
30	1.195	62	1.491	94	1.969
32	1.210	64	1.514	96	1.988

(Gerlach, Dingl. 178, 49.)

Sp. gr. of  $\text{SnCl}_4 + \text{Aq}$ .

Deg. Baumé	% Sn	Deg. Baumé	% Sn	Deg. Baumé	% Sn
65.7	29.45	55	24.47	34	14.90
65	29.12	54	24.02	33	14.45
64	28.64	53	23.56	32	14.00
63	28.17	52	23.11	31	13.56
62	27.70	51	22.65	30	13.11
61	27.24	50	22.20	29	12.67
60	26.77	49	21.74	28	12.23
59	26.30	48	21.29	27	11.79
58	25.84	47	20.83	26	11.35
57	25.38	46	20.38	25	10.91
56	24.93				

(Heermann, Ch. Z. 1907, 31, 680.)

Sol in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25, 217.)

Easily sol in  $\text{PCl}_5$  and  $\text{PBu}_3$ . (Walden, Z. anorg. 1900, 25, 211.)

Very sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1899, 20, 830.)

Very sol. in absolute alcohol, from which it is pptd by  $\text{H}_2\text{O}$ . Easily sol in ether; decomp. by oil of turpentine. Miscible with  $\text{CS}_2$  and  $\text{Bu}_2$ .

Sol in acetone (Naumann, B. 1904, 37, 4328.)

Sol. in acetone and in methylal (Eidtmann, C. C. 1899, II, 1014.)

Sol in ethyl acetone. (Naumann, B. 1904, 37, 3601.)

Distribution of  $\text{SnCl}_4$  between  $\text{H}_2\text{O}$  and xylene

$n$  = pts by wt of  $\text{Cl}$  in 100 pts of  $\text{H}_2\text{O}$  layer.

$m$  = pts. by wt of  $\text{Cl}$  in 100 pts. of xylene layer

$k$  = partition coefficient

50 cc. xylene + 60 g  $\text{SnCl}_4$ ,  $5\text{H}_2\text{O}$ .

$t^\circ$	$n$	$m$	$k$
$66^\circ$	40.35	0.08	504.4
$80^\circ$	39.95	0.175	228.5
$97.5^\circ$	40.24	0.33	122.1
$111^\circ$	40.27	0.68	59.3

(Smurnoff, Z. phys. Ch. 1907, 58, 377.)

50 cc xylene + 60 g  $\text{SnCl}_4$ ,  $4\text{H}_2\text{O}$ .

$t^\circ$	$n$	$m$	$k$
$66^\circ$	41.905	0.925	45.3
$80^\circ$	41.915	1.555	27.0
$100^\circ$	41.845	2.515	16.7
$111^\circ$	41.68	3.235	12.9

(Smurnoff.)

50 cc. xylene + 60 g  $\text{SnCl}_4$ ,  $3\text{H}_2\text{O}$ .

$t^\circ$	$n$	$m$	$k$
$80^\circ$	43.205	9.95	4.4
$94^\circ$	42.545	9.325	4.6
$100^\circ$	42.645	10.56	5.1
$111^\circ$	42.31	10.03	4.2

(Smurnoff.)

+  $2\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ .  
+  $3\text{H}_2\text{O}$ . Tr. pt.  $83^\circ$ . (Meyerhoffer, Bull. Soc. 1891 (3) 6, 85.)

+  $4\text{H}_2\text{O}$ . Tr. pt.  $63^\circ$ . (Meyerhoffer.)

+  $5\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol. Sol in  $\text{HCl} + \text{Aq}$ . Tr. pt.  $56^\circ$ . (Meyerhoffer.)

+  $8\text{H}_2\text{O}$ . More deliquescent than the  $5\text{H}_2\text{O}$  salt. Tr. pt.  $19^\circ$ . (Meyerhoffer.)

+  $9\text{H}_2\text{O}$ . (Nollner, Z. Ch. 1866, 45.)

(b) *Metastannic chloride*—Sol. in cold  $H_2O$ ; solution coagulates on boiling. Conc.  $HCl$ +Aq ppts. from  $SnCl_4$ +Aq. When solution does not contain  $HCl$ , the addition of  $HCl$ +Aq causes a ppt., which dissolves in  $H_2O$ ,  $HNO_3$ , and  $H_2SO_4$ +Aq also ppt.  $K_2SO_4$ ,  $Na_2SO_4$ , and  $NaCl$ +Aq produce ppts. insol. in  $H_2O$ , but sol. in  $HCl$ +Aq.  $NH_4Cl$  or  $KCl$ +Aq do not ppt.  $KNO_3$ +Aq ppts. slowly. (Rose)

Tin (stannous) hydrogen chloride,  $SnCl_2$ ,  $HCl$ + $3H_2O$

Decomp. by  $H_2O$ .

Melts at  $-25^\circ$ . (Engel, C R 106, 1398.)

Tin (stannic) hydrogen chloride.

See Chlorostannic acid.

Tin (stannous) hydrazine chloride,  $SnCl_2$ ,  $2N_2H_4$ ,  $HCl$

Very hygroscopic.

Sol. in  $H_2O$  and abs. alcohol (Curtius J. pr 1894, (2) 50, 341)

Tin (stannic) chloride with  $MCl$ .

See Chlorostannate, M.

Tin (stannous) chloride ammonia,  $SnCl_2$ ,  $NH_3$ .

(Berzelius)

$SnCl_2$ ,  $4NH_3$  Ppt. (Naumann. B. 1904, 37, 4326)

Tin (stannic) chloride ammonia,  $SnCl_4$ ,  $2NH_3$ .

Sol. in cold  $H_2O$  without decomp., but decomposes by heating

Tin (stannous) chloride arsenate.

See Arsenate chloride, stannous.

Tin (stannic) chloride cyanhydric acid,  $SnCl_4$ ,  $2HCN$ .

Decomp. on moist air or with  $H_2O$ . (Klein, A. 74, 85)

Tin (stannous) chloride hydrazine,  $SnCl_2$ ,  $2N_2H_4$ .

Decomp. by  $H_2O$ .

Insol. in  $NH_4OH$ +Aq. (Franzen, Z. anorg. 1908, 60, 286.)

Tin (stannic) chloride nitrogen sulphide,  $SnCl_4$ ,  $2N_2S_4$ .

Insol. in most solvents.

Decomp. by warm  $NH_4OH$ +Aq

Decomposes in the air (Wölsblling, Z. anorg. 1908, 57, 284.)

Decomp. by  $H_2O$ . (Davis, Chem. Soc, 1906, 89, 1576)

Tin (stannic) chloride phosphine,  $3SnCl_4$ ,  $2PH_3$ .

Decomp. by  $H_2O$  (Rose, Pogg. 24, 159)

Tin (stannous) chloride potassium stannous sulphate.

See Sulphate, potassium stannous stannous chloride.

Tin (stannic) chloride sulphur tetrachloride,  $SnCl_4$ ,  $2SCl_4$ .

Very hygroscopic

Sol. in  $CHCl_3$ , ligrom, petroleum ether,  $CS_2$ ,  $POCl_3$ ; very sol. in completely dry absolute ether, in benzene, acetic acid ester and in  $SCl_2$  (Ruff, B. 1904, 37, 4517.)

Tin (stannic) chloride sulphide,  $2SnCl_4$ ,  $SnS_2$ .

See Stannic sulphochloride.

Tin (stannic) chlorobromide,  $SnClBr_3$ .

Decomp. by  $H_2O$ . (Ladenburg, A. suppl 8, 60.)

$SnCl_2Br_2$  Decomp. by  $H_2O$ . (Ladenburg)

Tin (stannous) chloriodide,  $SnClI_3$ .

Decomp. immediately by  $H_2O$  (Henry, Phil. Trans. 1845, 363.)

Tin (stannic) chloriodide,  $SrCl_2I_4$ .

Fumes in the air

Decomp. by  $H_2O$  (Lenormand, J. Pharm 1898, 8)

$SnClI_3$  (Lenormand, J. Pharm. 1899, 10, 114)

Tin (stannous) fluoride,  $SnF_2$ .

Easily sol. in  $H_2O$ . (Berzelius, Pogg. 1, 34.)

Tin (stannic) fluoride,  $SnF_4$ .

Very hygroscopic.

Sol. in  $H_2O$ . Slowly decomp. in aq. solution with separation of  $SnO_2$ . (Ruff, B. 1904, 37, 681.)

Tin (stannic) fluoride with MF.

See Fluostannate, M.

Tin (stannous) hydroxide,  $2SnO$ ,  $H_2O$ .

Decomp. to  $SnO$  when boiled with  $H_2O$ . More easily sol. in acids than  $Sn$  or  $SnO$ . Sol. in  $NaOH$ , and  $KOH$ +Aq, even when dil. Insol. or very sl. sol. in  $NH_4OH$ ,  $(NH_4)_2CO_3$ , and  $K_2CO_3$ +Aq; sol. in cold  $CaO_2H_2$ , and  $BaO_2H_2$  with decomposition on boiling (Freymy, A. ch. (3) 12, 460.) Only sl. sol. in  $NH_4Cl$ +Aq hot or cold. (Brett.) Sl. sol. in  $Na_2CO_3$ +Aq. (Mercer.)

## Solubility in NaOH + Aq.

G Na in 20 ccm	G Sn in 20 ccm
0.2480	0 1904
0 3680	0 2614
0 6394	0 4304
0 8326	0 5560
0 9661	0 7849
2 1234	1 8934

(Ruhensbauer, Z. anorg. 1902, 30. 335.)

Not pptd in presence of Na citrate (Spiller)

Sol in water-glass + Aq (Ordway.)

$\text{SnO}_2 \cdot \text{H}_2\text{O}$ . Solubility in 1 l.  $\text{H}_2\text{O}$  = 0.000135 g. mol at 25° (Goldschmidt, Z. phys. Ch. 1906, 66. 389)

**Tin hydroxide,  $\text{SnO}$ ,  $6\text{SnO}_2 + 5\text{H}_2\text{O}$ .**

+  $9\text{H}_2\text{O}$  (Schiff, A. 120. 153.)

**Tin sesquihydroxide,  $\text{Sn}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ .**

Insol in  $\text{H}_2\text{O}$  Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Fuchs, J. pr. 5. 318)

**Tin (stannic) hydroxide.**

" $\alpha$ " modification.

Obtained by pptn by alkali in stannic chloride solution.

Freshly pptd. substance when air dried contains 73.5%  $\text{H}_2\text{O}$ ; when dried over  $\text{H}_2\text{SO}_4$  or in a vacuum for 1 month 12.6%  $\text{H}_2\text{O}$ . Heated to glowing loses all  $\text{H}_2\text{O}$  and passes into the anhydride. The " $\alpha$ " form is capable of existing in all degrees of hydration. (Loefer, Z. anorg. 1895, 9. 372-375.)

" $\alpha$ " stannic hydrate is a white amorphous substance which is very sol. in  $\text{HNO}_3$  when moist, sol. in  $\text{H}_2\text{SO}_4$  even dil., sol. in  $\text{HCl}$  and not pptd by an excess. Very sol. in  $\text{NaOH} + \text{Aq}$  and is not pptd by an excess.

A solution of  $\alpha$  stannic acid in  $\text{HCl}$  is identical with a solution of freshly prepared aqueous stannic chloride and gives no ppt with dil  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  or arsenic acid even on long standing.

" $\beta$ " modification.

Obtained by oxidizing and dissolving Sn in  $\text{HNO}_3$ , and from solution of sodium stannate by pptn. Freshly pptd. from  $\text{HNO}_3$  when air dried contains 21.3%  $\text{H}_2\text{O}$ , and when dried over  $\text{H}_2\text{SO}_4$  or in a vacuum 11.3%,—corresponding to  $\text{Sn}(\text{OH})_4$  and  $\text{SnO}(\text{OH})_2$  respectively.

Freshly pptd. from sodium stannate solution and air dried contains 22.5%  $\text{H}_2\text{O}$  and when dried over  $\text{H}_2\text{SO}_4$  or in a vacuum contains 12.1%,—corresponding to  $\text{Sn}(\text{OH})_4$  and  $\text{SnO}(\text{OH})_2$ . Passes into the anhydride when heated to glowing.

The " $\beta$ " form is capable of existing in all degrees of hydration. It is a white amorphous substance which is insol in  $\text{HNO}_3$ ; in-

sol in  $\text{H}_2\text{SO}_4$  even when conc.; insol in  $\text{HCl}$  but changed by contact with the acid in that when the acid has been removed the ppt. is readily sol. in  $\text{H}_2\text{O}$ , though pptd. again from solution by addition of  $\text{HCl}$ . When freshly prepared the " $\beta$ " form is sol. in  $\text{NaOH} + \text{Aq}$ . but is pptd. by an excess of  $\text{NaOH}$ .

A solution of " $\beta$ " stannic acid in  $\text{HCl}$  behaves quite differently from an aq. solution of stannic chloride in that it ppts metastannic sulphate when treated with  $\text{H}_2\text{SO}_4$ .

This ppt. dissolves when heated with dilute  $\text{HNO}_3$  or  $\text{HCl}$ , but the solution on standing spontaneously forms another ppt. A solution of " $\beta$ " stannic acid in  $\text{HCl}$  gives a ppt. when treated with arsenic acid (Loefer, Z. anorg. 1895, 9. 372.)

See also Stannic acid.

**Tin hydroxyl chloride,  $\text{SnO}(\text{OH})\text{Cl}$ .**

See Chlorostannic acid.

**Tin (stannous) iodide,  $\text{SnI}_2$ , and  $+2\text{H}_2\text{O}$ .**

Sl sol. in cold, more abundantly in hot  $\text{H}_2\text{O}$ , without decomp.

Solubility in  $\text{H}_2\text{O}$ .

t°	Pts $\text{SnI}_2$ in 100 pts solution	t°	Pts $\text{SnI}_2$ in 100 pts solution
98.5	3.43	97.3	3.70
84.9	3.05	87.4	3.24
73.9	2.56	77.6	2.75
60.1	2.09	67.5	2.34
51.5	1.79	59.7	2.03
41.0	1.50	49.5	1.72
30.5	1.21	39.4	1.38
20.8	1.03	29.6	1.11
		19.8	0.95

(Young, J. Am. Chem. Soc. 1897, 19. 846.)

Solubility of  $\text{SnI}_2$  in  $\text{HI} + \text{Aq}$  at t°.

Pts.  $\text{SnI}_2$  per 100 pts. solvent.

t°	5.82% HI	9.60% HI	14.20% HI	20.44% HI	24.80% HI	30.10% HI	36.28% HI
20	0.98	0.20	0.60	1.81	4.20	8.65	25.31
30	1.16	0.23	0.64	1.81	4.06	10.28	23.46
40	1.40	0.33	0.71	1.90	4.12	10.06	23.15
50	1.69	0.46	0.82	2.14	4.34	10.35	23.76
60	2.07	0.66	1.12	2.51	4.78	11.03	24.64
70	2.48	0.91	1.37	2.92	5.48	11.97	25.72
80	2.95	1.23	1.83	3.70	6.38	13.07	27.23
90	3.46	1.65	2.40	4.58	7.82	15.52	29.84
100	4.03	2.23	3.63	5.82	9.60	...	34.05

(Young, J. Am. Chem. Soc. 1897, 19. 851.)

Solubility of  $\text{SnI}_2$  at low temp. in 29.95% HI+Aq.

Temp	Pts in 100 pts solution	Pts. in 100 pts solvent
1.5	12.96	14.89
1.5	13.15	15.14
6.0	12.35	14.09
10.5	11.01	12.36
15.2	10.48	11.70
24.8	9.36	10.33
30.7	8.78	9.62
34.8	8.70	9.50
40.3	9.51	10.50

(Young, J. Am. Chem. Soc. 1897, **19**, 854.)Solubility of  $\text{SnI}_2$  at low temp. in 39.6% HI+Aq.

Temp	Pts in 100 pts of solution		Pts in 100 pts. of solvent
	I	II	
0°	13.52	13.56	15.66
5.7°	16.44	16.37	19.71
10.5°	19.47	19.60	24.27
15.7°	23.56	23.68	30.92
20.3°	25.50	25.60	34.30

(Young, J. Am. Chem. Soc. 1897, **19**, 852-853.)

Sol. in  $\text{SnCl}_2$ +Aq. Sol in warm alkali chlorides or iodides + Aq, also in dil.  $\text{HCl}$ +Aq. Very sl. sol. in  $\text{CHCl}_3$ ,  $\text{CS}_2$ , or  $\text{C}_6\text{H}_6$ . (Personne, C. R. **54**, 216.)

Sol. in  $\text{KOH}$ +Aq. (Rose.)Sol. in acetone. (Naumann, B. 1904, **37**, 4328.)Tin (stannic) iodide,  $\text{SnI}_4$ .Decomp. by  $\text{H}_2\text{O}$  into  $\text{SnO}_2$  and  $\text{HI}$ .Very sol in  $\text{PCl}_5$ . (Beckmann, Z. anorg. 1906, **51**, 110.)Sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, **25**, 212.)Easily sol. in  $\text{PCl}_5$  and  $\text{PBr}_5$ . (Walden, Z. anorg. 1900, **25**, 211.)Sol. in liquid  $\text{AsBr}_3$  forming a solution with sp. gr. = 3.731 at 15°. (Retgers, Z. phys. Ch. 1893, **11**, 342.)Sol. in  $\text{SOCl}_2$ ,  $\text{S}_2\text{Cl}_2$  and  $\text{SO}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, **25**, 215.)Sol. in  $\text{SnCl}_4$ . (Walden.)Sol. in anhydrous alcohol, ether, and benzene. 1 pt.  $\text{CS}_2$  dissolves 1.45 pts.  $\text{SnI}_4$  at ordinary temp. (Schneider, Pogg. **127**, 624.)100 pts. methylene iodide,  $\text{CH}_2\text{I}_2$ , dissolve 22.9 pts.  $\text{SnI}_4$  at 10°. Sp. gr. of solution = 3.481. (Retgers, Z. anorg. **3**, 343.)

## Solubility in organic solvents at t°.

Solvent	t°	G $\text{SnI}_4$ in 100 g. of the sat. solution	Sp. gr. of the sat. solution
$\text{OCl}_4$	22.4	5.25	1.59
$\text{OCl}_4$	50.0	12.50	1.63
$\text{CHCl}_3$	28.0	8.21	1.50
$\text{C}_6\text{H}_6$	20.2	12.65	0.95

(McDermott, J. Am. Chem. Soc. 1911, **33**, 1964.)Sol. in methyl acetate. (Naumann, B. 1909, **42**, 3700.)

Sol. in acetone. (Eidman, C. C. 1899, II, 1014.)

Solubility in  $\text{CS}_2$ .

100 g. of the sat. solution contain at:

-58° -84° -89° -94° -114.5°  
16.27 10.22 9.68 10.65 9.41 g.  $\text{SnI}_4$ .(Arcotowski, Z. anorg. 1896, **11**, 274.)Sol. in allyl mustard oil (Mathews, J. phys. Ch. 1905, **9**, 647.)Tin (stannous) hydrogen iodide,  $\text{SnI}_2$ ,  $\text{HI}$ .Not obtained in pure state. (Young, J. Am. Chem. Soc. 1897, **19**, 856.)Tin (stannous) iodide ammonia,  $\text{SnI}_2 \cdot 2\text{NH}_3$ .(Ephraim and Schmidt, B. 1909, **42**, 3857.) $\text{SnI}_2 \cdot 8\text{NH}_3$ . (Ephraim and Schmidt.)Tin (stannic) iodide ammonia,  $\text{SnI}_4 \cdot 8\text{NH}_3$ .(Personne, C. R. **54**, 218.) $\text{SnI}_4 \cdot 4\text{NH}_3$ . (Personne.) $\text{SnI}_4 \cdot 8\text{NH}_3$ . (Rammelsberg, Pogg. **48**, 169.)

## Tin iodosulphide,

See Tin sulphoidide.

Tin monoxide (Stannous oxide),  $\text{SnO}$ .Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Very sl. sol. in boiling  $\text{NH}_4\text{Cl}$ +Aq. (Rose.) Insol. in  $\text{NaOH}$  or  $\text{KOH}$ +Aq.Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, **20**, 830.)Insol. in acetone. (Naumann, B. 1904, **37**, 4329.)Tin dioxide (Stannic oxide),  $\text{SnO}_2$ .Insol. in  $\text{H}_2\text{O}$  or conc. acids except conc.  $\text{H}_2\text{SO}_4$ . Insol. in conc. alkalis or  $\text{NH}_4\text{OH}$ +Aq.Not absolutely insol. in dil.  $\text{HNO}_3$ +Aq. (Mulder.)Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, **20**, 830.)Min. *Cassiterite* (Tin stone). Not attacked by acids.

**Tin sesquioxide,  $\text{Sn}_2\text{O}_3$ .**

While moist, easily sol in  $\text{NH}_4\text{OH} + \text{Aq.}$   
Sl sol. in dil., more easily in conc  $\text{HCl} + \text{Aq}$   
(Berzelius)

**Tin (stannic) oxybromide,  $\text{Sn}_2\text{Br}_2\text{O} + 12\text{H}_2\text{O}$ .**

Decomp by  $\text{H}_2\text{O}$  into  $\text{SnBr}_2$  and  $\text{H}_2\text{SnO}_3$ ,  
 $\text{Sn}_2\text{Br}_2\text{O}_3$ . As above (Preis and Ray-  
mann, C. C. 1882. 773.)

**Tin (stannic) oxybromide nitrogen pent-  
oxide,  $\text{SnO}_2, 3\text{Br}_2, \text{N}_2\text{O}_5$ .**

Decomp by  $\text{H}_2\text{O}$  (Thomas, C. R. 1896,  
122. 33)

**Tin (stannous) oxychloride,  $\text{SnO}, \text{SnCl}_2 + 3\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  Sol in  $\text{HCl}, \text{HClO}_2, \text{H}_2\text{O}_2$ , and  
dil  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (J. Davy, Schw.  
J. 10. 325.)

$\text{Sn}_2\text{Cl}_4\text{O}_3 + 10\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  or  
alcohol.

Can be recrystallized from alcohol but  
not from  $\text{H}_2\text{O}$  (Tschermak, W. A. B. 44.  
2. 736)

$3\text{SnO}_2, 2\text{SnCl}_2 + 6\text{H}_2\text{O}$ . Very sl. sol. in  
 $\text{H}_2\text{O}$ . Sol. in dil. acids (Ditte, A. ch. 1882,  
(5) 27. 146.)

$4\text{SnO}, \text{SnCl}_2 + 6\text{H}_2\text{O}$ . (Ditte)

**Tin (stannic) oxychloride,  $\text{SnO}_2, \text{SnCl}_4$ .**

Sol. in  $\text{H}_2\text{O}$  (Scheurer-Kestner, A. ch.  
(3) 47. 6.)

**Tin (metastannic) oxychloride,  $3\text{SnO}_2, \text{SnCl}_4 + 3\text{H}_2\text{O}$ .**

Sol. in little, decomp by much  $\text{H}_2\text{O}$ .  
(Weber, Pogg. 122. 338.)

$4\text{SnO}_2, \text{SnCl}_4 + 7\text{H}_2\text{O}$ . (Weber)

"Metastannyl chloride  $\beta$ ,"  $\text{Sn}_2\text{O}_3\text{Cl}_2$ . De-  
liquescant. Sol. without decomp. in a small  
amount of  $\text{H}_2\text{O}$  or in a large amount of  $\text{H}_2\text{O}$   
containing a few drops  $\text{HCl}$ .

Sol. in abs. alcohol. (Engel, C. R. 1897,  
124. 767.)

$+4\text{H}_2\text{O}$  and  $+9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  acidified  
with one drop of  $\text{HCl}$ . Pptd. by excess  $\text{HCl}$ .  
(Engel, C. R. 1897, 124. 768)

"Parastannyl chloride,"  $\text{Sn}_2\text{O}_3\text{Cl}_2 + 2\text{H}_2\text{O}$ .

Decomp. by excess  $\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; pptd. by  $\text{HCl}$  (Engel, C. R.  
1897, 125. 465.)

**Tin (stannic) oxychloride nitrogen pent-  
oxide,  $\text{SnOCl}_2, 3\text{SnCl}_4, \text{N}_2\text{O}_5$ .**

Hydroscopic; sol. in  $\text{H}_2\text{O}$ .

Decomp. by heat. (Thomas, C. R. 1896,  
122. 32.)

**Tin (stannous) oxyiodide,  $\text{SnO}, 3\text{SnI}_2$ ;  
 $2\text{SnO}, 3\text{SnI}_2$ ;  $\text{SnO}, \text{SnI}_2$ ; and  $2\text{SnO}, \text{SnI}_2$ .**

Decomp. by much  $\text{H}_2\text{O}$  (Personne, C. R.  
54. 216)

**Tin oxysulphide,  $\text{Sn}_2\text{S}_2\text{O} + 11\text{H}_2\text{O}$ .**

Very sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ ; slowly sol.  
in  $\text{H}_2\text{O}$ . (Schmidt, B. 1894, 27. 2739.)

**Tin phosphide,  $\text{Sn}_2\text{P}$ .**

(Ragg, C. C. 1898, II 170.)

$\text{SnP}$ . Sol. in  $\text{HCl} + \text{Aq}$ . Insol. in  $\text{HNO}_3$   
 $+ \text{Aq}$

$\text{SnP}_2$ . Not attacked by  $\text{HCl}$ . Easily at-  
tacked by aqua regia. (Emmerling, B. 1879,  
12. 155.)

$\text{SnP}_2$ . Insol. in  $\text{HCl}$ . Slowly attacked by  
dil.  $\text{HNO}_3$  at  $50^\circ$ . Oxidized by fuming  $\text{HNO}_3$   
with ignition. (Johbois, C. R. 1909, 148.  
638)

$\text{Sn}_2\text{P}_2$ . Insol. in mercury.

Decomp. by  $\text{HCl}$  (Stead, J. Soc. Chem.  
Ind 1897, 16. 206)

$\text{Sn}_2\text{P}_2$ . Attacked by  $\text{HCl}, \text{HNO}_3$ , and al-  
kalies. (Johbois, C. R. 1909, 148. 637.)

The only true compounds are  $\text{Sn}_2\text{P}_2$  and  
 $\text{SnP}_2$  (Johbois, C. R. 1909, 148. 637.)

**Tin phosphochloride,  $\text{Sn}_2\text{P}_2\text{Cl}_4$ .**

(Mahn, Jena. Zeit. 5. 1680.)

**Tin (stannous) selenide,  $\text{SnSe}$ .**

Decomp. by boiling  $\text{HCl} + \text{Aq}$ . Slowly  
oxidised by boiling  $\text{HNO}_3 + \text{Aq}$ , and easily  
dissolved in aqua regia (Schneider, Pogg.  
127. 624) Easily sol. in alkalies  $+ \text{Aq}$   
(Uelsmann, A. 116. 122), or scarcely even on  
boiling (Schneider), according to method  
of preparation. Sol. in alkali sulphides or  
selenides  $+ \text{Aq}$ .

**Tin (stannic) selenide,  $\text{SnSe}_2$ .**

Not attacked by  $\text{H}_2\text{O}$  or dil. acids; scarcely  
attacked by boiling conc.  $\text{HCl} + \text{Aq}$ ; gradu-  
ally decomp by hot  $\text{HNO}_3 + \text{Aq}$ ; easily dis-  
solved by warm aqua regia, and hot conc.  
 $\text{H}_2\text{SO}_4$ .

Sol. in cold, more easily in warm  $\text{KOH}$ ,  
 $\text{NaOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Uelsmann, A.  
116. 122)

**Tin (stannous) sulphide,  $\text{SnS}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves  $0.14 \times 10^{-6}$  mols.  $\text{SnS}$   
at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)

Insol. in dil., sol. in conc  $\text{HCl} + \text{Aq}$ . Sl.  
sol. in hot conc  $\text{HNO}_3 + \text{Aq}$  Insol. in  $\text{KOH}$   
 $+ \text{Aq}$

$+ \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}, \text{H}_2\text{S} + \text{Aq}$ , or dil.  
acids; sol. with decomp. in conc. acids;  
easily sol. in hot conc.  $\text{HCl} + \text{Aq}$ . Insol.  
in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
Insol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . Scarcely  
sol. in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ , but easily sol. in the  
same on addition of  $\text{S}$ . (Rose.)

10%  $\text{NaOH} + \text{Aq}$  dissolves  $\text{SnS}$  by violent  
boiling.

Insol. in cold, sl. sol. in hot  $\text{Na}_2\text{SO}_3 + \text{Aq}$ .  
(Materne, C. C. 1908, II. 557.)

Sol. in alkali polysulphides  $+ \text{Aq}$ .

Insol. in acetone. (Eidmann, C. C. 1899,

II. 1014); (Naumann, B. 1904, 37. 4329.), ethyl acetate. (Naumann, B. 1910, 43. 314.)

### Tin (stannic) sulphide, $\text{SnS}_2$ .

*Anhydrous (Morass gold.)* Insol. in HCl or  $\text{HNO}_3 + \text{Aq}$ , but decomp. by aqua regia. Sol. in hot  $\text{KOH} + \text{Aq}$  or  $\text{K}_2\text{CO}_3 + \text{Aq}$ ; also in hot  $\text{K}_2\text{S}$ ,  $\text{Na}_2\text{S} + \text{Aq}$ , and  $(\text{NH}_4)_2\text{S} + \text{Aq}$ .

1 l.  $\text{H}_2\text{O}$  dissolves  $1.13 \times 10^{-4}$  mole.  $\text{SnS}_2$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)  $+x\text{H}_2\text{O}$  Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , but readily in  $\text{KOH}$ ,  $\text{K}_2\text{S}$ , or  $\text{Na}_2\text{S} + \text{Aq}$ , also in hot conc.  $\text{HCl} + \text{Aq}$ . Decomp. by hot  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{KHSO}_4 + \text{Aq}$ . Sol. in  $\text{K}_2\text{CO}_3 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett.)

Pptd.  $\text{SnS}_2$  is insol. in cold, sol. in hot  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$ . Sol. in  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Very sol. in  $\text{NaOH} + \text{Aq}$  (Materne, C. C. 1906, II. 557.)

Sol. in boiling conc.  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  (Clarke, C. N. 21. 124.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790), ethyl acetate (Naumann, B. 1910, 43. 314.); acetone (Naumann, B. 1904, 37. 4329, Eidmann, C. C. 1899, II. 1014.)

### Tin sesquisulphide, $\text{Sn}_2\text{S}_3$ .

Sol. in moderately conc. HCl (Antony and Niccoli, Gazz. ch. it. 1892, 22. (2) 408.)

### Tin sulphochloride, $\text{SnS}_2 \cdot 2\text{SnCl}_4$ .

$\text{H}_2\text{O}$  dissolves out  $\text{SnCl}_4$ . (Dumas, Schw. J. 66. 409.)

$\text{SnS}_2 \cdot \text{Cl}_{11} = \text{SnCl}_4 \cdot 2\text{SnCl}_4$ . Sol. in  $\text{H}_2\text{O}$  with separation of S.

Gradually sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{POCl}_3$  (Casselmann, A. 83. 267.)

### Tin sulphiodide, $\text{Sn}_2\text{S}_2\text{I}_4$ .

Decomp. by  $\text{H}_2\text{O}$  into  $\text{SnO}_2$ , S, and HI, by cold conc.  $\text{HCl} + \text{Aq}$  with separation of S, also by aqua regia, and  $\text{HNO}_3 + \text{Aq}$ .

Cold  $\text{KOH} + \text{Aq}$  separates S and  $\text{SnO}_2$ .

Completely sol. in hot  $\text{KOH} + \text{Aq}$ .

Sol. in cold, more easily in hot  $\text{CS}_2$  or  $\text{CHCl}_3$ .

Decomp. by alcohol. (Schneider, Pogg. 111. 249.)

### Tin sulphophosphide, $\text{Sn}_3\text{P}_2\text{S}_5$ .

Insol. in HCl,  $\text{HNO}_3$ , and aqua regia.

Sol. in aq. alkali hydroxides, containing  $\text{Cl}_2$  or  $\text{Br}_2$  in solution. (Granger, C. R. 1896, 122. 322.)

### Tin (stannous) telluride, $\text{SnTe}$ .

Not attacked by conc.  $\text{HCl} + \text{Aq}$ . (Ditte, C. R. 97. 42.)

### Titanic acid, $\text{TiO}_2 \cdot x\text{H}_2\text{O}$ .

*$\alpha$ -Titanic acid*—Insol. in  $\text{H}_2\text{O}$  or alcohol. When dried in the cold, is completely sol. in

acids, especially HCl, or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but when the solution in acids is boiled, it is converted into  $\beta$ -titanic acid. Very sl. sol. even when moist in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Berthier.) Sl. sol. in alkali carbonates  $+ \text{Aq}$ . A complete solution in an alkali carbonate  $+ \text{Aq}$  can only be obtained by adding a Ti salt drop by drop to the alkaline solution, and allowing the ppt. to dissolve entirely before adding more Ti salt. On boiling the solution in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (or in  $\text{K}_2\text{CO}_3$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$  with  $\text{NH}_4\text{Cl}$ ) the titanic acid is pptd.

Relatively easily sol. in mineral acids, decreasing in the following order HCl,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ . Insol. in perchloric acid (Landecker, Z. anorg. 1909, 64. 67.)

Sol. in dil.  $\text{H}_2\text{SO}_4$ . 40 g.  $\text{H}_2\text{O} + 70$  g.  $\text{H}_2\text{SO}_4$  (sp. gr. 1.145) dissolves 0.33 g.  $\text{TiO}_2$  in 15 min. (Hall and Smith, Proc. Am. Phil. Soc. 1906, 44. 193.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

*$\beta$ -Titanic acid, Melasthanic acid*—Insol. in  $\text{H}_2\text{O}$ , acids except HF, or alkali hydrates or carbonates  $+ \text{Aq}$ . When digested with conc.  $\text{H}_2\text{SO}_4$  until acid is evaporated, the residue is sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

*$\gamma$ -Titanic acid*—Sol. in pure  $\text{H}_2\text{O}$ , but  $\beta$ -acid is pptd. by boiling (Knop, A. 123 351.)

Colloidal  $\text{TiO}_2 \cdot x\text{H}_2\text{O} + \text{Aq}$  has been prepared by Graham (Chem. Soc. 17. 325.)

### Barium titanate, $2\text{BaO} \cdot 3\text{TiO}_2$ .

(Bourgeois, C. R. 103. 141.)

### Barium pertitanate peroxide.

See Pertitanate, barium peroxide.

### Calcium titanate, $\text{CaTiO}_3$ .

(Ebelmen, C. R. 32. 711.)

Min. *Perofskite*. Scarcely attacked by HCl  $+ \text{Aq}$  or other acids, except hot  $\text{H}_2\text{SO}_4$ , which decomposes it.

$\text{CaO} \cdot 2\text{TiO}_2$ . Min. *Titanomorphite*. Partially decomp. by  $\text{HCl} + \text{Aq}$ , completely by  $\text{H}_2\text{SO}_4$ .

### Cobaltous titanate, $\text{CoTiO}_3$ .

(Bourgeois, C. C. 1893, I. 228.)

### Ferrous orthotitanate, $\text{Fe}_2\text{TiO}_4$ .

(Hautefeuille, C. R. 59. 733.)

### Ferroferric titanate, $\text{FeTiO}_3 \cdot x\text{Fe}_2\text{O}_3$ .

Min. *Menaccanite*. Very sl. sol. in HCl or aqua regia with separation of  $\text{TiO}_2$ .

### Ferric titanate.

Not attacked by boiling  $\text{H}_2\text{SO}_4$  or conc.  $\text{HCl} + \text{Aq}$ . (Wöhler and Liebig, Pogg. 21. 578.)

**Magnesium titanate,  $MgTiO_3$ .**

Insol in  $H_2O$  and acids (Hautefeuille, A. ch. (4) 4. 169.)

Min. *Géologie*

When finely powdered, is easily sol in hot  $HCl$ , or in cold  $HF$  in a few hours (Dick, Miner, Mag 1894, 10. 146.)

$Mg_2TiO_4$ . Slowly decomp by boiling with  $HNO_3$ +Aq (Hautefeuille, A. ch. (4) 4. 169.)

**Potassium titanate,  $K_2TiO_3$ .**

Anhydrous. Decomp with  $H_2O$

+4 $H_2O$ . Deliquescent. Very sol. in  $H_2O$ .

Precipitated from aqueous solution by alcohol. (Demoly, Compt. chim. 1849. 325.)

**Potassium titanate, acid,  $K_2O, 3TiO_2+2H_2O$** 

Insol. in  $H_2O$  (Demoly)

$K_2O, 6TiO_2+2H_2O$  (Demoly)

$K_2O, 3TiO_2+3H_2O$ . Insol in  $H_2O$ . Completely sol in  $HCl$ +Aq if only cold  $H_2O$  is used for washing. When heated to  $100^\circ$ , no longer completely sol in  $HCl$ +Aq. (Rose, Fogg. 74. 583.)

$K_2O, 12TiO_2$  (Rose, Gilb. Ann. 73. 78)

**Sodium titanate,  $Na_2TiO_3$ .**

Anhydrous. Decomp. by  $H_2O$  into  $NaOH$ , and an acid titanate, insol in  $H_2O$

+4 $H_2O$ . Deliquescent. Very sol. in  $H_2O$ .

Precipitated from aqueous solution by alcohol (Demoly.)

**Sodium titanate, acid,  $2Na_2O, 9TiO_2+5H_2O$ .**

If not heated to  $100^\circ$ , is sol. in cold  $HCl$ +Aq (Rose, Gilb. Ann. 73. 78)

$2Na_2O, 3TiO_2$ . Insol. in  $H_2O$ ; slowly sol in cold, easily in hot  $HCl$ +Aq (Cormmuns, C. R. 115. 823.)

$Na_2O, 2TiO_2$ . As above (C)

$Na_2O, 3TiO_2$ . Insol in  $H_2O$ , and nearly so in boiling  $HCl$ +Aq. (C.)

**Strontium titanate,  $2SrO, 3TiO_2$ .**

(Bourgeois, C. R. 103. 141.)

**Zinc titanate,  $ZnO, TiO_2(?)$ .**

(Lévy, A. ch. (6) 24. 456.)

$2ZnO, TiO_2(?)$ . (Lévy)

$3ZnO, 2TiO_2$ . Slowly attacked by warm  $H_2SO_4$  or  $HNO_3$ +Aq, and by  $H_2SO_4$ +HF. Wholly sol in cold  $HCl$ +Aq (Lévy)

$4ZnO, 5TiO_2$ . Not attacked by cold conc. acids, but sol. by boiling except in  $HCl$ +Aq. (Lévy)

$ZnO, 3TiO_2$ . Insol in  $H_2O$ , alcohol, or ether. Dil.  $HNO_3$ ,  $H_2SO_4$ , or  $HCl$ +Aq do not attack even on boiling; boiling  $H_2SO_4$  dissolves with difficulty; not attacked by conc. boiling alkalis+Aq (Lévy, A. ch. (6) 25. 471)

**Pertitanic acid.**

See Pertitanic acid.

**Titanium,  $Ti$ .**

Decomp.  $H_2O$  even under  $100^\circ$  (Wbhler); not attacked by  $H_2O$  under  $500^\circ$ . (Kern, C. N. 33. 57.)

Does not decomp<sup>2</sup>  $H_2O$  at  $100^\circ$ . (Schneider, Z. anorg. 1894, 8. 85)

Sol. in  $HCl$ +Aq if warmed. Rapidly sol. in  $HF$ +Aq. Sol. in cold dil.  $H_2SO_4$ +Aq,  $HNO_3$ +Aq, or  $HClH_2O_2$ +Aq. Dissolves almost instantaneously in  $HF$ +Aq. (Merz.)

Sol. in molten lead and iron; sol. in  $HCl$ ,  $HNO_3$ , and aqua regia (Moissan, C. R. 1895, 120. 293.)

Amorphous. Loses its spontaneous inflammability when left for a time in contact with  $H_2O$ . (Schneider, Z. anorg. 1895, 8. 85.)

**Titanium amide,  $Ti(NH_2)_4$ .**

Violently attacked by  $H_2O$ . (Stahler, B. 1905, 38. 2029.)

**Titanium tribromide,  $TiBr_3+6H_2O$ .**

Very hygroscopic. (Stahler, B. 1904, 37. 4409.)

**Titanium tetrabromide,  $TiBr_4$ .**

Deliquescent. Decomp. by  $H_2O$ . (Duppa, C. R. 42. 352)

Sol. in absolute alcohol and in dry ether (Rosenheim and Schutte, Z. anorg. 1900, 24. 238.)

**Titanium bromonitride,  $TiNBr$ .**

Decomp. by a small amount of  $H_2O$ . On addition of more  $H_2O$ , a part dissolves forming a solution which decomp on warming with separation of titanate acid. It behaves similarly toward dil.  $HNO_3$ , dil.  $HCl$  and dil.  $H_2SO_4$ . Completely sol. in warm dil.  $H_2SO_4$ . (Ruff, B. 1908, 41. 2262.)

**Titanium carbide,  $TiC$ .**

Sol in  $HNO_3$ +Aq (Shumer, C. N. 55. 71.) Insol in  $HCl$ . Slowly sol. in aqua regia. (Moissan, C. R. 1895, 120. 295.)

**Titanium carbide nitride,  $Ti_3C_2N_2=Ti(CN)_2, 3Ti_3N_4$ .**

Insol. in, and not attacked by boiling  $HNO_3$  or  $H_2SO_4$  (Wollaston), but sol. in  $HNO_3$ +HF (Berzelius)

**Titanium dichloride,  $TiCl_3$ .**

Very deliquescent. Decomposes  $H_2O$  with violence. Insol in ether,  $CS_2$ , or  $CHCl_3$ . Decomp by 99.5% alcohol.

**Titanium trichloride,  $TiCl_3$ .**

Deliquescent. Sol in  $H_2O$  with evolution of heat.

+4 $H_2O$  (Glatzel, B. 9. 1829.)

+6 $H_2O$ . Very sol in  $H_2O$ . (Pohdori, Z. anorg. 1898, 19. 307.)

**Titanium tetrachloride,  $\text{TiCl}_4$ .**

Anhydrous. Sol. in  $\text{H}_2\text{O}$  with evolution of much heat,  
 $+5\text{H}_2\text{O}$  Deliquescent

**Titanium sulphuryl chloride,  $\text{TiCl}_2\text{SO}_2 = \text{TiCl}_2\text{OSO}_2\text{Cl}$** 

Deliquesces gradually in moist air (Clausnitzer, B. 11. 2011.)

**Titanium chloride ammonia,  $\text{TiCl}_4 \cdot 4\text{NH}_3$ .**

Deliquescent. Solution in  $\text{H}_2\text{O}$  is not quite clear. (Rose)

According to Persoz (A. ch. 46. 315), is  $\text{TiCl}_4 \cdot 6\text{NH}_3$ .

$\text{TiCl}_4 \cdot 6\text{NH}_3$  and  $\text{TiCl}_4 \cdot 4\text{NH}_3$ . Both compds. are unstable in moist air, insol. in ether. (Rosenheim, Z. anorg. 1901, 28. 245.)

$\text{TiCl}_4 \cdot 8\text{NH}_3$ . Violently decomp. by  $\text{H}_2\text{O}$ . (Stahler, B. 1905, 38. 2627.)

**Titanium tetrachloride cyanobromide,  $\text{TiCl}_4 \cdot \text{NCClBr}$** 

(Schneider, Z. anorg. 1894, 8. 92.)

**Titanium chloride cyanhydric acid,  $\text{TiCl}_4 \cdot 2\text{HCN}$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  with evolution of heat (Wohler, A. 73. 226.)

**Titanium trichloride nitrogen sulphide,  $2\text{TiCl}_3 \cdot \text{N}_2\text{S}_4$ .**

Decomp. rapidly in air (Davis, Chem. Soc. 1906, 89. (2) 1576.)

**Titanium tetrachloride nitrogen sulphide,  $\text{TiCl}_4 \cdot \text{N}_2\text{S}_4$** 

Hydroscopic

Decomp. by  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{KOH}$  and alcohol. (Wölbling, Z. anorg. 1908, 57. 282.)

**Titanium chloride phosphine.**

Decomp. by  $\text{H}_2\text{O}$ ,  $\text{HCl} + \text{Aq}$ ,  $\text{KOH} + \text{Aq}$ ,  $\text{K}_2\text{CO}_3 + \text{Aq}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Rose)

**Titanium tetrachloride phosphoryl chloride,  $\text{TiCl}_4 \cdot 2\text{POCl}_3$ .**

(Ruff, B. 1903, 36. 1783.)

**Titanium chloronitride,  $\text{TiNCl}$ .**

Decomp. by small amount cold  $\text{H}_2\text{O}$ . On the addition of more  $\text{H}_2\text{O}$  it is only partially decomp. For complete solution, the addition of dil.  $\text{HCl}$  or a mixture of warm dil.  $\text{H}_2\text{SO}_4$  and  $\text{HF}$  is necessary. Easily sol in conc.  $\text{HNO}_3$  and in conc.  $\text{H}_2\text{SO}_4$ . (Ruff, B. 1903, 41. 2259.)

**Titanium difluoride.**

(Hautefeuille, C. R. 57. 151.)

Probably sesquifluoride.

**Titanium sesquifluoride,  $\text{Ti}_2\text{F}_3$ .**

Appears to be two modifications, one sol in  $\text{H}_2\text{O}$ , and the other insol. in  $\text{H}_2\text{O}$  (Hautefeuille, C. R. 59. 189.)

Insol. in  $\text{H}_2\text{O}$  (Weber, Pogg. 120. 292.)

**Titanium tetrafluoride,  $\text{TiF}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Unverdorben.)

Sol. in  $\text{H}_2\text{O}$ , but solution decomp. upon evaporation (Marignac, Ann. Min. (5) 15. 258.)

Sol in  $\text{H}_2\text{O}$  (Emich, M. 1904, 25. 910.)

Very hygroscopic

Sol in  $\text{H}_2\text{O}$ . Sl. sol in conc.  $\text{HF} + \text{Aq}$ .

Sol in cold  $\text{POCl}_3$  without decomp. Decomp. in warm  $\text{POCl}_3$ .

Sol in alcohol and dry pyridine.

Insol. in ether,  $\text{CS}_2$ ,  $\text{CCl}_4$ ,  $\text{SiCl}_4$ ,  $\text{SbBr}_3$ ,  $\text{SO}_2\text{Cl}_2$ ,  $\text{SOCl}_2$ ,  $\text{SCl}_2$ ,  $\text{AsCl}_3$ ,  $\text{SO}_3$ ,  $\text{CrO}_3$ ,  $\text{PCl}_3$  (Ruff, B. 1903, 36. 1780.)

$+2\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (Ruff, B. 1903, 36. 1780.)

**Titanium hydrogen fluoride,  $2\text{HF}$ ,  $\text{TiF}_4 = \text{H}_2\text{TiF}_6$ .**

Sol in  $\text{H}_2\text{O}$  with decomposition and separation of a basic salt. Corresponds to fluosilicic acid, and may be considered as fluotitanic acid  $\text{H}_2\text{TiF}_6$ .

**Titanium fluoride with MF.**

See Fluotitanate, M.

**Titanium tetrafluoride ammonia,  $\text{TiF}_4 \cdot 2\text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$ ; decomp. in aq. solution on boiling. (Ruff, B. 1903, 36. 1781.)

**Titanium monohydroxide,  $\text{TiO}_2\text{H}_2$ .**

Ppt. (Wohler, A. 73. 49.)

$\text{Ti}_2\text{O}_3\text{H}_2$ . Not attacked by cold conc. acids; sl. attacked on warming. Insol. in cold or hot  $\text{KOH} + \text{Aq}$ . (Winkler, B. 1890, 23. 2859.)

**Titanium sesquihydroxide,  $\text{Ti}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ .**

\* Decomposes very quickly with  $\text{H}_2\text{O}$ , forming titanium dihydroxide

$\text{TiO}_2\text{H}_2$ . (Polidori, Z. anorg. 1899, 19. 306.)

**Titanium dihydroxide.**

See Titanic acid.

**Titanium hydroxychloride,  $\text{TiCl}_3(\text{OH})$ .**

Deliquescent. Easily sol in  $\text{H}_2\text{O}$  and alcohol. Sol. in ether.

$\text{TiCl}_3(\text{OH})_2 + 1\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. Aqueous solution decomp. by boiling.

$\text{TiCl}(\text{OH})_2 + \text{H}_2\text{O}$ . Nearly insol in  $\text{H}_2\text{O}$ . Insol in alcohol and ether. (Konig and v. der Pfordten, B. 21. 1708.)

See also Titanium oxychloride.

**Titanium diiodide,  $\text{TiI}_2$ .**

Very hygroscopic; insol. in organic solvents; sol in conc.  $\text{HF}$  and boiling  $\text{HCl}$ , decomp. by

$\text{H}_2\text{O}$ , alkalis,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ . (Defacqz, C. R. 1908, 147. 66.)

**Titanium trioxide**,  $\text{Ti}_2\text{O}_3 + 6\text{H}_2\text{O}$ .

Very hygroscopic. (Stahler, B. 1904, 37. 4410.)

**Titanium tetraoxide**,  $\text{Ti}_4\text{O}_7$ .

Fumes on air, and dissolves rapidly in  $\text{H}_2\text{O}$  with evolution of heat. Solution decomposes on standing. (Weber)

**Titanium nitride**,  $\text{Ti}_3\text{N}_4$ .

Difficultly sol. in warm  $\text{HNO}_3 + \text{Aq}$ . More easily sol. in aqua regia. (Rose.)

Insol. in dil. acids. Decomp. by hot conc.  $\text{H}_2\text{SO}_4$  and by conc.  $\text{HNO}_3$ , especially when  $\text{HF}$  is added, and by boiling  $\text{KOH} + \text{Aq}$ . (Ruff and Eisner, B. 1908, 41. 2252.)

Decomp. by  $\text{H}_2\text{O}$  and dil. acids

Insol. in all ordinary indifferent organic solvents (Ruff, B. 1912, 45. 1309.)

$\text{Ti}_3\text{N}_4$ . Insol. in  $\text{H}_2\text{O}$ . (Wohler.)

Is  $\text{TiN}$ , according to Guerin (C. R. 82. 972.)

**Titanium monoxide**,  $\text{TiO}$ .

(Moissan, C. R. 1895, 120. 290.)

**Titanium sesquioxide**,  $\text{Ti}_2\text{O}_3$ .

Insol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . Difficultly sol. in  $\text{H}_2\text{SO}_4$ . (Ebelmen, A. ch. (3) 20. 392.)

When moist, insol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ , but quickly decomp. to  $\text{TiO}_2$ . Sol. in oxygen acids, but quickly decomp. (Berzelius.)

**Titanium dioxide**,  $\text{TiO}_2$ .

*Amorphous*. Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , even when heated for a long time

Sol. in conc.  $\text{H}_2\text{SO}_4$  by long digestion.

$\text{TiO}_2$ , strongly ignited at  $1000^\circ$ , is practically insol. in conc.  $\text{H}_2\text{SO}_4$  and  $\text{HF}$ .

When less strongly ignited (by heating ortho or metatitanic acid to  $700^\circ$ ) it is easily sol. therein. (Bornemann and Schürmeister, C. C. 1910, II. 1870.)

Ignited  $\text{TiO}_2$  is very difficultly sol. in  $\text{HF}$ . (Pennington, J. Am. Chem. Soc. 1896, 18. 56.)

The solubility of ignited  $\text{TiO}_2$  in  $\text{H}_2\text{SO}_4$  is helped by  $\text{H}_2\text{O}_2$ . (Weiss and Landecker, Z. anorg. 1909, 64. 71.)

The solubility in  $\text{H}_2\text{SO}_4$  is increased by addition of  $\text{H}_2\text{O}_2$ .  $\text{H}_2\text{O}_2$  brings  $\text{TiO}_2$  quickly and completely into solution in the presence of  $\text{NH}_4\text{OH}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{NaOH}$ ,  $\text{Na}_2\text{CO}_3$ , and  $\text{Na}_2\text{HPO}_4$ . (Weiss and Landecker, Z. anorg. 1909, 64. 71.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

*Crystalline*. Min. *Rutile*, *Brookite*, and *Anatase*? Solubility as above

See also Titanic acid.

**Titanium oxide**,  $\text{Ti}_2\text{O}_3$ .

(Deville, C. R. 53. 163.)

True formula is  $\text{Ti}_2\text{O}_{12}$  (v. der Pfordten, A. 237. 201.)

**Titanium peroxide**,  $\text{TiO}_2$ .

Sol. in acids. Solution in  $\text{H}_2\text{SO}_4$  is very stable, but the  $\text{HCl}$  solution decomposes very easily. (Weber, B. 15. 2599; Piccini, B. 15. 2221; Classen, B. 24. 370.)

**Titanium oxychloride**,  $\text{TiO}_2$ ,  $\text{TiOCl}_2 + 8\text{H}_2\text{O}$ .

Sol. in much  $\text{H}_2\text{O}$  (Merz, Bull. Soc. 1867. 401.)

$\text{Ti}_2\text{O}_3\text{Cl}_2$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with separation of  $\text{TiO}_2$

See also Titanium hydroxychloride.

**Titanium oxyfluoride**.

Insol. in  $\text{H}_2\text{O}$  (Berzelius)

**Titanium oxyfluoride with MF**.

See Fluoxyperytitanate, M.

**Titanium phosphide**,  $\text{TiP}$ .

Sl. sol. in boiling aqua regia

Insol. in dil. or conc. acids and alkalis.

Sl. attacked by fuming  $\text{HNO}_3$  in sealed tube at  $250^\circ$ – $300^\circ$ . (Gewecke, A. 1908, 361. 84.)

**Titanium phosphochloride**.

See Phosphorus titanium chloride.

**Titanium silicide**,  $\text{TiSi}_2$ .

Sol. in  $\text{HF}$ ; insol. in other min. acids

Slowly sol. in 10%  $\text{KOH} + \text{Aq}$ . (Hönigschmid, C. R. 1906, 143. 226.)

**Titanium monosulphide**,  $\text{TiS}$ .

Insol. in alkalis. Difficultly sol. in nitric acid and aqua regia

Insol. in  $\text{HF}$ . (v. der Pfordten, A. 234. 257.)

**Titanium disulphide**,  $\text{TiS}_2$ .

Decomp. slowly on moist air. Insol. in  $\text{HCl}$  or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Ebelmen.)

Sol. in aqua regia or  $\text{HNO}_3 + \text{Aq}$ . Decomp. by  $\text{KOH} + \text{Aq}$  or  $\text{NaOH} + \text{Aq}$ . Insol. in  $\text{KSH} + \text{Aq}$ . (Rose.)

Sol. in  $\text{HF}$  at  $100^\circ$ . (v. der Pfordten, A. 234. 257.)

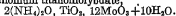
**Titanium sesquisulphide**,  $\text{Ti}_2\text{S}_3$ .

Insol. in caustic alkalis +  $\text{Aq}$ . Sol. in  $\text{HF}$  at a high temp. Insol. in aqua regia. (v. der Pfordten, A. 234. 257.)

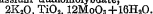
**Titanomolybdic acid**,  $\text{TiO}_3$ ,  $12\text{MoO}_3 + 22\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$

Sol. in ether. (Péchar, C. R. 1893, 117. 790.)

**Ammonium titanomolybdate,**

Sol in  $\text{H}_2\text{O}$  and acids; completely insol in solutions of ammonium salts (Pécharde.)

**Potassium titanomolybdate,**

Efflorescent.

Sol in  $\text{H}_2\text{O}$ . (Pécharde.)

**Titanodectungstic acid,**  $\text{H}_5\text{TiW}_{10}\text{O}_{48} + x\text{H}_2\text{O}.$ 

(Lecarme, Bull. Soc. (2) 36. 17.)

**Titanotungstic acid or Titanoduodecitungstic acid,**  $\text{H}_5\text{TiW}_{12}\text{O}_{48} + x\text{H}_2\text{O}$ 

(Lecarme, Bull. Soc. (2) 36. 17.)

**Titanous acid.****Sodium titanite,**  $\text{Na}_2\text{TiO}_3 = 3\text{Na}_2\text{O} \cdot \text{Ti}_2\text{O}_3.$ 

Sol in dil acids (Koenig and v. der Pfordten, B 22. 2075.)

**Titanyl compounds.**

See Titanium oxy-compounds.

**Triamine cobaltic compounds.**

See Dichrocoaltic compounds.

**Trithionic acid,**  $\text{H}_2\text{S}_3\text{O}_6$ 

Known only in aqueous solution

Solution in  $\text{H}_2\text{O}$  gradually decomposes in the cold rapidly at  $80^\circ$ . Not decomp. if very dilute or in presence of acids, except  $\text{HNO}_3$ ,  $\text{HClO}_4$ , and  $\text{HIO}_3$ . (Fordos and Gélas, A. ch. (3) 28. 451.)

**Trithionates.**

The trithionates are all sol in  $\text{H}_2\text{O}$ , and very easily decomposed.

**Ammonium trithionate,**  $(\text{NH}_4)_2\text{S}_3\text{O}_6$ 

Very deliquescent and unstable.

Very sol. in  $\text{H}_2\text{O}$

Insol. in abs alcohol (Divers and Ogawa, Chem. Soc. 1900, 77. 337.)

**Barium trithionate,**  $\text{BaS}_3\text{O}_6 + 2\text{H}_2\text{O}.$ 

Very sol. in  $\text{H}_2\text{O}$ . Precipitated from aqueous solution by large excess of alcohol. Aqueous solution is very unstable. (Kessler, Pogg 74. 250.)

**Lead trithionate,**  $\text{PbS}_3\text{O}_6.$ 

Very sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Fogh, C. R. 110. 524.)

**Potassium trithionate,**  $\text{K}_2\text{S}_3\text{O}_6.$ 

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Kessler, Pogg 74. 270.)

Sol in  $\text{H}_2\text{O}$  with decomp.

Insol. in alcohol. (Langlois, A. 1841, 40. 102.)

**Sodium trithionate,**  $\text{Na}_2\text{S}_3\text{O}_6.$ 

Very sol. in  $\text{H}_2\text{O}$

+  $3\text{H}_2\text{O}$ . (Vilhers, C. R. 106. 1356.)

**Thalious trithionate,**  $\text{Th}_2\text{S}_3\text{O}_6.$ 

Sol in  $\text{H}_2\text{O}$ . (Bevan, C. N. 38. 294.)

**Zinc trithionate.**

Sol in  $\text{H}_2\text{O}$ , but decomposes upon warming the solution. (Fordos and Gélas, C. R. 16. 1070.)

**Tungsten, W.**

*Metallic* Not attacked by heating with fuming  $\text{HNO}_3$ , aqua regia, or other acids, or by boiling  $\text{KOH} + \text{Aq}$ . Sol. in  $\text{KOH} + \text{Aq}$  and  $\text{NaClO} + \text{Aq}$  (v. Uslar, A. 94. 255.)

Not easily acted upon by moist air, if no  $\text{CO}_2$  present. Sol. in a mixture of  $\text{HF}$  and  $\text{HNO}_3$ . Very slowly sol. in  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and  $\text{HF}$ . (Moissan, C. R. 1896, 123. 15.)

Very slowly attacked by  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and even  $\text{CrO}_3$ . A mixture of  $\text{CrO}_3$  and  $\text{H}_2\text{SO}_4$  dissolved 1.67 g. in 16 hrs. from a fine wire and 1.36 g. in 14 hours (Fink, Met. Chem. Eng. 1910, 8. 341.)

Compact tungsten is not attacked by dil., and only sl. dissolved by conc.  $\text{H}_2\text{SO}_4$ . Not attacked by dil. or conc.  $\text{HCl}$ ,  $\text{HNO}_3$  and  $\text{HNO}_3 + \text{HCl}$  attack slowly by long heating, forming thin layer of  $\text{WO}_3$ . Slowly sol. in  $\text{HNO}_3 + \text{HF}$ . (Weiss, Z. anorg. 1910, 65. 339.)

*Aluminothemic tungsten* is insol in acids and in aqua regia. Sol. in fused  $\text{KOH}$  (Stavenhagen, B 1899, 32. 1515.)

Insol. in  $\text{HCl}$  of any concentration at room temp. and only very sl. sol. at  $110^\circ$ . After being in contact with hot conc.  $\text{HCl}$  (sp. gr. 1.15) for 175 hrs. the metal lost 0.5% of its weight. Sl. sol. in dil.  $\text{HCl}$  at  $110^\circ$ .

Insol. in conc.  $\text{H}_2\text{SO}_4$  at room temp. and in dil.  $\text{H}_2\text{SO}_4$  at  $110^\circ$ . Somewhat sol. in conc.  $\text{H}_2\text{SO}_4$  at high temp.

Insol. in conc.  $\text{HNO}_3$ , and hot or cold  $\text{HF}$ .

Sl. sol. in aqua regia.

Very sol. in  $\text{HF} + \text{HNO}_3$ . (Ruder, J. Am. Chem. Soc. 1912, 34. 387.)

Insol. in aqua regia and acids; sol. in fused  $\text{KOH}$ . (Stavenhagen, B 1899, 32. 1514.)

Insol. in  $\text{KOH} + \text{Aq}$

Sol in fused  $\text{KOH}$

Slowly sol. in fused  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$  or mixture of the two.

Somewhat sol. in  $\text{NaOCl} + \text{Aq}$ . (Ruder, J. Am. Chem. Soc. 1912, 34. 388.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

*Crystalline*. Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4$ . Oxidised by  $\text{HNO}_3$  or aqua regia (D'Elhujar.)

Sol. in boiling  $\text{KOH} + \text{Aq}$ . (Ruche, A. ch. (3) 50. 5.)

*Amorphous*. Easily oxidised by  $\text{HNO}_3 + \text{Aq}$ . (Zettnow.)

**Tungsten amide.**

See Tungsten nitride.

**Tungsten arsenide,  $WAs_2$ .**

Insol in  $H_2O$  and other solvents. Not attacked by boiling  $HF$  or  $HNO_3$ . Sol in cold  $HF + HNO_3$ , and in hot aqua regia. Not attacked by hot  $KOH + Aq$  or  $NaOH + Aq$ . Decomp. by fused  $KOH$  or  $NaOH$ . (Defacqz, C. R. 1901, 132, 139.)

**Tungsten boride,  $WB_2$ .**

Slowly attacked by conc. acids; vigorously attacked by aqua regia. (Tucker and Moody, Chem. Soc. 1902, 81, 16.)

**Tungsten dibromide,  $WBr_2$ .**

Partly sol in  $H_2O$ , the rest decomposing to  $WO_3$  and  $HBr$ .

**Tungsten pentabromide,  $WBr_5$ .**

Decomp. by moist air or  $H_2O$ . Sol. in caustic alkalis +  $Aq$ .

Very hygroscopic. Fumes in the air.

Decomp. by  $H_2O$ .

Sol in  $HF$ , or conc.  $HCl$ . Sl. sol. in fuming  $HBr$ . Decomp. by dil.  $HCl$ , conc.  $HNO_3$ , or dil.  $H_2SO_4$ . Readily attacked by fused alkalis or alkalis +  $Aq$ . Sol in  $CCl_4$ ,  $CHCl_3$ ,  $CHBr_3$ , abs. alcohol, ether, essence of terebenthine and benzene. (Defacqz, C. R. 1899, 128, 1232.)

**Tungsten hexabromide,  $WBr_6$ .**

Decomp. by  $H_2O$  and in the air.

Sol in  $NH_4OH + Aq$ . (Smith, J. Am. Chem. Soc. 1897, 18, 1100.)

**Tungsten bromochloride,  $WCl_5$ ,  $WBr_5$ .**

Decomp. by  $H_2O$ . Sol in  $HF$ . Decomp. by  $HNO_3$  or  $H_2SO_4$ . Violently attacked by fused alkali or alkali +  $Aq$ . Sol. in most organic solvents.

$WCl_5$ ,  $3WBr_5$ . Properties like those of  $WCl_5$ ,  $WBr_5$ . (Defacqz, C. R. 1899, 129, 516.)

Decomp. by  $H_2O$ . Sol. in 40%  $HF + Aq$ . 22° B.  $HCl + Aq$  gives a sl. ppt. of  $WO_3$ . Decomp. by  $HNO_3$  and by  $H_2SO_4$ . Sol. in abs. alcohol, ether,  $CS_2$ ,  $C_6H_6$  and glycerine. Sol. in  $CCl_4$  only on warming. Nearly insol. in oil of turpentine. (Defacqz.)

**Tungsten bronze.**

See—

Tungstate tungsten oxide, barium.

Tungstate tungsten oxide, barium potassium.

Tungstate tungsten oxide, barium sodium.

Tungstate tungsten oxide, calcium potassium.

Tungstate tungsten oxide, calcium sodium.

Tungstate tungsten oxide, lithium.

Tungstate tungsten oxide, lithium potassium.

Tungstate tungsten oxide, potassium.

Tungstate tungsten oxide, potassium sodium.

Tungstate tungsten oxide, potassium strontium.

Tungstate tungsten oxide, sodium.

Tungstate tungsten oxide, sodium strontium.

**Tungsten carbide,  $W_2C$ .**

Sol in boiling  $HNO_3$ , very slowly acted upon by other acids. (Moussan, C. R. 1896, 123, 16.)

WC. Insol. in  $HCl$  acids, only sl. sol. in  $H_2SO_4$ , and conc.  $HNO_3$ ; sol. in fused  $KClO_3$  and  $KNO_3$ . (Williams, C. R. 198, 126, 1724.)

**Tungsten dichloride,  $WCl_2$ .**

Decomp. on the air or with  $H_2O$ . (Roscoe.)

**Tungsten tetrachloride,  $WCl_4$ .**

Deliquescent. Partly sol in  $H_2O$ , with subsequent decomposition. (Roscoe.)

**Tungsten pentachloride,  $WCl_5$ .**

Very deliquescent. Decomp. with  $H_2O$  with hissing and evolution of heat and separation of  $W_2O_5$ .

Very sl. sol. in  $CS_2$ . (Roscoe.)

**Tungsten hexachloride,  $WCl_6$ .**

Not decomp. by moist air or  $H_2O$ . Decomp. by alcohol. Very sol. in  $CS_2$ . (Roscoe.)

Easily sol. in  $POCl_3$ . (Teclu, A. 187, 255.)

**Tungsten chloride nitrogen sulphide,  $WCl_4$ ,  $N_4S_4$ .**

(Davis, Chem. Soc. 1906, 89, (2) 1575.)

**Tungsten chloroarsenide,  $W_2AsCl_5$ .**

Hygroscopic, decomp. by  $H_2O$  and acids; sol. in aq. solution of alkalis; insol. in anhydrous organic solvents. (Defacqz, C. R. 1901, 132, 139.)

**Tungsten chlorosulphide,  $W_2S_2Cl_4$ .**

Decomp. by  $H_2O$ .

Sol. in  $S_2Cl_2$ . (Smith and Oberholtzer, Z. anorg. 1894, 5, 68.)

$WCl_5$ ,  $3WS_2$ . Decomp. by  $H_2O$ . Insol. in  $CS_2$ , alcohol and  $C_6H_6$ . (Defacqz, A. ch. 1901, (7) 22, 266.)

**Tungsten hexafluoride,  $WF_6$ .**

Fumes in the air.

Decomp. by  $H_2O$ . Easily sol. in aq. alkalis. (Ruff, B. 1905, 38, 747.)

**Tungsten diiodide,  $WI_2$ .**

Not decomp. by  $H_2O$ . (Roscoe, A. 162, 366.)

Insol. in  $H_2O$ ,  $CS_2$  and alcohol. Decomp. by boiling  $H_2O$ ,  $HNO_3$ ,  $H_2SO_4$  and aqua regia; sol. in fused  $KOH$ , and alkali carbonates. (Defacqz, C. R. 1898, 126, 936.)

**Tungsten tetraiodide,  $WI_4$ .**

Insol. in  $H_2O$ , ether, chloroform and turpentine, sol. in abs. alcohol, decomp. when boiled with  $H_2O$ ; sol. with decomp. in dil.  $HCl$  and  $H_2SO_4$ , in  $HNO_3$  and aqua regia, and in alkali hydroxides and carbonates fused or in aq. solution. (Defacqz, C. R. 1898, 127. 511.)

**Tungsten nitride,  $W_2N_2$ .**

(Uhrlaub)

$W_2N_2$ . Insol. in  $HNO_3$ , dil.  $H_2SO_4$  and  $NaOH + Aq$  (Rideal, Chem. Soc. 1889, 55. 44.)

**Tungsten nitride amide,  $W_2N_2H_4 = 2WN_2, W(NH_2)_2$ .**

Not attacked by acids or caustic alkalis +  $Aq$ . (Wöhler, A. 73. 191.)

**Tungsten nitride amide oxide,  $W_2N_2H_4O_4 = 3WN_2, W_2(NH_2)_2, 2WO_3$ .**

Not attacked by acids or alkalis (Wöhler.)

**Tungsten monoxide,  $WO$ .**

Insol. in  $H_2O$ . Not attacked by  $HCl$ ,  $HF$ ,  $H_2SO_4$ , or  $KOH + Aq$ .  $HNO_3 + Aq$  or aqua regia convert it into  $WO_3$  (Headen, Sil. Am. J. 145. 280.)

**Tungsten dioxide,  $WO_2$ .**

(a) When prepared in the dry way, is attacked only by aqua regia, which oxidises to  $WO_3$ .

(b) When moist, is sol. in  $HCl$  or  $H_2SO_4 + Aq$ , also in  $KOH + Aq$ . Insol. in  $NH_4OH + Aq$ . (Riche, A. ch. (3) 50. 5.)

*Cryst.* Insol. in  $HCl$ ,  $H_2SO_4$  and conc. aq. alkalis; sol. in  $HNO_3$ . (Hallopeau, C. R. 1898, 127. 135.)

**Tungsten oxide, blue.**

$W_2O_5$  (Riche, A. ch. (3) 50. 33);  $W_2O_6$  (v. Uslar),  $W_2O_{11}$  (Gmelin).

All are probably the same substance. Not attacked by boiling  $HNO_3$  or aqua regia. Slowly sol. in boiling  $KOH + Aq$ .

**Tungsten trioxide,  $WO_3$ .**

Insol. in  $H_2O$  or acids. Sl. sol. in dil.  $KOH + Aq$ ,  $NaOH + Aq$ ,  $Na_2CO_3 + Aq$ , or  $H_2CO_3 + Aq$ , but easily sol. in conc. boiling solutions of same.  $NH_4OH + Aq$  when boiling has a solvent action.

Insol. in conc. and dil.  $H_2SO_4$ . (Desi, J. Am. Chem. Soc. 1897, 19. 214.)

Min. *Tungstite*. Insol. in acids. Sol. in  $NH_4OH + Aq$ .

**Tungsten oxide,  $W_2O_5$ .**

Sol. in alkalis (Desi, J. Am. Chem. Soc. 1897, 19. 214.)

$W_2O_5$ . Insol. in acids and alkalis (Desi, J. Am. Chem. Soc. 1897, 19. 228.)

+  $H_2O$ . Like  $W_2O_4 + H_2O$ . (Allon and Gottschalk, Am. Ch. J. 1902, 27. 336.)

$W_2O_5$ . (Desi, J. Am. Chem. Soc. 1897, 19. 219.)

$W_2O_5$ . (Desi.)

$W_2O_4 + H_2O$ . Insol. in  $H_2O$  containing a little  $HCl$ .

Slowly attacked by cold, conc.  $MOH + Aq$ . (Allen and Gottschalk, Am. Ch. J. 1902, 27. 333.)

**Tungsten trioxide ammonia,  $WO_3, 3NH_3$ .**

(Rosenheim and Jacobssohn, Z. anorg. 1906, 50. 306.)

**Tungsten oxybromide, etc.**

See Tungstyl bromide, etc.

**Tungsten monophosphide,  $WP$ .**

Not attacked by  $HF$  or  $HCl$ .

Sol. in warm  $HNO_3 + HF$ . Slowly attacked by hot  $HNO_3$ .

Not attacked by  $KOH + Aq$  or  $NaOH + Aq$ . (Defacqz, C. R. 1901, 132. 34.)

**Tungsten diphosphide,  $WP_2$ .**

Insol. in  $H_2O$  and in most organic solvents; insol. in  $HCl$  and  $HF$ ; sol. in a mixture of  $HF$  and  $HNO_3$  in the cold, and in aqua regia on warming. (Defacqz, C. R. 1900, 130. 916.)

**Tungsten phosphide,  $W_2P_2$ .**

Not attacked by any acid, not even by aqua regia (Wöhler and Wright, A. 79. 244.)

$W_2P_2$ . (Wöhler and Wright.)

**Tungsten diselenide,  $WSe_2$ .**

(Uelsmann.)

**Tungsten triselenide,  $WSe_3$ .**

Easily sol. in alkali sulphides or selenides +  $Aq$ . (Uelsmann, Jahrb. f. Ch. 1860. 92.)

**Tungsten silicide.**

Sol. in  $HF$

Only very sl. sol. in other acids (Warren, C. N. 1898, 78. 319.)

$WSi_2$ . Not attacked by ordinary acids and scarcely by warm aqua regia, but violently attacked by  $HNO_3 + HF$ . Sl. attacked by 10% alkalis +  $Aq$ . (Hönigschmid, M. 1907, 28. 1017.)

Not attacked by dil. or conc.  $HCl$ ,  $HF$ ,  $HNO_3$  or  $H_2SO_4$ , nor by  $NaOH$  or aqua regia.

Attacked by  $HNO_3 + HF$  or by fused alkalis. (Defacqz, C. R. 1907, 144. 850.)

$WSi_2$ . Violently attacked by  $HNO_3 + HF$ . Not attacked by  $HNO_3$ ,  $H_2SO_4$ ,  $HCl$  or  $HF$ . (Friley, Rev. Mét. 1911, 8. 509.)

$W_2Si_2$ . Insol. in acids including  $HF$ ; sol. in a mixture of  $HF$  and  $HNO_3$ ; sol. in fused alkali hydroxides and carbonates. (Vigouroux, C. R. 1898, 127. 394.)

**Tungsten disulphide,  $WS_2$ .**Oxidised by  $HNO_3 + Aq.$  (Berzelius)

Insol. in min acids

Sol. in a mixture of HF and  $HNO_3$  and in fused alkalis and alkali carbonates (Defacqz, C R 1899, 128. 611.)**Tungsten trisulphide,  $WS_3$ .**Somewhat sol in cold, abundantly in hot  $H_2O$ , but separated out by the addition of salts, especially  $NH_4Cl$  or acids. Sol. in alkali sulphides, and hydrosulphides + Aq. Sol. in caustic alkalis, and alkali carbonates + Aq. Slowly sol. in  $NH_4OH + Aq$  in the cold.**Tungstic acid,  $H_2WO_4$ .**Insol. in  $H_2O$  Sol. in HF Insol in tungstates + Aq.44.7%  $H_2WO_4$  is sol. in 50% HF + Aq at 25°.55.8%  $H_2WO_4$  is sol. in 50% HF + Aq at 50°.100 g sat.  $H_2WO_4 + HCl + Aq$  contain 0.68 g.  $H_2WO_4$  at 80°9.8%  $H_2WO_4$  is sol in sat alcoholic HCl at 75°.

Insol in alcoholic solutions of HBr and HI (Rosenheim, Chem Soc 1911, 100. (2) 402.)

Freshly pptd tungstic acid dissolves in  $H_2O_2$  (Kellner, Dissert 1909.)Insol in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 830) $H_4WO_6$  Precipitate Sl sol. in  $H_2O$  and aqueous solutions of the tungstates. Sol in 250-300 pts  $H_2O$ . When freshly pptd, sol. in alkali hydrates or carbonates + Aq. (Anthony, J. pr. 8. 6)**Metatungstic acid,  $H_2W_2O_{11} + 9H_2O$ .**Sol in  $H_2O$ . Solution may be boiled and evaporated to a syrupy consistency, when it suddenly gelatinises and ordinary tungstic acid is precipitated.Sol in  $H_2O$ . When heated to 50°, it becomes insol. in  $H_2O$ . (Soboleff, Z. anorg. 1896, 12. 28.)**Solubility in  $H_2O$  at t°.**

t°	100 ccm $H_2O$ dissolve g of the cryst. acid	Sp gr of the solution
0	41.46	1.6025
22	88.57	2.5239
43.5	111.87	3.6503

(Soboleff.)

Sp. gr. of solution of metatungstic acid at 17.5° containing:

2.79	12.68	27.61	43.75% $WO_3$ .
1.0257	1.1275	1.3274	1.6343

(Scheibler, J. pr. 83. 273.)

Sp. gr. of aqueous solution calculated by M = Mendeleeff, and G = (Gerlach (Z. anal. 27. 300), containing.

	5	10	15	20	25% $WO_3$ .
M	1.047	1.098	1.153	1.214	1.285
G	1.0469	1.0980	1.1544	1.2172	1.2873
	30	35	40	45	50% $WO_3$ .
M	1.366	1.458	1.555	1.581 (?)	
G	1.3660	1.4540	1.5527	1.6630	1.7860

**Solubility in ether at t°.**

t°	100 ccm. ether dissolve g of the cryst. acid
0	83.456
7.8	88.389
18.2	99.66
24.3	110.76

(Soboleff, Z. anorg. 1896, 12. 32.)

*Colloidal* Sol. in  $H_2O$  Not precipitated by acids or alcohol. Can be evaporated to dryness and heated to 200°, and still remains sol. in  $H_2O$  Sol. in  $\frac{1}{2}$  pt. of  $H_2O$ 

Sp. gr of aqueous solution containing:

	5	20	50	66.5	79.8% $WO_3$ .
	1.0475	1.2168	1.8001	2.596	3.243

(Graham, Chem. Soc. 17. 318.)

Perhaps paratungstic acid,  $H_{10}W_{12}O_{41}$ . (Klein, Bull Soc (2) 36. 547)**Tungstates.**Few normal tungstates are sol in  $H_2O$ , even some of the K and  $NH_4$  salts are very sl sol. Most of the metatungstates, however, are easily sol in  $H_2O$ Tungstates insol in  $H_2O$  are usually insol in dil. acids.**Aluminum tungstate,  $Al_2(WO_4)_3 + 8H_2O$ .**Precipitate. Insol. in  $H_2O$  and  $Na_2WO_4 + Aq.$  Sol. in  $(NH_4)_2Al_2(SO_4)_4 + Aq.$   $NaOH + Aq.$   $NH_4OH + Aq.$ Easily sol. in  $H_3PO_4$ ,  $H_2C_2O_4$ , and  $H_2C_2O_4 + Aq.$  (Lotz, A. 83. 65.)Sol. in 1500 pts.  $H_2O$  at 15°. (Lefort, C. R. 87. 748.) $Al_2O_3 + 4WO_3 + 9H_2O$ . Sol. in 400 pts  $H_2O$  at 15°. (Lefort, C. R. 87. 748.) $Al_2O_3 + 5WO_3 + 6H_2O$ . Sol. in  $H_2O$ , from which it is pptd by alcohol. (Lefort.)Formula according to Lefort is  $Al_2O_3 + 3WO_3 + 3H_2O + 2WO_3$ 

See also Aluminicotungstic acid.

**Aluminum paratungstate,  $5Al_2O_3 + 36WO_3 + 46H_2O = Al_2O_3 + 7WO_3 + 9H_2O$  (?).**

Easily sol in an alum solution. (Lotz, A. 83. 65.)

**Aluminum ammonium tungstate,  $3(NH_4)_2O + Al_2O_3 + 9WO_3 + 4H_2O$ .**Sol. in conc  $HNO_3$  and in conc. HCl (Balke and Smith, J. Am. Chem. Soc. 1903, 25. 1230.)

**Aluminum ammonium antimony tungstate.**

See *Aluminicoantimoniotungstate, ammonium*.

**Aluminum antimony tungstate.**

See *Aluminicoantimoniotungstic acid*.

**Aluminum zinc tungstate,  $Al_2O_3$ ,  $ZnO$ ,  $9WO_3$ ,  $+20H_2O$ .**

Very sol. in  $H_2O$  (Dapiels, J. Am. Chem. Soc. 1908, 30, 1850)

$2Al_2O_3$ ,  $3ZnO$ ,  $18WO_3$ ,  $+16H_2O$ . Sol. in much  $H_2O$

Sol. in very dil. mineral acids or in acetic acid. (Daniels.)

**Ammonium tungstate,  $(NH_4)_2WO_4$ .**

Known only in solution

$(NH_4)_2WO_4 + 3H_2O = 2(NH_4)_2O$ ,  $3WO_3$ ,  $+3H_2O$ . Sol. in  $H_2O$  with decomp. Decomp. on air with evolution of  $NH_3$  and formation of *paratungstate*. Sol. in  $NH_4OH$  + Aq (Marignac, A. ch. (3) 69, 23.)

$(NH_4)_2WO_4 + 5H_2O = 2(NH_4)_2O$ ,  $5WO_3$ ,  $+5H_2O$ . Sol. at ordinary temp. in 26-29 pts  $H_2O$  with partial decomposition. (Marignac.)

$+2\frac{1}{2}H_2O$ ,  $+3H_2O$ ,  $+4H_2O$ ,  $+4\frac{1}{2}H_2O$ , and  $+5H_2O$ . (Pmagel, Dissert, 1904.)

$(NH_4)_2WO_4 + 8H_2O = 3(NH_4)_2O$ ,  $8WO_3$ ,  $+8H_2O$ . Sol. in  $H_2O$ . (Marignac.)

*Colloidal*  $(NH_4)_2O$ ,  $6WO_3$ ,  $+4$  or  $6H_2O$ . Miscible with water in nearly all proportions (Taylor, J. Am. Chem. Soc. 1902, 24, 632.)

**Ammonium metatungstate,  $(NH_4)_2W_6O_{21}$ .**

$+6H_2O$ . (Marignac, A. ch. (4) 3, 74.)

$+8H_2O$ . Efflorescent. Very sol. in  $H_2O$

1 pt. dissolves at  $15^\circ$  in 0.84 pt.  $H_2O$ . (Lotz.)

1 pt. dissolves at ordinary temp. in 0.35 pt.  $H_2O$ . (Riche.)

Solubility increases rapidly with the temperature

Saturated solution at  $40^\circ$  is solid on cooling.

Sl. sol. in ordinary, insol. in absolute alcohol (Lotz.) Insol. in ether (Riche.)

$[(NH_4)_2W_6O_{21} + 5H_2O$  of Marguerite.]

$(NH_4)_6W_{12}O_{41} + 17H_2O = 3(NH_4)_2O$ ,  $16WO_3$ ,  $+17H_2O$ . Very efflorescent. Decomp. by dissolving in pure  $H_2O$ . (Marignac, A. ch. (4) 3, 75.)

**Ammonium paratungstate,  $(NH_4)_{10}W_{12}O_{41} = 5(NH_4)_2O$ ,  $12WO_3$ .**

(Marignac, A. ch. (3) 69, 25)

According to Lotz (A. 91, 49) and Scheibler (J. pr. 80, 208), formula is  $(NH_4)_8W_8O_{34} = 3(NH_4)_2O$ ,  $7WO_3$

$+5H_2O$ . (Scheibler, J. pr. 43, 232)

$+11H_2O$ . Sol. in 25-28 pts. cold  $H_2O$ . (Anthon)

Sol. in 26.1 pts.  $H_2O$  at  $10.7^\circ$ , and 5.8 pts at  $100^\circ$  (Lotz.)

Sol. in 33.3 pts. cold  $H_2O$ , and 9.6 pts at  $100^\circ$ . (Riche.)

Sol. in 22-38 pts  $H_2O$  at  $15-18^\circ$  The solution gradually decomposes, with the formation of a more soluble salt. (Marignac)

Not much more sol. in  $NH_4OH$  + Aq than in  $H_2O$  Insol. in alcohol (Anthon)

Sol. in  $H_2O_2$  (Kellner, Dissert, 1909.)

**Ammonium bismuth tungstate.**

See *Bismuthicotungstate, ammonium*.

**Ammonium cadmium paratungstate,**

$3(NH_4)_2O$ ,  $12CdO$ ,  $35WO_3$ ,  $+35H_2O$ .

Ppt. Sol. in  $H_2O$  acidulated with  $HNO_3$ . (Lotz, A. 91, 49.)

**Ammonium cerium tungstate.**

See *Cericotungstate, ammonium*.

**Ammonium cobaltous tungstate,  $8(NH_4)_2O$ ,**

$2CoO$ ,  $15WO_3$ ,  $+3H_2O$

(Carnot, C. R. 109, 147.)

**Ammonium hydroxylamine tungstate,**

$NH_4OWO_2NH_4$ .

Sol. in  $H_2O$ . (Hofmann, Z. anorg. 1898, 16, 465)

**Ammonium iron (ferric) tungstate,  $5(NH_4)_2O$ ,**

$Fe_2O_3$ ,  $5WO_3$ ,  $+5H_2O$

Sol. in  $H_2O$ . (Borek.)

**Ammonium lanthanum tungstate.**

See *Lanthanicotungstate, ammonium*.

**Ammonium magnesium paratungstate,**

$2(NH_4)_2O$ ,  $3MgO$ ,  $12WO_3$ ,  $+24H_2O$ .

Very slightly sol. in  $H_2O$ . (Marignac, A. ch. (3) 69, 58)

$(NH_4)_2O$ ,  $2MgO$ ,  $7WO_3$ ,  $+10H_2O$ . Very sl. sol. in  $H_2O$ ; sol. in  $H_2O$  acidulated with  $HNO_3$  (Lotz.)

**Ammonium mercuric tungstate,  $(NH_4)_2WO_4$ ,**

$HgWO_4$ ,  $+H_2O$ .

Insol. in  $H_2O$ . Decomp. by acids or alkalies (Anthon)

**Ammonium neodymium tungstate.**

See *Neodymicotungstate, ammonium*.

**Ammonium nickel tungstate.**

See *Nickelicotungstate, ammonium*.

**Ammonium potassium paratungstate,**

$5K(NH_4)_2O$ ,  $12WO_3$ ,  $+11H_2O$ .

Sol. in boiling  $H_2O$ , sl. sol. in cold  $H_2O$ . (Hallopeau, C. R. 1896, 123, 180)

**Ammonium potassium sodium paratungstate,**

$5(K, Na, NH_4)_2O$ ,  $12WO_3$ ,  $+13H_2O$ , where  $K : Na : NH_4 = 3 : 3 : 4$ .

$10(K, Na, NH_4)_2O$ ,  $24WO_3$ ,  $+26H_2O$ , where  $K : Na : NH_4 = 3 : 3 : 14$ . (Laurent.)

**Ammonium sodium paratungstate**,  $4(\text{NH}_4)_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 5\text{H}_2\text{O}$ .

Can be crystallised from  $\text{H}_2\text{O}$  without decomp. (Lotz, A. 91. 57.)

+  $14\text{H}_2\text{O}$ . Sol. in warm  $\text{H}_2\text{O}$ . (Hallopeau, C. R. 1896, 123. 181.)

$(\text{NH}_4)_2\text{O}$ ,  $4\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 25\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Hallopeau, C. R. 1895, 120. 1344.)

$5\text{Na}_2\text{O}$ ,  $15(\text{NH}_4)_2\text{O}$ ,  $45\text{WO}_3 + 48\text{H}_2\text{O}$ . (Marignac, A. ch. (3) 69. 53.)

$2\text{Na}_2\text{O}$ ,  $3(\text{NH}_4)_2\text{O}$ ,  $12\text{WO}_3 + 15\text{H}_2\text{O}$ . (Marignac)

$3(\text{NH}_4)_2\text{O}$ ,  $2\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 15\text{H}_2\text{O}$ .  $3(\text{NH}_4)_2\text{O}$ ,  $3\text{Na}_2\text{O}$ ,  $16\text{WO}_3 + 22\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Hallopeau, C. R. 1896, 123. 181.)

$3\text{Na}_2\text{O}$ ,  $4(\text{NH}_4)_2\text{O}$ ,  $16\text{WO}_3 + 18\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 236.)

Is  $2\text{Na}_2\text{O}$ ,  $3(\text{NH}_4)_2\text{O}$ ,  $12\text{WO}_3 + 13\text{H}_2\text{O}$ , according to Knorre (B. 19. 823)

Very sol. in hot  $\text{H}_2\text{O}$  (Knorre, B. 1886, 19. 823.)

$(\text{NH}_4)_2\text{O}$ ,  $3\text{Na}_2\text{O}$ ,  $16\text{WO}_3 + 38\text{H}_2\text{O}$ . (Wyrouboff, Bull. Soc. Min. 1892, 15. 85.)

$6(\text{NH}_4)_2\text{O}$ ,  $2\text{Na}_2\text{O}$ ,  $20\text{WO}_3 + 24\text{H}_2\text{O}$ . Can be cryst. from boiling  $\text{H}_2\text{O}$ . (Baragiola, Dissert. 1902.)

$4\text{Na}_2\text{O}$ ,  $16(\text{NH}_4)_2\text{O}$ ,  $50\text{WO}_3 + 50\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$  (Gibbs, Proc. Am. Acad. 15. 12.)

**Ammonium zinc paratungstate**,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{ZnO}$ ,  $7\text{WO}_3 + 13\text{H}_2\text{O}$ .

Sl. sol. in boiling  $\text{H}_2\text{O}$ , but more easily on addition of oxalic, tartaric, phosphoric, or dil. nitric acids, or of ammonium tungstate. (Lotz, A. 91. 49.)

**Ammonium zirconium tungstate**. See Zirconotungstate, ammonium.

**Ammonium metatungstate nitrate**. See Nitrate metatungstate, ammonium.

**Ammonium tungstate vanadate**. See Vanadiotungstate, ammonium.

**Antimony tungstate**,  $\text{Sb}_2\text{O}_3$ ,  $5\text{WO}_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (Lefort)  $\text{Sb}_2\text{O}_3$ ,  $6\text{WO}_3 + 8\text{H}_2\text{O}$ . Ppt. See also Antimonotungstic acid.

**Barium tungstate**,  $\text{BaWO}_4$ .

Anhydrous. Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{HNO}_3 + \text{Aq.}$  (Geuther and Forsberg, A. 120. 270.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or boiling  $\text{H}_3\text{PO}_4 + \text{Aq.}$  Sol. in boiling, less sol. in cold  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq.}$  (Anthon.)

+  $2\frac{1}{2}\text{H}_2\text{O}$ . Insol. precipitate (Scheibler.) Pptd.  $\text{BaWO}_4$  is attacked by dil. acids. More sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  than in  $\text{H}_2\text{O}$ . (Smith and Bradbury, B. 24. 2390.)

**Barium ditungstate**,  $\text{Ba}_2\text{W}_2\text{O}_{11} + \text{H}_2\text{O}$  (?).

Nearly insol. in  $\text{H}_2\text{O}$ . 100 ccm.  $\text{H}_2\text{O}$  dissolve about 0.05 g. at  $15^\circ$ . (Lefort, A. ch. (5) 15. 325.)

**Barium tungstate**,  $\text{BaW}_2\text{O}_{10} + 4\text{H}_2\text{O}$  (?).

Sol. in about 300 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . Decomp. by boiling  $\text{H}_2\text{O}$  into an insol. salt. (Lefort, C. R. 68. 798.)

+  $6\text{H}_2\text{O}$  (Scheibler.)

**Barium metatungstate**,  $\text{BaW}_2\text{O}_{11} + 9\text{H}_2\text{O}$ .

Efflorescent. Quite sol. in hot  $\text{H}_2\text{O}$ . Partly decomp. by cold  $\text{H}_2\text{O}$  into  $\text{BaW}_2\text{O}_{10}$  and  $\text{WO}_3$ , which recombine on heating. (Scheibler, J. pr. 80. 204.)

**Barium tungstate**,  $\text{BaW}_2\text{O}_{11} + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq.}$  (Zettnow.)  $\text{BaW}_2\text{O}_{11}$ . Barium bronze. (Hallopeau, A. ch. 1900, (7) 19. 121.)

**Barium paratungstate**,  $\text{Ba}_3\text{W}_{12}\text{O}_{41} + 14\text{H}_2\text{O}$ , or  $\text{Ba}_2\text{W}_2\text{O}_{11} + 8\text{H}_2\text{O}$ .

Insol. in cold  $\text{H}_2\text{O}$ ; when freshly pptd. is sl. sol. in  $\text{HNO}_3 + \text{Aq.}$  (Lotz, A. 91. 60.) Sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Wackenroder.)

+  $27\text{H}_2\text{O} = \text{Ba}_3\text{W}_{12}\text{O}_{41} + 16\text{H}_2\text{O}$ . Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$  (Knorre, B. 13. 327.)

**Barium tungstate**,  $\text{BaW}_2\text{O}_{11} + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq.}$  (Zettnow.)  $\text{BaW}_2\text{O}_{11}$ . Barium bronze. (Hallopeau, A. ch. 1900, (7) 19. 121.)

**Barium paratungstate**,  $\text{Ba}_3\text{W}_{12}\text{O}_{41} + 14\text{H}_2\text{O}$ , or  $\text{Ba}_2\text{W}_2\text{O}_{11} + 8\text{H}_2\text{O}$ .

Insol. in cold  $\text{H}_2\text{O}$ ; when freshly pptd. is sl. sol. in  $\text{HNO}_3 + \text{Aq.}$  (Lotz, A. 91. 60.) Sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Wackenroder.)

+  $27\text{H}_2\text{O} = \text{Ba}_3\text{W}_{12}\text{O}_{41} + 16\text{H}_2\text{O}$ . Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$  (Knorre, B. 13. 327.)

**Barium potassium tungstate tungsten oxide**,  $\text{BaW}_2\text{O}_{11}$ ,  $5\text{K}_2\text{W}_2\text{O}_{11}$ .

(Engels, Z. anorg. 1903, 37. 136.)

**Barium silver metatungstate**. (Scheibler.)

**Barium sodium paratungstate**,  $2\text{BaO}$ ,  $3\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 24\text{H}_2\text{O}$ . (Marignac), or  $\text{BaO}$ ,  $2\text{Na}_2\text{O}$ ,  $7\text{WO}_3 + 14\text{H}_2\text{O}$  (Scheibler).

Insol. in  $\text{H}_2\text{O}$

**Barium sodium tungstate tungsten oxide**,  $2\text{BaW}_2\text{O}_{11}$ ,  $3\text{Na}_2\text{W}_2\text{O}_{11}$ .

$\text{BaW}_2\text{O}_{11}$ ,  $5\text{Na}_2\text{W}_2\text{O}_{11}$  (Engels, Z. anorg. 1903, 37. 131.)

**Bismuth tungstate**,  $\text{Bi}_2\text{O}_3$ ,  $6\text{WO}_3 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  with decomp. Pptd. by alcohol from aqueous solution. (Lefort, C. R. 87. 748.)

**Cadmium tungstate**,  $\text{CdWO}_4$ .

Anhydrous +  $\text{H}_2\text{O}$ . Sol. in about 2000 pts.  $\text{H}_2\text{O}$  (Lefort.)

+  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in hot phosphoric or oxalic acids, or in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Anthon, J. pr. 9. 341.)

Sol. in  $\text{KCN} + \text{Aq.}$  (Smith and Bradbury, B. 24. 2390.)

**Cadmium ditungstate,  $\text{CdW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?)**

Sol. in about 500 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Lefort, A. ch (5) 15. 346.)

**Cadmium tritungstate,  $\text{CdW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?) (Lefort.)****Cadmium metatungstate,  $\text{CdO}, 4\text{WO}_3 + 10\text{H}_2\text{O}$ .**

Not efflorescent (Scheibler, J pr 83. 273)  
Somewhat less sol in  $\text{H}_2\text{O}$  than the Mn salt.  
(Wyruboff, Bull. Soc. Min 1892, 15. 84)

**Cadmium paratungstate,  $\text{Cd}_2\text{W}_7\text{O}_{24} + 16\text{H}_2\text{O}$ .**

Ppt. (Gonzalez.)  
Insol. in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , and hot  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{C}_2\text{O}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$

**Cadmium sodium paratungstate,  $2\text{CdO}, \text{Na}_2\text{O}, 7\text{WO}_3 + 18\text{H}_2\text{O}$ .**

Difficultly sol in cold  $\text{H}_2\text{O}$ . (Knorre, B. 19. 824.)

**Calcium tungstate,  $\text{CaWO}_4$ .**

Insol. in  $\text{H}_2\text{O}$  or dil. acids Sol in about 500 pts.  $\text{H}_2\text{O}$ . (Lefort)

Decomp. by  $\text{KOH} + \text{Aq}$  (Anthon)  
When freshly pptd, sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Wackenroder)

Sol in  $\text{Mg}$ , and  $\text{NH}_4$  salts, also  $\text{Na}_2\text{WO}_4 + \text{Aq}$  (Sonstadt, C. N 11. 97.)  
Min. *Scheelite*. Decomp by  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ , with separation of  $\text{WO}_3$ .

**Calcium ditungstate,  $\text{CaW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?)**

Sol. in 30 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort, A. ch (5) 15. 328.)

**Calcium tritungstate,  $\text{CaW}_3\text{O}_{10} + 6\text{H}_2\text{O}$  (?)**

Sol. in cold  $\text{H}_2\text{O}$ . (Lefort.)

**Calcium metatungstate,  $\text{CaW}_4\text{O}_{13} + 10\text{H}_2\text{O}$ .**

Easily sol in  $\text{H}_2\text{O}$  (Scheibler)

**Calcium paratungstate,  $\text{Ca}_2\text{W}_7\text{O}_{24} + 18\text{H}_2\text{O}$  (or  $\text{Ca}_5\text{W}_{15}\text{O}_{41} + 30\text{H}_2\text{O}$ ).**

Much more sol. than Si or Ba salt (Knorre B. 18. 328.)

Easily sol. in  $\text{H}_2\text{O}$ . (Knorre, B 1885, 18. 326)

**Calcium potassium tungstate tungsten oxide,  $\text{CaW}_4\text{O}_{13}, 5\text{K}_2\text{W}_4\text{O}_{13}$ .**

(Engels, Z. anorg. 1903, 37. 149)

**Calcium sodium paratungstate,  $2\text{CaO}, 3\text{Na}_2\text{O}, 12\text{WO}_3 + 3\text{H}_2\text{O}$ .**

(Gonzalez, J. pr. (2) 36. 44)

**Calcium sodium tungstate tungsten oxide,  $\text{CaW}_4\text{O}_{13}, 5\text{Na}_2\text{W}_4\text{O}_{13}$ .**

Engels, Z. anorg. 1903, 37. 145.)

**Cerium tungstate,  $\text{Ce}_2(\text{WO}_4)_3 + \text{H}_2\text{O}$ .**

Precipitate (Cossa and Zecchino, Gazz. ch. it 10. 225)

**Cerium metatungstate,  $\text{Ce}_2\text{O}_3, 12\text{WO}_3 + 30\text{H}_2\text{O}$ .**

Permanent. Sol. in  $\text{H}_2\text{O}$ . (Scheibler)

**Cerium sodium tungstate,  $\text{Ce}_2\text{Na}_8(\text{WO}_4)_7$ .**

Insol. in  $\text{H}_2\text{O}$ . Slowly sol in dil. acids, easily in  $\text{HCl} + \text{Aq}$  (Högbom, Bull. Soc. (2) 42. 2)

$\text{Ce}_2(\text{WO}_4)_3, 3\text{Na}_2\text{WO}_4$ . (Didier, C. R. 102. 823)

**Cerium tungstate chloride,  $3\text{Ce}_2(\text{WO}_4)_3, 2\text{CeCl}_3$ .**

(Didier, C. R. 102. 823.)

**Chromic tungstate, basic,  $\text{Cr}_2\text{O}_3, 2\text{WO}_3 + 5\text{H}_2\text{O}$ .**

Sol in 400 pts  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort, C. R. 87. 748.)

**Chromic tungstate,  $\text{Cr}_2(\text{WO}_4)_3 + 7$ , and  $13\text{H}_2\text{O}$ .**

Sol in  $\text{CaCl}_2 + \text{Aq}$ , and in phosphoric, oxalic, or tartaric acids +  $\text{Aq}$  (Lotz) +  $3\text{H}_2\text{O}$  (Lefort, C. R. 87. 748)

$\text{Cr}_2\text{O}_3, 4\text{WO}_3 + 6\text{H}_2\text{O}$  Sol in about 50 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Lefort)

$\text{Cr}_2\text{O}_3, 5\text{WO}_3$  Not attacked by aqua regia (Smith and Oberholtzer, Z. anorg 5. 63.)

**Chromic paratungstate,  $\text{Cr}_2\text{W}_7\text{O}_{24} + 9\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4$  paratungstate +  $\text{Aq}$ ; sol in  $\text{CrCl}_3 + \text{Aq}$  (Lotz.)

**Cobaltous tungstate,  $\text{CoWO}_4$ .**

Anhydrous. Insol in  $\text{H}_2\text{O}$  and acids. +  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and cold  $\text{HNO}_3 + \text{Aq}$ . Sl. sol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . Completely sol. in warm  $\text{H}_3\text{PO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Anthon, J pr 9. 344)

Sol in about 500 pts.  $\text{H}_2\text{O}$ . (Lefort.)

**Cobaltous ditungstate,  $\text{CoW}_2\text{O}_7$  (?)**

+  $3\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$  Sl. sol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  Completely sol. in  $\text{H}_3\text{PO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Anthon.)

+  $5\text{H}_2\text{O}$ . Sol in about 100 pts  $\text{H}_2\text{O}$ . (Lefort)

+  $8\text{H}_2\text{O}$  (?) (Lefort)

**Cobaltous tritungstate,  $\text{CoW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?)**

Sol in  $\text{H}_2\text{O}$  (Lefort, C. R. 88. 798)

**Cobaltous metatungstate,  $\text{CoW}_4\text{O}_{13} + 9\text{H}_2\text{O}$ .**

Sol in  $\text{H}_2\text{O}$ . (Scheibler, J pr. 83. 317.)

**Cobaltous paratungstate,  $\text{Co}_2\text{W}_7\text{O}_{24} + 25\text{H}_2\text{O}$ .**

(Gonzalez, J. pr. (2) 36. 44)

Cobaltous sodium paratungstate,  $2\text{CoO}$ ,  $3\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 3\text{H}_2\text{O}$ .

(Gonzalez.)

Cupric tungstate,  $\text{CuWO}_4$ .

+  $2\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  Sol. in  $\text{H}_3\text{PO}_4$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . (Anthon.)

100 cc.  $\text{H}_2\text{O}$  at  $15^\circ$  dissolve 0.1 g. (Lefort)

Cupric ditungstate,  $\text{CuW}_2\text{O}_7$  (?).

+  $4\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  and  $\text{HNO}_3$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Anthon, J. pr. 9. 346.)

+  $5\text{H}_2\text{O}$  Sol. in about 300 pts.  $\text{H}_2\text{O}$  (Lefort)

Cupric metatungstate,  $\text{CuW}_6\text{O}_{13} + 11\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Scheibler)

Cupric paratungstate,  $\text{Cu}_3\text{W}_7\text{O}_{21} + 19\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  (Knorre, B. 19. 826.)

Cuprocupric tungstate,  $\text{Cu}_3\text{WO}_4$ ,  $2\text{CuWO}_4$ .

Insol. in  $\text{H}_2\text{O}$  (Zettnow, Pogg. 130. 255.)

Cupric sodium paratungstate,

$\text{Cu}_3\text{Na}_3(\text{W}_7\text{O}_{21})_2 + 32\text{H}_2\text{O}$ .

Ppt (Knorre, B. 19. 826.)

$\text{CuO}$ ,  $4\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 32\text{H}_2\text{O}$ . Ppt. (Gonzalez, J. pr. (2) 38. 52.)

Cupric tungstate ammonia,  $\text{CuWO}_4$ ,  $2\text{NH}_3 + \text{H}_2\text{O}$ .

(Schiff, A. 128. 39)

$\text{CuWO}_4$ ,  $4\text{NH}_3$  Gives off  $\text{NH}_3$  at ord temp Sol. in  $\text{H}_2\text{O}$  Sol. in dil  $\text{NH}_4\text{OH} + \text{Aq}$ . (Briggs, Chem Soc. 1904. 85. 676)

$\text{CuO}$ ,  $4\text{WO}_3$ ,  $6\text{NH}_3 + 8\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  Nearly insol. in dil  $\text{NH}_4\text{OH} + \text{Aq}$  (Briggs, Chem. Soc. 1904. 85. 676.)

Didymium tungstate,  $\text{Dy}_2(\text{WO}_4)_3$ .

Precipitate. (Frerichs and Smith, A. 191. 355)

Didymium metatungstate.

Sol. in  $\text{H}_2\text{O}$ . (Scheibler)

Didymium sodium tungstate,  $\text{DyNa}_3(\text{WO}_4)_3$ .

Acid Sol. in  $\text{H}_2\text{O}$ . Slowly sol. in dil. acids Sol. in conc  $\text{HCl} + \text{Aq}$

$\text{DyNa}_3(\text{WO}_4)_3$ . As above. (Högbom, Bull. Soc. (2) 42. 2.)

Erbium sodium tungstate,  $\text{Na}_3\text{Er}_2(\text{WO}_4)_6$ .

Insol. in  $\text{H}_2\text{O}$ . (Högbom.)

Glucinum metatungstate.

Very sol. in  $\text{H}_2\text{O}$ .

Indium tungstate,  $\text{In}_2(\text{WO}_4)_3 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids. (Renz, Dissert. 1902.)

Iron (ferrous) tungstate,  $\text{FeWO}_4$ .

Min. *Ferberite*, *Resmite*

+  $3\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$  Sol. in cold  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . Decomp. by boiling acids with separation of  $\text{WO}_3$  Sol. in boiling  $\text{H}_3\text{PO}_4 + \text{Aq}$  or warm  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . (Anthon, J. pr. 9. 343)

+  $\text{rH}_2\text{O}$  Very unstable (Lefort, A. ch. (5) 15. 314.)

Iron (ferrous) ditungstate,  $\text{FeW}_2\text{O}_7$  (?).

Insol. in  $\text{H}_2\text{O}$  Sol. in hot  $\text{H}_3\text{PO}_4 + \text{Aq}$  or  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  Decomp. by dil  $\text{HCl} + \text{Aq}$  or by  $\text{KOH} + \text{Aq}$  (Ebelmen, C. R. 17. 1198)

+  $\text{rH}_2\text{O}$  Very unstable. (Lefort.)

Iron (ferrous) tritungstate,  $\text{FeW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?).

Ppt. Decomp. by cold, more rapidly by hot  $\text{H}_2\text{O}$  (Lefort)

Iron (ferrous) metatungstate.

Sol. in  $\text{H}_2\text{O}$ . (Scheibler, J. pr. 83. 315)

Iron (ferric) tungstate, basic,  $\text{Fe}_2\text{O}_3$ ,  $2\text{WO}_3 + 4\text{H}_2\text{O}$ .

Sol. in about 50 pts  $\text{H}_2\text{O}$ . (Lefort.)

$2\text{Fe}_2\text{O}_3$ ,  $3\text{WO}_3 + 6\text{H}_2\text{O}$  Sol. in about 300 pts  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort)

Iron (ferric) tritungstate (?),  $\text{Fe}_2\text{O}_3$ ,  $4\text{WO}_3 + 4\text{H}_2\text{O} = \text{Fe}_2\text{O}_3$ ,  $3\text{WO}_3 + \text{WO}_3$ ,  $4\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$  without decomp (Lefort.)

Iron (ferric) metatungstate.

Sol. in  $\text{H}_2\text{O}$ . (Scheibler, J. pr. 83. 273.)

Iron (ferrous) manganous tungstate,  $7\text{FeWO}_4$ ,  $\text{MnWO}_4$ .

(Geuther and Forsberg, A. 120. 277.)

$4\text{FeWO}_4$ ,  $\text{MnWO}_4$ . (G. and F.)

$3\text{FeWO}_4$ ,  $\text{MnWO}_4$ . Partially sol. in conc.

$\text{HCl} + \text{Aq}$ . (G. and F.)

$3\text{FeWO}_4$ ,  $2\text{MnWO}_4$  (G. and F.)

$\text{FeWO}_4$ ,  $\text{MnWO}_4$ . (Zettnow, Pogg. 130. 250.)

$\text{FeWO}_4$ ,  $2\text{MnWO}_4$ . (G. and F.)

$\text{FeWO}_4$ ,  $7\text{MnWO}_4$ . (G. and F.)

$x\text{FeWO}_4$ ,  $y\text{MnWO}_4$ . Min. *Wolftramite*. Sol. in  $\text{HCl} + \text{Aq}$ , and boiling  $\text{H}_3\text{PO}_4 + \text{Aq}$ .

Lanthanum tungstate,  $\text{La}_2(\text{WO}_4)_3$ .

Precipitate

Lanthanum metatungstate.

Sol. in  $\text{H}_2\text{O}$  (Scheibler.)

Lanthanum silver tungstate.

See Lanthanocotungstate, silver.

Lanthanum sodium tungstate,  $\text{Na}_3\text{La}_2(\text{WO}_4)_7$ .

Insol. in  $\text{H}_2\text{O}$ . Slowly sol. in dil. acids.

Sol. in  $\text{HCl} + \text{Aq}$

$\text{La}_2\text{Na}_3(\text{WO}_4)_6$  As above. (Högbom, Bull. Soc. (2) 42. 2.)

**Lead tungstate,  $PbWO_4$ .**

Insol in  $H_2O$  or cold  $HNO_3 + Aq$ . Sol. in  $KOH + Aq$ . Decomp. by hot  $HNO_3 + Aq$  (Anthon, J. pr. 9. 342)

Sol. in about 4000 pts.  $H_2O$  (Lefort)  
Min *Scheele's*, *Stolz's*. Sol. in  $KOH + Aq$ ; decomp. by  $HNO_3$ .

Absolutely insol. in  $NH_4NO_3 + Aq$  (Smith and Bradbury, B. 24. 2930.)

**Lead ditungstate,  $PbW_2O_7 + 2H_2O$  (?).**

\* Sol. in about 80 pts.  $H_2O$  at  $15^\circ$ . (Lefort)

**Lead tritungstate,  $PbW_3O_{10} + 2H_2O$  (?).**

\* Ppt. (Lefort)

**Lead metatungstate,  $PbW_4O_{13} + 5H_2O$ .**

Sl. sol. in cold, more in hot  $H_2O$ . Sol. in hot  $HNO_3 + Aq$  (Scheibler, J. pr. 83. 318)

**Lead paratungstate,  $Pb_2W_7O_{24}$ .**

Insol. in  $H_2O$ , dil.  $HNO_3 + Aq$ ,  $(NH_4)_2WO_4 + Aq$ , or  $Pb(NO_3)_2 + Aq$ . Sol. in  $NaOH + Aq$  or boiling  $H_3PO_4 + Aq$ . (Lotz, A. 91. 49)

**Lead sodium paratungstate,  $PbO, 4Na_2O, 12WO_3 + 28H_2O$ .**

(Gonzalez)

**Lithium tungstate,  $Li_2WO_4$ .**

Rather easily sol. in  $H_2O$  (Gmelin.)

**Lithium metatungstate,  $Li_2W_4O_{13}$ .**

Insol. in  $H_2O$  (Knorre, J. pr. (2) 27. 94.)  
 $+ xH_2O$ . Syrup. (Scheibler.)

**Lithium paratungstate,  $Li_{10}W_{13}O_{41} + 33H_2O$  (or  $Li_6W_7O_{34} + 19H_2O$ ).**

According to Scheibler, more sol. than the paratungstates of the other alkali metals

**Lithium tungstate tungsten oxide,  $Li_2W_6O_{18}$ .**

*Lithium bronze*. Insol. in  $H_2O$ .

**Lithium potassium tungstate tungsten oxide,  $Li_2W_6O_{18}, 3K_2W_6O_{12}$ .**

*Lithium potassium bronze*. Insol. in  $H_2O$ . (Feit, B. 21. 135.)

**Lithium sodium tungstate,  $Li_2WO_4 + 3H_2O, 3(Na_2WO_4 + 3H_2O)$ .**

(Traube, N. Jahrb. Miner, 1894, I. 190.)

**Magnesium tungstate,  $MgWO_4$ .**

*Anhydrous*. Insol. in  $H_2O$ . Gradually decomp. by boiling conc.  $HNO_3 + Aq$ . (Geuther and Forsberg, A. 120. 272)

$+ 3H_2O$ . Very sol. in  $H_2O$ ; nearly insol. in alcohol. (Lefort, A. ch. (5) 15. 329)

$+ 7H_2O$ . Slowly sol. in cold, very easily in hot  $H_2O$ . (Ullik, W. A. B. 56. 2. 152.)

**Magnesium ditungstate,  $MgW_2O_7 + 8H_2O$  (?).**

Sol. in about 100 pts.  $H_2O$  (Lefort)

**Magnesium tritungstate,  $MgW_3O_{10} + 4H_2O$  (?).**

Easily sol. in  $H_2O$  with gradual decomp. (Lefort)

**Magnesium metatungstate,  $MgW_4O_{13} + 8H_2O$ .**

Sol. in  $H_2O$ . (Scheibler)

**Magnesium paratungstate,  $Mg_2W_7O_{24} + 24H_2O$ .**

Very difficultly sol. in cold, somewhat sol. in hot  $H_2O$  (Knorre, B. 19. 825)

**Magnesium potassium tungstate,  $MgWO_4, K_2WO_4$ .**

$+ 2H_2O$ . Very sl. sol. in  $H_2O$ . (Ullik)  
 $+ 6H_2O$ . Precipitate

**Magnesium potassium paratungstate,  $5(\frac{1}{3}K_2O, \frac{1}{3}MgO), 12WO_3 + 24H_2O$ .**

Insol. in cold, sol. in hot  $H_2O$ . (Hallopeau, C. R. 1898, 127. 621.)

**Magnesium sodium paratungstate,  $3MgO, 3Na_2O, 14WO_3 + 33H_2O$ .**

Nearly insol. in  $H_2O$ . (Knorre, B. 19. 825)

**Manganous tungstate,  $MnWO_4$ .**

Min *Hübnerite*. Partially sol. in  $HCl + Aq$   
 $+ 2H_2O$ . Insol. in  $H_2O$ ; sol. in warm  $H_3PO_4$  and  $H_2C_2O_4 + Aq$ , sl. sol. in  $HC_2H_3O_2 + Aq$ . Insol. in cold  $HCl + Aq$ . (Anthon.)  
 $+ H_2O$ . Sol. in about 2500 pts.  $H_2O$  at  $15^\circ$  (Lefort)

**Manganous ditungstate,  $MnW_2O_7 + 3H_2O$  (?).**

Sol. in about 450 pts.  $H_2O$  at  $15^\circ$  (Lefort, A. ch. (5) 15. 333)

**Manganous tritungstate,  $MnW_3O_{10} + 5H_2O$  (?).**

Decomp. by  $H_2O$  into  $MnW_2O_7$  and  $MnW_4O_{13}$  (Lefort, A. ch. (5) 17. 480.)

**Manganous metatungstate,  $MnW_4O_{13} + 10H_2O$ .**

Very sol. in  $H_2O$ . (Wyrouboff, Bull. Soc. Min. 1892, 15. 82)

**Manganous paratungstate,  $5MnO, 12WO_3 + 34H_2O$ .**

(Gonzalez, J. pr. (2) 36. 44)

$Mn_2W_7O_{24} + 11H_2O$ . When recently pptd., sol. in a small amt. of  $H_2O$  acidulated with  $HNO_3$ . (Lotz.)

**Manganous potassium tungstate,  $2MnO, 3K_2O, 12WO_3 + 16H_2O$ .**

Completely insol. in  $H_2O$ . (Hallopeau, Bull. Soc. 1898, (3) 19. 955.)

**Manganous sodium paratungstate**,  $3\text{Na}_2\text{O}$ ,  $3\text{MnO}$ ,  $14\text{WO}_3 + 36\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  (Knorre, B 19. 826.)

**Manganic sodium tungstate.**

See Permanganotungstate, sodium.

**Mercurous tungstate**,  $\text{Hg}_2\text{WO}_4$

Insol in  $\text{H}_2\text{O}$  (Anthon)

Impossible to obtain pure, as it is decomp. into—

$2\text{Hg}_2\text{O}$ ,  $3\text{WO}_3 + 8\text{H}_2\text{O}$  Sol. in 100 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort)

**Mercurous metatungstate**,  $\text{Hg}_2\text{W}_2\text{O}_{13} + 25\text{H}_2\text{O}$ .

Ppt (Scheibler, J pr 83. 319.)

**Mercuric tungstate**,  $\text{HgWO}_4$

Sl sol in  $\text{H}_2\text{O}$  and very unstable. (Lefort, A. ch. (5) 15. 356.)

$3\text{HgO}$ ,  $2\text{WO}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Anthon.)

$2\text{HgO}$ ,  $3\text{WO}_3$ . Insol. in  $\text{H}_2\text{O}$  (Anthon)

$3\text{HgO}$ ,  $5\text{WO}_3 + 5\text{H}_2\text{O}$  Sol in about 250 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Lefort)

$2\text{HgO}$ ,  $5\text{WO}_3 + 7\text{H}_2\text{O}$  Decomp by hot or cold  $\text{H}_2\text{O}$ . (Lefort, C R 88. 798.)

**Mercuric tritungstate**,  $\text{HgW}_3\text{O}_{10} + 7\text{H}_2\text{O}$  (?).

Sol in about 120 pts  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort, A ch (5) 15. 360)

**Molybdenum tungstate.**

Easily sol. in  $\text{H}_2\text{O}$ . Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  or in alcohol of 0.87 sp. gr (Berzelius)

**Neodymium tungstate**,  $\text{Nd}_2(\text{WO}_4)_3$

Very sl. sol. in  $\text{H}_2\text{O}$ . 1 pt. is sol. in 52630 pts.  $\text{H}_2\text{O}$  at  $22^\circ$ , 59580 pts at  $65^\circ$ ; 68040 pts at  $98^\circ$ . (Hutchcock, J Am Chem Soc. 1895, 17. 532)

**Nickel tungstate**,  $\text{NiWO}_4$ .

$+3\text{H}_2\text{O}$  Sol in about 1000 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort)

$+6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . Sol in boiling  $\text{H}_3\text{PO}_4 + \text{Aq}$ ,  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or in warm  $\text{NH}_4\text{OH} + \text{Aq}$ . (Anthon)

**Nickel ditungstate**,  $\text{NiW}_2\text{O}_7 + 5\text{H}_2\text{O}$  (?).

Sol in about 250 pts.  $\text{H}_2\text{O}$  (Lefort)

**Nickel tritungstate**,  $\text{NiW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?).

Sol in  $\text{H}_2\text{O}$ . Pptd. by alcohol Decomp. by cold or warm  $\text{H}_2\text{O}$  after above pptn. (Lefort)

**Nickel metatungstate**,  $\text{NiW}_4\text{O}_{13} + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Scheibler, J pr. 83. 273.)

**Nickel paratungstate**,  $\text{Ni}_2\text{W}_2\text{O}_{11} + 14\text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . Completely sl sol in warm  $\text{H}_3\text{PO}_4$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Anthon.)

**Potassium tungstate**,  $\text{K}_2\text{WO}_4$ .

*Anhydrous.* Rather deliquescent. Easily sol in  $\text{H}_2\text{O}$ .

$+ \text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  Insol in alcohol

$+ 2\text{H}_2\text{O}$  Very sol. in  $\text{H}_2\text{O}$  with absorption of heat.

1 pt. dissolves in 1.94 pts cold, and 0.66 pt. boiling  $\text{H}_2\text{O}$  Alcohol does not mix with conc. aq. solution, but slowly separates out the salt from it. Acids, even  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{H}_3\text{PO}_4$  or  $\text{H}_2\text{C}_2\text{O}_4$ , separate out  $\text{WO}_3$  from solution. (Riche, A. ch (3) 60. 45)

**Potassium ditungstate**,  $\text{K}_2\text{W}_2\text{O}_7 + 2\text{H}_2\text{O}$ .

Sol in about 8 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , but on heating is converted into—

$+ 8\text{H}_2\text{O}$  100 pts.  $\text{H}_2\text{O}$  dissolve only 2-3 pts. at  $15^\circ$ . (Lefort, A. ch. (5) 9. 102)

**Potassium tritungstate**,  $\text{K}_2\text{W}_3\text{O}_{10} + 2\text{H}_2\text{O}$ .

Sol. in 5-6 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  Can be recryst. from hot  $\text{H}_2\text{O}$ . (Lefort, A. ch (5) 9. 105)

**Potassium metatungstate**,  $\text{K}_2\text{W}_4\text{O}_{13} + 5\text{H}_2\text{O}$ .

Not efflorescent. Easily sol in  $\text{H}_2\text{O}$ . (Marignac.)

$(\text{K}_4\text{W}_6\text{O}_{17} + 8\text{H}_2\text{O}$  of Margueritte)

$+ 8\text{H}_2\text{O}$  Extremely efflorescent (Scheibler)

**Potassium octatungstate**,  $\text{K}_2\text{W}_8\text{O}_{28}$ .

Insol. in  $\text{H}_2\text{O}$ . (Knorre, J pr. (2) 27. 49)

**Potassium tungstate**,  $\text{K}_2\text{W}_{10}\text{O}_{34} + 9\text{H}_2\text{O} = 4\text{K}_2\text{O}$ ,  $10\text{WO}_3 + 9\text{H}_2\text{O}$ .

Properties resemble the paratungstate. (Gibbs, Proc Am Acad. 18. 11)

$+ 8\text{H}_2\text{O} = \text{K}_4\text{W}_8\text{O}_{28} + 4\text{H}_2\text{O}$  Sol in 15 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , but decomposed by heating into  $\text{K}_2\text{W}_2\text{O}_7$  and  $\text{K}_2\text{W}_6\text{O}_{18}$  (Lefort, A. ch. (5) 9. 104.)

$\text{K}_{10}\text{W}_{12}\text{O}_{47}$  Very difficulty sol. in cold, appreciably sol in hot  $\text{H}_2\text{O}$ , probably with decomposition (Knorre.)

**Potassium paratungstate**,  $\text{K}_{10}\text{W}_{12}\text{O}_{47} + 11\text{H}_2\text{O}$  (or  $\text{K}_4\text{W}_7\text{O}_{24} + 6\text{H}_2\text{O}$ , according to Lotz and Scheibler)

Much more sol in hot than cold  $\text{H}_2\text{O}$ . (Anthon)

Sol in 100 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , in 8.5 pts at  $100^\circ$  (Anthon)

Sol in 46.5 pts. cold, and 15.15 pts boiling  $\text{H}_2\text{O}$ . (Riche)

By shaking the crystals several days at  $20^\circ$ , 1 pt dissolves in 71 pts  $\text{H}_2\text{O}$  If the salt is treated with boiling water, more goes into solution the longer it is boiled, until after several days' boiling 1 pt of the salt dissolved in 5.52 pts  $\text{H}_2\text{O}$  at  $18^\circ$ . Kept in a closed flask, this solution contained after 26 days 1 pt of salt to 11.9 pts  $\text{H}_2\text{O}$ ; after 153 days, 1 pt of salt to 15.6 pts  $\text{H}_2\text{O}$ ; after 334 days, 1 pt of salt to 15.6 pts  $\text{H}_2\text{O}$  Insol in alcohol (Marignac)

$+ 8\text{H}_2\text{O}$ .

**Potassium sodium tungstate**,  $K_2WO_6$ ,  $2Na_2WO_4 + 14H_2O$ .

Easily sol. in hot and cold  $H_2O$  (Ullk, W. A. B. 58, 2, 150.)  
Deliquescent. Sol in 1 pt. cold, and  $\frac{1}{2}$  pt. hot  $H_2O$ . (Anthon.)

**Potassium sodium paratungstate**,  $Na_2O$ ,  $4K_2O$ ,  $12WO_3 + 15H_2O$ .

Sol in  $H_2O$  (Marignac.)  
 $\frac{8}{11}Na_2O$ ,  $\frac{3}{11}K_2O$ ,  $12WO_3 + 25H_2O$ . Sol in  $H_2O$ . (Marignac.)

**Potassium strontium tungstate tungsten oxide**,  $5K_2W_6O_{13}$ ,  $SrW_6O_{12}$ .  
(Engels, Z. anorg. 1903, 37, 143.)

**Potassium uranous tungstate.**

See Uranosotungstate, potassium.

**Potassium zirconium tungstate.**

See Zirconotungstate, potassium.

**Potassium tungstate tungsten oxide**,  $K_2WO_4$ ,  $W_2O_6$ .

*Potassium tungsten bronze.* (Scheibler, J. pr. 83 321.)

Formula is  $K_3W_6O_{13}$ . Not attacked by acids, and only very sl. by alkalis (Knorre, J. pr. (2) 27, 49.)

$K_2WO_4$ ,  $4WO_3$ . Not attacked by acids, even HF, or by alkalis + Aq. Insol in alcohol. (Zettnow, Pogg, 130, 262.)  
Does not exist (Knorre.)

**Potassium sodium tungstate tungsten oxide**,  $5K_2W_6O_{13} + 2Na_4W_6O_{18}$ .

*Potassium sodium tungsten bronze* Properties as potassium bronze.

$3K_2W_6O_{13}$ ,  $2Na_4W_6O_{18}$ . As above (Knorre, J. pr. (2) 27, 49.)

**Praseodymium tungstate**,  $Pr_2(WO_4)_3$ .

Very sl. sol. in  $H_2O$ .

Insol. in  $H_2O$  at  $20^\circ$ ; at  $75^\circ$ , 1 pt. is sol. in 23,800 pts.  $H_2O$  (Hitchcock, J. Am. Chem. Soc. 1895, 17, 529.)

**Rubidium metatungstate**,  $Rb_2O$ ,  $4WO_3 + 8H_2O$ .

Sol in about 10 pts. cold  $H_2O$ .

Moderately sol. in warm  $H_2O$ . (Wyruboff, Bull. Soc. Min. 1892, 15, 69.)

**Rubidium pentatungstate**,  $Rb_5W_5O_{16}$ .

Almost insol. in hot  $H_2O$ . When finely powdered, it is sol. in alkali carbonates + Aq (Schaeffer, Z. anorg. 1904, 38, 163.)

**Rubidium octotungstate**,  $Rb_8W_8O_{22}$ .

Insol. in  $H_2O$ , acids, and alkalis (Schaeffer, Z. anorg. 1904, 38, 103.)

**Rubidium paratungstate**,  $5Rb_2O$ ,  $12WO_3 + 18H_2O$ .

Very sl. sol. in  $H_2O$  (Schaeffer, Z. anorg. 1904, 38, 173.)

**Samarium metatungstate**,  $Sm_2O_3$ ,  $12WO_3 + 35H_2O$ .

Easily sol. in  $H_2O$ . (Cleve.)

**Samarium sodium tungstate**,  $Na_2Sm_4(WO_4)_6$ .

Insol. in  $H_2O$ . Slowly sol. in dil. acids, easily in conc. HCl + Aq. (Högbom, Bull. Soc. (2) 42, 2.)

**Silver (argentous) tungstate**,  $Ag_2O$ ,  $2WO_3$ .

$HNO_3$  + Aq separates  $WO_3$ . KOH + Aq dissolves out  $WO_3$  and separates  $Ag_2O$  (Wöhler and Rautenberg, A. 114, 120.)

Does not exist. (Muthmann, B. 20, 983.)

**Silver tungstate**,  $Ag_2WO_4$ .

Sol in about 2000 pts  $H_2O$  at  $15^\circ$ . Easily decomp. by NaCl + Aq or  $HNO_3$  + Aq (Lefort.)

$Ag_2W_2O_7$ . Insol. in  $H_2O$ . Nearly insol. in  $HCl$ ,  $H_2O_2$  or  $H_3PO_4$  + Aq. More sol. in KOH,  $NH_4OH$  + Aq, or  $H_2C_2O_4$  + Aq. (Anthon, J. pr. 9, 347.)

+  $H_2O$ . Sol in about 5000 pts  $H_2O$  at  $15^\circ$  (Lefort.)

**Silver metatungstate**,  $Ag_2W_6O_{13} + 3H_2O$ .

Sl. sol. in  $H_2O$ . (Scheibler, J. pr. 83, 318.)

Nearly insol. in  $H_2O$ . (Rosenheim, Z. anorg. 1911, 69, 250.)

**Silver paratungstate**,  $Ag_{10}W_{12}O_{41} + 8H_2O$ .

(Gonzalez, J. pr. (2) 38, 44.)

**Silver tungstate ammonia**,  $Ag_3WO_4$ ,  $4NH_3$ .

Sol in  $H_2O$  with rapid decomp (Widmann, Bull. Soc. (2) 20, 64.)

**Sodium tungstate**,  $Na_2WO_4 + 2H_2O$ .

Sol. in 4 pts. cold, and 2 pts. boiling  $H_2O$ . (Vauquelin and Hecht.)

Sol in 1 l pts. cold, and 0.5 pt. boiling  $H_2O$ . (Anthon.)

Sol. in 2.44 pts.  $H_2O$  at  $0^\circ$ , 1.81 pts. at  $15^\circ$ ; 0.81 pt. at  $100^\circ$ . (Riche.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	% $Na_2WO_4$	Mols. $H_2O$ to 1 mol $Na_2WO_4$	Mols of anhydrous salt to 100 mols $H_2O$
-3.5	41.67	22.87	4.37
+0.5	41.73	22.80	4.39
21.0	42.27	22.30	4.48
43.5	43.98	20.80	4.81
80.5	47.65	17.95	5.57
100.0	49.31	16.79	5.95

(Funk, B. 1900, 33, 3701.)

See also +10 $H_2O$ .

Sp. gr. of  $\text{Na}_2\text{WO}_4 + \text{Aq}$  at  $24.5^\circ$  containing:

5	10	15 % $\text{Na}_2\text{WO}_4 + 2\text{H}_2\text{O}$ ,
1.036	1.075	1.119
20	25	30 % $\text{Na}_2\text{WO}_4 + 2\text{H}_2\text{O}$ ,
1.166	1.215	1.274
35	40	44 % $\text{Na}_2\text{WO}_4 + 2\text{H}_2\text{O}$ .
1.349	1.430	1.492

(Franz, J. pr. (2) 4. 238.)

Sp. gr. of  $\text{Na}_2\text{WO}_4 + \text{Aq}$  at  $25^\circ$

Sp. gr. at $20^\circ$	Percent $\text{Na}_2\text{WO}_4$	Per cent $\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$
1.02016	2.21	2.48
1.03945	4.26	4.78
1.04292	4.69	5.15
1.05831	6.25	7.01
1.07449	7.83	8.79
1.08209	8.61	9.66
1.09687	10.08	11.31
1.12114	12.30	13.81
1.13036	13.16	14.77
1.14392	14.44	16.21
1.16896	16.66	18.62
1.19154	18.62	20.79
1.19938	19.10	21.44
1.20787	19.74	22.16
1.21720	20.59	23.11
1.25041	23.16	25.99
1.25083	23.30	26.15
1.26234	24.05	27.00
1.28143	25.46	28.58
1.33993	29.50	33.11
1.38826	32.68	36.68
1.41072	33.91	38.06
1.47193	37.30	41.87
1.48481	38.20	42.87
1.48595	38.43	43.14

(Pawlewski, B. 1900, 33. 1224.)

$\text{Na}_2\text{WO}_4 + \text{Aq}$  is pptd by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but not by  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HCN}$ , oxalic, or tartaric acids +  $\text{Aq}$ , but pptn. by the former acids is not prevented by presence of the latter, but when heated with  $\text{HCl}$ ,  $\text{H}_2\text{O}_3 + \text{Aq}$ , or in presence of  $\text{H}_3\text{PO}_4 + \text{Aq}$ , mineral acids cause no ppt. (Zettnow, Pogg, 130. 16.)

Much more sol in  $\text{H}_2\text{O}_2$  than in  $\text{H}_2\text{O}$ . (Kellner, Dissert, 1909.)  
Sl. sol in liquid  $\text{NH}_3$ . (Franklin, Am Ch J 1898, 20. 829.)

Insol. in alcohol. (Riche, A. ch (3) 50. 52.)

Insol. in methyl acetate (Naumann, B 1909, 42. 3790.)  
+  $10\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{WO}_4$	Mols $\text{H}_2\text{O}$ to 1 mol $\text{Na}_2\text{WO}_4$	Mols anhydrous salt to 100 mols $\text{H}_2\text{O}$
-5	30.60	37.04	2.70
-4.0	31.87	34.92	2.86
-3.5	32.98	33.19	3.01
-2.0	34.52	30.90	3.23
0	36.54	28.37	3.52
+3.0	39.20	25.33	3.95
+5.0	41.02	23.48	4.26

(Funk, B. 1900, 33. 3701.)

**Sodium ditungstate,  $\text{Na}_2\text{W}_2\text{O}_7$ .**

Sol. in  $\text{H}_2\text{O}$  by heating several hours to  $130^\circ$ – $150^\circ$  (Knorre, J. pr (2) 27. 80.)  
+  $6\text{H}_2\text{O}$ . Sol. in 13 pts  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort, C R. 88. 798.)

**Sodium tritungstate,  $\text{Na}_2\text{W}_3\text{O}_{13} + 4\text{H}_2\text{O}$ .**

Sol in 1 pt  $\text{H}_2\text{O}$ . Decomp. on standing into sol *tetratingstate* and insol *ditungstate* (Lefort, C R. 88. 798.)

Neither this nor the other *tritungstates* of Lefort exist, according to Knorre (J. pr. (2) 27. 49.)

**Sodium metatungstate,  $\text{Na}_2\text{W}_6\text{O}_{21}$ .**

Anhydrous. Insol in  $\text{H}_2\text{O}$   
+  $10\text{H}_2\text{O}$ . Sol. at  $13^\circ$  in 0.935 pt.  $\text{H}_2\text{O}$  to form a solution of 3.02 sp. gr. (Scheibler.)  
Sol. at  $19^\circ$  in 0.195 pt.  $\text{H}_2\text{O}$ . (Forcher.)  
Precipitated by alcohol.

**Sodium pentatungstate,  $\text{Na}_2\text{W}_5\text{O}_{18}$ .**

Sl. sol. in  $\text{H}_2\text{O}$  by heating 3 hours at  $150^\circ$ . (Knorre, J. pr. (2) 27. 49.)

**Sodium octotungstate,  $\text{Na}_2\text{W}_8\text{O}_{24}$ .**

Insol in  $\text{H}_2\text{O}$ . Very difficultly attacked by acids and alkalis. (Knorre)  
+  $12\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ , and can be recryst. without decomp. (Ulrik, W. A. B. 56, 2. 157.)

$3\text{Na}_2\text{O}$ ,  $8\text{WO}_3 + 17\text{H}_2\text{O}$ . Very efflorescent. Very sol. in hot  $\text{H}_2\text{O}$ . (Wells, J. Am. Chem. Soc. 1907, 29. 112.)

**Sodium tungstate,  $\text{Na}_2\text{W}_2\text{O}_7$  (?)**

+  $16\text{H}_2\text{O}$  (?). (Magnac, A. ch. (3) 69. 51.)

+  $21\text{H}_2\text{O}$  (?). Much more sol. and much more rapidly than the paratungstate (Magnac.)

$\text{Na}_2\text{W}_2\text{O}_{11} + 7\text{H}_2\text{O}$  (?). Mixture of  $\text{Na}_2\text{W}_4\text{O}_{13}$  and  $\text{Na}_2\text{WO}_4$ . (Knorre, J. pr. (2) 27. 49.)

$\text{Na}_2\text{W}_3\text{O}_{17} + 11\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$  (Magnac.)

100 pts  $\text{H}_2\text{O}$  dissolve 16 pts at  $15^\circ$  (Lefort, A. ch (5) 9. 97.)

Formula is  $4\text{Na}_2\text{O}$ ,  $10\text{WO}_3 + 23\text{H}_2\text{O}$ , according to Gibbs (Proc. Am. Acad. 16. 5.)

**Sodium paratungstate**,  $\text{Na}_{10}\text{W}_{12}\text{O}_{41} + 21\text{H}_2\text{O}$ .  
 $+ 25\text{H}_2\text{O}$ .  
 $+ 28\text{H}_2\text{O} = 3\text{Na}_2\text{W}_7\text{O}_{24} + 16\text{H}_2\text{O}$ , according to Lotz and Scheibler.

Sol. in 8 pts cold  $\text{H}_2\text{O}$  (Anthon), in 12 6 pts at 22° (Forehor)

Sol. in about 12 pts.  $\text{H}_2\text{O}$  (Marignac)  
 The aqueous solution saturated at 35-40° contained to 1 pt. of the salt, after

1	12	77	227	410 days,
at 18°	18°	18°	16°	20°
9.25	11.26	10.92	11.90	11.74 pts. $\text{H}_2\text{O}$ .

The solution saturated by very long boiling, after a part of the salt had crystallised out, contained, after:

1	2	12 days,
0.68	0.91	2.59 pts. $\text{H}_2\text{O}$ to 1 pt. salt,
72	222	405 days,
6.88	9.75	8.80 pts. $\text{H}_2\text{O}$ to 1 pt. salt.

(Marignac.)

Decomp by boiling with  $\text{H}_2\text{O}$  (Knorre, B. 18. 2362.)

**Sodium strontium paratungstate**,  $\text{Na}_2\text{O}$ ,  $4\text{SrO}$ ,  $12\text{W}_7\text{O}_{24} + 29\text{H}_2\text{O}$   
 (Gonzalez, J. pr (2) 36. 44.)

**Sodium strontium tungstate tungsten oxide**,  $5\text{Na}_2\text{W}_7\text{O}_{24}$ ,  $\text{SrW}_6\text{O}_{12}$ .  
 $12\text{Na}_2\text{W}_7\text{O}_{24}$ ,  $\text{SrW}_6\text{O}_{12}$  (Engels, Z anorg 1903, 37. 138.)

**Sodium thorium tungstate**,  $\text{Na}_4\text{Th}(\text{WO}_4)_4$ .  
 Insol in  $\text{H}_2\text{O}$ . Slowly sol in dil. acids, easily in conc.  $\text{HCl} + \text{Aq}$  (Högbom, Bull Soc. (2) 42. 2.)

**Sodium ytterbium tungstate**,  $\text{Yb}_2\text{O}_3$ ,  $9\text{Na}_2\text{O}$ ,  $12\text{WO}_3$ .  
 Insol. in  $\text{H}_2\text{O}$ . (Cleve, Z. anorg 1902, 32. 154.)  
 $2\text{Yb}_2\text{O}_3$ ,  $4\text{Na}_2\text{O}$ ,  $7\text{WO}_3$ . Ppt. (Cleve)

**Sodium yttrium tungstate**,  $\text{Na}_4\text{Y}_2(\text{WO}_4)_7$ .  
 Insol in  $\text{H}_2\text{O}$ , and very slowly attacked by dil. acids. (Högbom, Bull. Soc (2) 42. 2.)

**Sodium zinc paratungstate**,  $\text{Na}_2\text{O}$ ,  $2\text{ZnO}$ ,  $7\text{WO}_3 + 15\text{H}_2\text{O}$ .  
 Difficultly sol. in cold, more sol in hot  $\text{H}_2\text{O}$ . (Knorre, B. 19. 823)  
 $+ 21\text{H}_2\text{O}$ . (Knorre.)

**Sodium tungstate tungsten oxide**,  $\text{Na}_2\text{WO}_4$ ,  $\text{W}_2\text{O}_6$ .

*Yellow tungsten bronze*. Gradually de-hydrates on air. Not decomp by any acid, even aqua regia, except  $\text{HF}$ , or by alkalis. (Wöhler, Pogg 2. 350)

Correct formula is  $\text{Na}_2\text{W}_6\text{O}_{18}$ , according to Phillip (B. 15. 499)

Sol in ammoniacal silver solution with separation of Ag. Easily sol. in boiling alkaline potassium ferricyanide + Aq (Phillip, B. 12. 2234.)

$\text{Na}_2\text{WO}_4$ ,  $2\text{W}_2\text{O}_5$ . *Blue tungsten bronze*. Not attacked by acids or alkalis (Scheibler.) Correct formula is  $\text{Na}_2\text{W}_6\text{O}_{18}$ , according to Phillip (B. 15. 506)

Sol. in ammoniacal silver solution with separation of Ag

$\text{Na}_4\text{W}_6\text{O}_{18}$  Properties as above. (Phillip, B. 15. 499.)

$\text{Na}_2\text{W}_2\text{O}_5$  Properties as above (Phillip.)

**Strontium tungstate**,  $\text{SrWO}_4$ .

Precipitate (Schultze.)  
 Sol in about 700 pts  $\text{H}_2\text{O}$ . (Lefort)

**Strontium ditungstate**,  $\text{SrW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?).  
 100 cem  $\text{H}_2\text{O}$  dissolve 0.35 g at 15°. (Lefort, A. ch. (5) 15. 326.)

**Strontium tritungstate**,  $\text{SrW}_3\text{O}_{10} + 5\text{H}_2\text{O}$  (?).  
 Sol. in  $\text{H}_2\text{O}$  with decomp. into  $\text{SrW}_2\text{O}_7$  and  $\text{SrW}_4\text{O}_{12}$  (Lefort, A. ch. (5) 17. 477)

**Strontium metatungstate**,  $\text{SrW}_4\text{O}_{13} + 8\text{H}_2\text{O}$ .  
 Solubility as calcium metatungstate. (Scheibler.)  
 Extraordinarily sol. in  $\text{H}_2\text{O}$  (Wyruboff, Bull Soc Min 1892, 15. 63)

**Strontium paratungstate**,  $\text{Sr}_2\text{W}_7\text{O}_{24} + 16\text{H}_2\text{O}$ , or  $\text{Sr}_2\text{W}_{12}\text{O}_{41} + 27\text{H}_2\text{O}$ .  
 Insol in cold, sl. sol in hot  $\text{H}_2\text{O}$ . (Knorre, B. 18. 327)

**Thallous tungstate**,  $\text{Tl}_2\text{WO}_4$ .  
 Very sl. sol in  $\text{H}_2\text{O}$  Sol in hot  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . (Flemming, J B 1868. 250.)

**Thallous metatungstate**,  $\text{Tl}_2\text{W}_4\text{O}_{13} + 3\text{H}_2\text{O}$ .  
 Nearly insol. in  $\text{H}_2\text{O}$  (Rosenheim, Z. anorg 1911, 69. 251.)

**Thallous paratungstate**,  $5\text{Tl}_2\text{O}$ ,  $12\text{WO}_3$ .  
 Insol in  $\text{H}_2\text{O}$ .  
 Sol. in  $\text{Na}_2\text{CO}_3 + \text{Aq}$  and  $\text{KOH} + \text{Aq}$ . decomposed by mineral acids (Schaeffer, Z anorg 1904, 38. 171)

**Thallous hydrogen tungstate**,  $\text{TlHWO}_4$ .  
 Insol in  $\text{H}_2\text{O}$ . Difficultly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in boiling alkali carbonates or hydrates + Aq. (Oetlinger, J. B. 1864. 254.)

**Thorium tungstate**.

Precipitate (Berzelius)  
 Insol. in  $\text{H}_2\text{O}$ .

**Tin (stannous) tungstate**,  $\text{SnWO}_4 + 6\text{H}_2\text{O}$ .  
 Insol in  $\text{H}_2\text{O}$  Sol in oxalic acid and in  $\text{KOH} + \text{Aq}$  Slowly sol. in hot  $\text{H}_3\text{PO}_4 + \text{Aq}$ . (Anthon, J. pr. 9. 341.)

**Tin (stannic) tungstate**,  $9\text{SnO}_2, 13\text{WO}_3$ .

Insol. in ammonium tungstate + Aq. Sol. in tin salts + Aq, also in phosphoric, oxalic, or tartaric acids + Aq (Lotz, A. 91. 49.)

**Tungsten tungstate**,  $\text{WO}_3, \text{WO}_3 = \text{W}_2\text{O}_6$ .

See Tungsten oxide,  $\text{W}_2\text{O}_6$

**Uranous tungstate**,  $\text{UO}_2, 3\text{WO}_3 + 6\text{H}_2\text{O}$ .

Decomp. by  $\text{NaOH}$  + Aq or  $\text{HNO}_3$  + Aq. Sol. in  $\text{HCl}$  + Aq, but not in  $\text{H}_2\text{SO}_4$ . (Rammelsberg)

**Uranyl tungstate**,  $\text{UO}_2, \text{WO}_3 + 2\text{H}_2\text{O}$ .

Sol. in about 100 pts.  $\text{H}_2\text{O}$ . (Lefort, C. R. 87. 748)

$\text{UO}_2, 3\text{WO}_3 + 5\text{H}_2\text{O}$  (?) Sol. in about 200 pts.  $\text{H}_2\text{O}$  (Lefort)

**Vanadium tungstate**.

Sl. sol. in  $\text{H}_2\text{O}$ .

**Ytterbium tungstate basic**,  $(\text{YbO})_2\text{WO}_4$ .

Ppt. (Cleve, Z. anorg. 1902, 32. 153.)

**Ytterbium metatungstate**,  $\text{Yb}_2\text{O}_3, 12\text{WO}_3 + 35\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Yttrium tungstate**,  $\text{Y}_2(\text{WO}_4)_3 + 6\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ , but more sol. in  $\text{Na}_2\text{WO}_4$  + Aq (Berlin)

**Zinc tungstate**,  $\text{ZnWO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Geuther and Foisberg, A. 120. 270)

+  $\text{H}_2\text{O}$  Sol. in 500 pts.  $\text{H}_2\text{O}$ .

**Zinc ditungstate**,  $\text{ZnW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?)

Sol. in 10 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , but solution soon decomposes. (Lefort.)

**Zinc tritungstate**,  $\text{ZnW}_3\text{O}_{10} + 5\text{H}_2\text{O}$ .

Insol. in boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{ZnSO}_4$  + Aq, or  $\text{Na}_4\text{W}_3\text{O}_{17}$  + Aq (Gibbs)

**Zinc metatungstate**,  $\text{ZnW}_2\text{O}_7 + 10\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  Loses crystal  $\text{H}_2\text{O}$  by ignition, and becomes insol. in  $\text{H}_2\text{O}$  (Scheibler, J. pr. 83. 273.)

+  $8\text{H}_2\text{O}$  More sol. in  $\text{H}_2\text{O}$  than magnesium comp. (Wyrouboff, Bull. Soc. Min. 1892, 15. 72)

**Zinc tungstate**,  $\text{Zn}_2\text{W}_2\text{O}_{14} + 18\text{H}_2\text{O} = 4\text{ZnO}, 10\text{WO}_3 + 18\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  Sol. in excess of zinc sulphate or of sodium tungstate + Aq. (Gibbs, Proc. Am. Acad. 15. 14.)

+  $29\text{H}_2\text{O}$ . (Gibbs)

**Zinc paratungstate**,  $5\text{ZnO}, 12\text{WO}_3 + 37\text{H}_2\text{O}$ .

(Gonzalez, J. pr. (2) 36. 44.)

**Zinc tungstate**,  $\text{Zn}_2\text{W}_{22}\text{O}_{75} + 66\text{H}_2\text{O} = 9\text{ZnO}, 22\text{WO}_3 + 66\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Zinc tungstate ammonia**,  $\text{ZnWO}_4, 4\text{NH}_3 + 3\text{H}_2\text{O}$ .

Decomp. in the air (Briggs, Chem. Soc. 1904, 85. 677)

**Pertungstic acid**

See Pertungstic acid.

**Tungstoarsenic acid**.

See Arseniotungstic acid.

**Tungstoboric acid**.

See Borotungstic acid.

**Tungstocyanhydric acid**,  $\text{H}_4\text{W}(\text{CN})_8 + 6\text{H}_2\text{O}$ .

Hydrosopic.

Sol. in  $\text{H}_2\text{O}$  and abs. alcohol Insol. in ether, benzene etc. (Olsson, Z. anorg. 1914, 88. 71)

**Ammonium tungstocyanide**,  $(\text{NH}_4)_4\text{W}(\text{CN})_8$ .

Easily sol. in  $\text{H}_2\text{O}$  Aqueous solution decomp. slowly

Insol. in organic solvents (Olsson, Z. anorg. 1914, 88. 62)

**Cadmium tungstocyanide**,  $\text{Cd}_2\text{W}(\text{CN})_8 + 8\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . Sl. sol. in dil.  $\text{HCl}$ . Sol. in conc.  $\text{NH}_4\text{OH}$  + Aq Insol. in organic solvents (Olsson, Z. anorg. 1914, 88. 68.)

**Cæsium tungstocyanide**,  $\text{Cs}_4\text{W}(\text{CN})_8$ .

Easily sol. in  $\text{H}_2\text{O}$  forming stable solutions Insol. in alcohol and other organic solvents (Olsson)

**Calcium tungstocyanide**,  $\text{Ca}_2\text{W}(\text{CN})_8 + 8\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. slowly

Insol. in organic solvents. (Olsson.)

**Lead tungstocyanide**,  $\text{Pb}_2\text{W}(\text{CN})_8 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  Solution decomp. after short time

Insol. in organic solvents. (Olsson.)

**Magnesium tungstocyanide**,  $\text{Mg}_2\text{W}(\text{CN})_8 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  Aqueous solution decomp. on heating

Insol. in organic solvents (Olsson.)

**Manganous tungstocyanide**,  $\text{Mn}_2\text{W}(\text{CN})_8 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  and in acids

Insol. in organic solvents. (Olsson.)

**Potassium tungstocyanide**,  $K_4W(CN)_8 + 2H_2O$ .

Easily sol in  $H_2O$  from which it can be cryst. 10 ccm  $H_2O$  dissolve 13-14 g salt at 18°.

Insol in alcohol, ether and other organic solvents. (Olsson.)

**Rubidium tungstocyanide**,  $Rb_4W(CN)_8 + 8H_2O$ .

Easily sol in  $H_2O$ . Can be cryst from  $H_2O$ . Insol in alcohol and other organic solvents. (Olsson.)

**Silver tungstocyanide**,  $Ag_4W(CN)_8$ .

Insol in  $H_2O$ .

Insol in acids. Decomp by dil HCl

Sol. in hot conc.  $NH_4OH + Aq$ .

Insol. in organic solvents. (Olsson.)

**Sodium tungstocyanide**,  $Na_4W(CN)_8 + 2\frac{1}{2}H_2O$ .

Hydroscopic.

Easily sol. in  $H_2O$ .

Insol. in organic solvents. (Olsson.)

**Strontium tungstocyanide**,  $Sr_4W(CN)_8 + 8H_2O + 9H_2O$ .

Easily sol. in  $H_2O$ . Aqueous solution decomp. on standing

Insol in organic solvents. (Olsson.)

**Thallium tungstocyanide**,  $Tl_4W(CN)_8$ .

Difficultly sol in cold  $H_2O$ , more sol in hot  $H_2O$

Insol in organic solvents (Olsson.)

**Zinc tungstocyanide**,  $Zn_2W(CN)_8 + 4H_2O$ .

Insol in  $H_2O$ , and acids

Sol. in conc.  $NH_4OH + Aq$ . (Olsson.)

**Metatungstolodic acid**.

**Ammonium metatungstolodate**,  $2(NH_4)_2O, 2Li_2O, 4WO_3 + 12H_2O$ .

Very sl sol in  $H_2O$ . (Chrétien, A. ch. 1898, (7) 15. 431)

**Potassium tungstolodate**,  $K_2H_2WIO_6$ .

(Blomstrand, J. pr. (2) 40. 327.)

$2K_2O, 2Li_2O, 4WO_3 + 8H_2O$ .

5.13 g. are sol in 1 l.  $H_2O$  at 15°; 8.25 g. at 100°. (Chrétien, A. ch. 1898, (7) 15. 431.)

**Tungstoperiodic acid**.

**Ammonium sodium tungstoperiodate**,  $2(NH_4)_2O, Na_2O, Li_2O, 2WO_3 + 16H_2O$ .

Ppt. (Rosenheim, A. 1899, 308. 64)

**Barium tungstoperiodate**,  $5BaO, Li_2O, 12WO_3 + 12H_2O$ .

Ppt. (Rosenheim.)

**Potassium tungstoperiodate**,  $5K_2O, Li_2O, 12WO_3 + 8H_2O$ .

Sol in  $H_2O$ . (Rosenheim.)

**Sodium tungstoperiodate**,  $3Na_2O, Li_2O, 2WO_3 + 4H_2O$ .

Ppt  $5Na_2O, Li_2O, 12WO_3 + 16H_2O$  Sol. in  $H_2O$  (Rosenheim)

**Strontium tungstoperiodate**,  $5SrO, Li_2O, 12WO_3 + 28H_2O$ .

Sol. in  $H_2O$ . (Rosenheim)

**Tungstophosphoric acid**,

See Phosphotungstic acid.

**Tungstosilicic acid**,

See Silicotungstic acid.

**Tungstotungstic acid**.

**Lithium tungstotungstate**,  $Li_2O, WO_3 + WO_3, 3WO_3$ .

Insol. in boiling  $H_2O$  and conc. HCl. (Hallopeau, C. R. 1898, 127. 514)

**Potassium tungstotungstate**,  $K_2O, WO_3 + WO_3, 3WO_3$ .

Insol. in hot  $H_2O$ , and conc. HCl (Hallopeau, Bull. Soc. 1899, (3) 21. 267.)

**Tungstous acid**.

**Sodium tungstite**,  $Na_2W_2O_6$ .

See Tungstate tungsten oxide, sodium.

**Tungstovanadic acid**.

See Vanadiotungstic acid.

**Tungstyl dibromide**,  $WO_3Br_2$ .

Not decomp by cold  $H_2O$ . (Roscoe.)

**Tungstyl tetrabromide**,  $WOBr_4$ .

Extremely deliquescent. Decomposes at once in moist air or with  $H_2O$ .

**Tungstyl dichloride**,  $WO_2Cl_2$ .

Not decomp. by cold, and but slowly by boiling  $H_2O$ . Sol in alkalis and ammonia.

**Tungstyl tetrachloride**,  $WOCl_4$ .

Easily decomp. by  $H_2O$  or moist air.

Very sol in  $CS_2$  and  $S_2Cl_2$ . Sl. sol. in benzene. (Smith, J. Am. Chem. Soc. 1899, 21. 1008)

**Tungstyl tetrafluoride**,  $WOF_4$ .

Sol in  $H_2O$  with decomp. Very hydroscopic.

Insol. in carbon tetrachloride.

Sl. sol in carbon bisulphide, dry benzene and ether.

Easily sol in chloroform and absolute alcohol (Ruff, Z. anorg. 1907, 52. 265)

**Tungstyl tetrafluoride ammonia**,  $2\text{WOF}_4 \cdot \text{NH}_3$ .

Sol in  $\text{H}_2\text{O}$  with decomp.  
Insol in liquid  $\text{NH}_3$ . (Ruff, Z. anorg 1907, 52. 266.)

**Ultramarine blue**,  $2\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_8 \cdot \text{Na}_2\text{S}_2$  (?)

Not attacked by solutions of alkalis or  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp by acids or acid salts + Aq. Decomp by alum + Aq.

**Ultramarine green**,  $\text{Na}_3\text{Al}_3\text{Si}_3\text{O}_8 \cdot \text{Na}_2\text{S}$  (?)

Decomp by mineral acids. Not attacked by alkalis. Decomp by alum + Aq.

**Ultramarine white**,  $2\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_8 \cdot \text{Na}_2\text{S}$  (?)

**Uranic acid**,  $\text{H}_2\text{UO}_4$ .

Insol in  $\text{H}_2\text{O}$ . Sol in acids. Very sol in cold dil.  $\text{HNO}_3 + \text{Aq}$ . Sl. sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ . Insol in  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol in  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{KHCO}_3$ , and  $\text{NaHCO}_3 + \text{Aq}$ ; less in  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Ebelmen.)

Easily sol. in malic and tartaric acids to form complex compds (Itzig, B. 1901, 34. 3822.)

$\text{H}_4\text{UO}_5$ . Insol. in  $\text{H}_2\text{O}$ ; sol in acids. (Ebelmen.)

#### Uranates.

Insol in  $\text{H}_2\text{O}$ ; sol in acids.

#### Ammonium uranate.

Sl. sol. in pure  $\text{H}_2\text{O}$ ; insol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{OH}$ .

Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Peligot, A. ch. (3) 5. 11.)

$(\text{NH}_4)_2\text{O}$ ,  $4\text{UO}_3 + 7\text{H}_2\text{O}$ . (Grubler, Dissert, 1908.)

$(\text{NH}_4)_2\text{O}$ ,  $6\text{UO}_3 + 10\text{H}_2\text{O}$ . Insol in cold and hot  $\text{H}_2\text{O}$  and alkalies + Aq. Very sol in  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and acetic acid + Aq (Zehenter, M. 1900, 21. 235.)

#### Barium uranate, $\text{BaUO}_4$ .

Insol in  $\text{H}_2\text{O}$ . Sol in dil. acids.

$\text{BaU}_2\text{O}_7$ . As above (Ditte, C. R. 95. 988)

$\text{BaU}_2\text{O}_{10} + 4\frac{1}{2}\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq}$ , and alcohol.

Easily sol. in cold dil.  $\text{HCl}$  or  $\text{HNO}_3$  and in hot acetic acid (Zehenter, M. 1904, 25. 200.)

$\text{Ba}_2\text{U}_2\text{O}_{17} + 8\text{H}_2\text{O}$ . Nearly insol. in hot or cold  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq}$ , and alcohol.

Easily sol. in cold dil.  $\text{HCl}$  or  $\text{HNO}_3$  and in hot acetic acid. (Zehenter.)

$\text{Ba}_2\text{U}_2\text{O}_{25} + 11\text{H}_2\text{O}$ . Same properties as  $\text{BaU}_2\text{O}_{10}$ . (Zehenter.)

**Bismuth uranate**,  $\text{Bi}_2\text{O}_3 \cdot \text{UO}_3 + \text{H}_2\text{O}$ .

Min. *Uranosphagrite*.

**Calcium uranate**,  $\text{CaUO}_4$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids (Ditte, C. R. 95. 988)

$\text{CaU}_2\text{O}_7$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Ditte)

**Cobalt uranate**.

Insol. in  $\text{H}_2\text{O}$ , sol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . (Persoz, J. pr. 3. 216)

Sol. in  $\text{HNO}_3 + \text{Aq}$ , insol. in  $\text{KNO}_3 + \text{Aq}$ . (Ebelmen, A. ch. (3) 5. 222.)

**Cupric uranate**,  $\text{CuU}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$  (Debray, A. ch. (3) 61. 451.)

**Lead uranate**,  $\text{PbUO}_4$ .

If ignited, very difficultly sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Wertheim, J. pr. 25. 228)

Insol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . (Persoz) 3PbO,  $2\text{UO}_3$ . Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Ditte, A. ch. (6) 1. 338.)

$\text{Pb}_2\text{U}_2\text{O}_{10}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ .

Insol. in  $\text{KOH} + \text{Aq}$ ,  $\text{NH}_4\text{OH}$  and cold acetic acid. Sol. in hot acetic acid. (Zehenter, M. 1904, 25. 215.)

$\text{Pb}_2\text{U}_2\text{O}_{10} + 4\text{H}_2\text{O}$ . Insol. in hot or cold  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ . Insol. in  $\text{KOH} + \text{Aq}$ ,  $\text{NH}_4\text{OH}$ , alcohol and ether. Sl. sol. in cold, more easily sol. in hot acetic acid. (Zehenter.)

**Lithium uranate**,  $\text{Li}_2\text{UO}_4$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby. Sol. in dil. acids

**Magnesium uranate**,  $\text{MgUO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Nearly insol. in cold  $\text{HCl} + \text{Aq}$ . Slowly sol. in  $\text{HCl} + \text{Aq}$  on warming,

and more rapidly by addition of a little  $\text{HNO}_3 + \text{Aq}$ . (Ditte)

$\text{MgU}_2\text{O}_7$ . Ppt. (Berzelius.)

**Neodymium uranate**,  $\text{Nd}_2(\text{UO}_2)_3 + 18\text{H}_2\text{O}$ .

Ppt (Orloff, Ch. Z. 1907, 31. 1119.)

**Potassium uranate**,  $\text{K}_2\text{UO}_4$  (?)

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids, etc., exactly as  $\text{Na}_2\text{UO}_4$ . (Ditte)

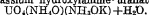
$\text{K}_2\text{U}_2\text{O}_7 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids, even acetic acid (Zimmermann, B. 14. 440.)

Insol. in  $\text{K}_2\text{CO}_3 + \text{Aq}$ , but easily sol. in alkali hydrogen carbonates + Aq. Sol. in  $\text{HCl} + \text{Aq}$ . (Ebelmen, A. ch. (3) 5. 220.)

$\text{K}_2\text{O}$ ,  $4\text{UO}_3 + 5\text{H}_2\text{O}$ . (Zehenter, M. 1900, 21. 235.)

$\text{K}_2\text{O}$ ,  $6\text{UO}_3 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  (Drenckmann, Zeit. ges. Nat. 17. 113.)

$+ 10\text{H}_2\text{O}$ . Nearly insol. in cold and hot  $\text{H}_2\text{O}$ . Easily sol. in hot acetic acid, dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and  $\text{HNO}_3$ . Insol. in  $\text{KOH} + \text{Aq}$ , alcohol and ether ((Zehenter, M. 1900, 21. 235.)

**Potassium hydroxylamine-uranate,**

Sl. sol. in  $\text{H}_2\text{O}$ , insol. in alcohol (Hofmann, A. 1899, 307. 318)

**Rubidium uranate,  $\text{RbUO}_4$** 

Insol. in  $\text{H}_2\text{O}$  (Ditte, A. ch. (6) 1. 338)

**Silver uranate,  $\text{Ag}_2\text{UO}_4$** 

Insol. in  $\text{H}_2\text{O}$  Easily sol. in acids. (Albeggoff, A. 233. 117.)

**Sodium uranate,  $\text{Na}_2\text{UO}_4$  (?)**

Insol. in  $\text{H}_2\text{O}$ , sol. in dil. acids. Sol. in alkali carbonates + Aq. (Ditte.)

$\text{Na}_2\text{U}_2\text{O}_7 + 6\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Stolba, Z. anal. 3. 74.)

$\text{Na}_2\text{O}$ ,  $3\text{UO}_3$ . Insol. in  $\text{H}_2\text{O}$  Easily sol. in very dil. acids. (Drenckmann.)

$\text{Na}_2\text{O}$ ,  $5\text{UO}_3 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , alcohol,  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$  + Aq. Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ . Sl. sol. even on boiling in conc. acetic acid. (Zehenter, M. 1900, 21. 235.)

**Sodium hydroxylamine uranate,**

Sol. in  $\text{H}_2\text{O}$  (Hofmann, A. 1899, 307. 319)  
 $\text{UO}_4(\text{NH}_2\text{ONa})_2 + 6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  (Hofmann)

**Strontium uranate,  $\text{SrUO}_4$** 

Insol. in  $\text{H}_2\text{O}$  Sol. in dil. acids.

$\text{SrU}_2\text{O}_7$  As above. (Ditte, C. R. 95. 988)

Very sl. sol. in  $\text{H}_2\text{O}$ . Sol. in all acids especially oxalic.

+  $\text{H}_2\text{O}$  Very sl. sol. in  $\text{H}_2\text{O}$  Sol. in all acids especially oxalic. (J. C. C. 1896, II. 512)

**Thallous uranate.**

Ppt. (Bolton, Am. Chemist, 1872, 2. 456.)

**Zinc uranate.**

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$  + Aq (Persoz, J. pr. 3. 216) Sol. in  $\text{HNO}_3$  + Aq, insol. in  $\text{KNO}_3$ , and  $\text{NH}_4\text{NO}_3$  + Aq (Ebelmen, A. ch. (3) 5. 221)

**Peruranic acid.**

See Peruranic acid.

**Uranium, U.**

Not attacked by  $\text{H}_2\text{O}$  Slowly decomp. by cold dil.  $\text{H}_2\text{SO}_4$  + Aq, rapidly on warming. Easily sol. in dil. or conc.  $\text{HCl}$  + Aq. Fused U is slightly attacked by conc. or fuming  $\text{HNO}_3$ , or conc.  $\text{H}_2\text{SO}_4$ . Amorphous U, however, is easily attacked thereby. Not attacked by acetic acid,  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{NH}_4\text{OH}$  + Aq. (Zimmermann, B. 16. 849)

When finely divided, it is decomp. by  $\text{H}_2\text{O}$  slowly at ordinary temps. and rapidly at  $100^\circ$ . (Moissan, C. R. 1896, 122. 1091.)

**Uranium antimonide,  $\text{U}_3\text{Sb}_2$** 

Violently attacked by conc.  $\text{HNO}_3$  (Cobani, C. R. 1903, 137. 383)

**Uranium arsenide,  $\text{U}_3\text{As}_2$** 

Violently attacked by conc.  $\text{HNO}_3$  (Cobani, C. R. 1903, 137. 383)

**Uranium boride,  $\text{UB}_2$** 

Sol. in  $\text{HNO}_3$  and HF. Decomp. by fused alkalis (Wedekind, B. 1913, 46. 1204.)

**Uranium tribromide,  $\text{UBr}_3$** 

Very hygroscopic. Sol. in  $\text{H}_2\text{O}$  with hissing (Albeggoff, A. 233. 117)

**Uranium tetrabromide,  $\text{UBr}_4$** 

Anhydrous. Very deliquescent. Sol. in  $\text{H}_2\text{O}$  with hissing (Hermann)

Insol. in alcohol. (v. Unruh, Dissert, 1909.)

Sol. in acetone (Eidmann, C. C. 1899, II. 1014); methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601)

+  $8\text{H}_2\text{O}$  Very deliquescent, and sol. in  $\text{H}_2\text{O}$  (Rammelsberg)

**Uranium carbide,  $\text{UC}_2$** 

(Ruff and Hemzelmann, Z. anorg. 1911, 71. 72)

Attacked slowly by  $\text{H}_2\text{O}$ . Slowly attacked by cold dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$  + Aq. Conc. acids, except  $\text{HNO}_3$ , react sl. in the cold, violently on heating. (Moissan, Bull. Soc. 1897, (3) 17. 12)

Sol. in fused  $\text{KNO}_3$  and  $\text{KClO}_3$ ; sol. in dil. acids in the cold and in conc. acids on heating; decomp. by  $\text{H}_2\text{O}$ . (Moissan, C. R. 1896, 122. 276.)

**Uranium trichloride,  $\text{UCl}_3$** 

Very sol. in  $\text{H}_2\text{O}$  (Peligot)

Very unstable (Zimmermann)

Very hygroscopic Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in conc.  $\text{HCl}$  and solution is much more stable than aqueous one (Rosenheim and Loebel, Z. anorg. 1908, 57. 234)

**Uranium tetrachloride,  $\text{UCl}_4$** 

Anhydrous Extremely deliquescent

Sol. in  $\text{H}_2\text{O}$  with evolution of heat Decomp. on boiling Sol. in  $\text{NH}_4\text{Cl}$  + Aq without decomp.

$\text{HCl}$  increases its solubility in  $\text{H}_2\text{O}$  (Alof, Dissert 1901.)

Sol. in alcohol, acetone, acetic ether, benzene ether Insol. in ether,  $\text{CHCl}_3$  and  $\text{C}_6\text{H}_6$  (Loebel)

Sol. in ethyl acetate (Naumann, B. 1904, 37. 3601.)

**Uranium pentachloride,  $\text{UCl}_5$** 

Deliquescent Sol. in  $\text{H}_2\text{O}$  with evolution of heat and decomposition. (Roscoe, B. 7. 1131)

Sol. in acetic acid, acetic ether, benzaldehyde, glycerine, benzyl alcohol (trace), nitrobenzene (trace), xylidine and p-toluidine (on warming)

Insol. in aniline, ligroin, pyridine, quinoline, thioethyl ether, thioamyl ether and  $\text{CS}_2$  (Pimmer, Dissert. 1904.)

Sol in abs alcohol Insol in ether,  $\text{C}_6\text{H}_6$ , nitrobenzene, ethylene bromide. Sl sol in  $\text{CCl}_4$  and  $\text{CHCl}_3$  Sol in benzoic ether, acetone and trichloroacetic acid. Best solvents are ethyl acetate and benzoinital. Sol in many organic compounds containing oxygen. (Loebel, Dissert. 1907.)

**Uranium difluoride,  $\text{UF}_2 + 2\text{H}_2\text{O}$ .**

Ppt (Giolitti and Agamennone, C. C. 1905, I 1130)

**Uranium tetrafluoride,  $\text{UF}_4$ .**

Insol in  $\text{H}_2\text{O}$  Very sl sol in dil. acids Sol in hot conc  $\text{H}_2\text{SO}_4$ , and slowly in warm conc  $\text{HNO}_3 + \text{Aq}$  (Bolton, J. B. 1866. 209.)

**Uranium hexafluoride,  $\text{UF}_6$ .**

Very sol in  $\text{H}_2\text{O}$  (Ditte, A. ch (6) 1. 339)

Fumes in the air

Very hygroscopic; sol. in  $\text{H}_2\text{O}$  (Ruff, B 1909, 42. 495)

Very hygroscopic. Sol. in  $\text{H}_2\text{O}$  Nearly insol. in  $\text{CS}_2$  Insol. in paraffine oil Sol in symmetrical tetrachloroethane (best solvent),  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , and nitrobenzene (v Unruh, Dissert. 1909.)

Decomp. by  $\text{H}_2\text{O}$ , alcohol and ether Nearly insol in  $\text{CS}_2$

Sol in  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , nitrobenzene and  $\text{C}_2\text{H}_5\text{Cl}$ . (Ruff, Z. anorg 1911, 72. 81.)

**Uranium hydrogen fluoride,  $\text{UF}_3 \cdot \text{SHF}$  (?).**

Sol in  $\text{H}_2\text{O}$ . (Ditte)

Is  $\text{UO}_2\text{F}_2 \cdot \text{HF} + \text{H}_2\text{O}$  (Smithells)

**Uranous hydroxide,  $\text{UO}_2 \cdot x\text{H}_2\text{O}$ .**

Easily sol in dil. acids

Insol in alkali hydrates and carbonates + Aq (Berzelius)

Sol. in alkali carbonates + Aq (Rammelsberg.)

$\text{U}(\text{OH})_4$  Sol in dil acids (Aloy, Bull. Soc 1899, (3) 21. 613)

**Uranouranic hydroxide,  $\text{U}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$  (?).**

Easily sol in acids

Decomp by  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , which dis-solves out  $\text{UO}_2$ . (Berzelius)

**Uranic hydroxide.**

See Uranic acid.

**Uranium tetraiodide,  $\text{UI}_4$**

Sol. in  $\text{H}_2\text{O}$ . (Günchard, C. R. 1907, 145. 921.)

**Uranium iodide.**

Sol in ethyl acetate.. (Naumann, B. 1904 37. 3601.)

**Uranium nitride,  $\text{U}_3\text{N}_4$ .**

(Colani, C. R. 1903, 137. 383.)

**Uranium suboxide,  $\text{UO}$  (?).**

(Guyard, Bull. Soc. (2) 1. 89)

Does not exist. (Zimmermann, A. 213. 301.)

$\text{UO}_2$  (?) Ppt. Decomp. by  $\text{H}_2\text{O}$  and in the air (Peligot)

**Uranium dioxide (Uranous oxide),  $\text{UO}_2$ .**

Insol. in dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Sol. in conc  $\text{H}_2\text{SO}_4$ , and easily in  $\text{HNO}_3 + \text{Aq}$ . (Peligot.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose.)

Only sl. sol. in  $\text{H}_2\text{SO}_4$ , but a considerable amount is converted into the sulphate which is nearly insol in  $\text{H}_2\text{SO}_4$

Slowly sol in  $\text{HCl}$ , the amount dissolved in a given time varying widely with the method of preparation of the oxide. (Colani, C. R. 1912, 155. 1251.)

Sl. more sol. in  $\text{HNO}_3$  than in aqua regia. (Raynaud, Bull. Soc 1912, (4) 11. 802.)

Very sol. in conc  $\text{HNO}_3$ ; less sol in dil.  $\text{HNO}_3$ . 1 gram is sol in 3100 grams  $\text{HCl}$  (1.17) at  $17^\circ$ ; 4650 grams  $\text{HBr}$  (1.52) at  $17^\circ$ ; 2200 grams  $\text{H}_2\text{SO}_4$  (1.79) at  $17^\circ$ ; 12,000 grams acetic acid at  $19^\circ$  (Raynaud, C. R. 1911, 163. 1481.)

Sl attacked by liquid  $\text{NH}_3$ . (Gois, Am. Ch. J. 1898, 20. 830)

Min. *Uraninite*. Easily sol. in warm  $\text{HNO}_3 + \text{Aq}$  Not attacked by  $\text{HCl} + \text{Aq}$

**Uranium trioxide (Uranic oxide),  $\text{UO}_3$ .**

Sol in  $\text{HNO}_3 + \text{Aq}$ . (Peligot.)

Insol. in boiling K tartarate + Aq. (Kahlenberg and Hülyer, Am. Ch. J. 1894, 16. 102.)

Sol. in oleic acid. (Gibbons, Arch. Pharm. 1883, 221. 621)

See Uranic acid.

**Uranium tetroxide,  $\text{UO}_4$ .**

Decomp. by  $\text{HCl} + \text{Aq}$  (Fairley, Chem. Soc. 31. 133.)

+  $2\text{H}_2\text{O}$ . Very hygroscopic (Zimmermann)

+  $3\text{H}_2\text{O}$

**Uranium pentoxide,  $\text{U}_2\text{O}_5$ .**

Sol. in acids. (Peligot.)

Mixture of  $\text{UO}_2$  and  $\text{U}_2\text{O}_5$  (Rammelsberg, Pogg. 59. 5.)

Mixture of  $\text{UO}_2$  and  $\text{U}_2\text{O}_5$  (Zimmermann, A. 232. 273.)

**Uranouranic oxide,  $\text{U}_2\text{O}_5$ .**

Green *uranium oxide*. Very slowly and slightly sol in dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , more easily when conc. Completely sol in boiling  $\text{H}_2\text{SO}_4$  Easily sol in  $\text{HNO}_3 + \text{Aq}$ .

**Uranous oxychloride,  $\text{UO}_2, \text{UCl}_4 + \text{H}_2\text{O}$ .**

Moderately sol in  $\text{H}_2\text{O}$ . (Aloy, Dissert 1901.)

$2\text{UO}_2, \text{UCl}_4 + \text{H}_2\text{O}$  Very sol. in  $\text{H}_2\text{O}$  and alcohol (Orloff, C. C 1903, II 481.)

$+13\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  and alcohol (Orloff.)

$4\text{UO}_2, \text{UCl}_4$ . Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Orloff.)

$5\text{UO}_2, \text{UCl}_4 + 10\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ . (Aloy, Dissert, 1901.)

**Uranous oxyfluoride,  $\text{UOF}_2 + 2\text{H}_2\text{O}$ .**

(Giolitta and Agamennone, C C 1905, I 1130.)

**Uranous oxysulphide,  $\text{U}_2\text{O}_3\text{S}_4 = \text{UO}_2, 2\text{US}_2$ .**

Slightly attacked by dil. easily by conc  $\text{HCl} + \text{Aq}$ . Sol in cold  $\text{HNO}_3 + \text{Aq}$  (Hermann, J B 1861. 258)

**Uranic oxy-compounds.**

See Uranyl compounds.

**Uranium phosphide,  $\text{U}_2\text{P}_3$ .**

Violently attacked by conc.  $\text{HNO}_3$ . (Colani, C. R. 1903, 137. 383)

$\text{U}_2\text{P}_3$ . Slowly attacked by  $\text{H}_2\text{O}$ , not by dil.  $\text{HCl} + \text{Aq}$ . More easily attacked by conc  $\text{HCl} + \text{Aq}$ . Quickly decomp. by boiling conc  $\text{HNO}_3$  and  $\text{HNO}_3 + \text{HCl}$ . (Colani, A. ch 1907, (8) 12. 59)

**Uranium selenide,  $\text{USe}_2$ .**

Spontaneously inflammable. Sol. in fuming  $\text{HNO}_3$ . (Colani, C. R. 1903, 137. 383)

$\text{USe}_2$ . As  $\text{US}_2$ . (Colani, C C. 1903, II 707.)

$\text{U}_2\text{Se}_3$  (Colani.)

**Uranium disilicide,  $\text{USi}_2$ .**

Sol in cold or hot conc  $\text{HF}$ , insol. in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and aqua regia. (Defacqz, C. R. 1908, 147. 1051)

**Uranium monosulphide,  $\text{US}$ .**

(Alibegoff, A. 233. 117)

**Uranium sesquisulphide,  $\text{U}_2\text{S}_3$ .**

Not attacked by  $\text{HCl}$  or dil.  $\text{HNO}_3 + \text{Aq}$ . Oxidised by fuming  $\text{H}_2\text{SO}_4$  or aqua regia. (Alibegoff, A. 233. 117.)

**Uranium disulphide,  $\text{US}_2$ .**

Insol. in cold or boiling dil.  $\text{HCl} + \text{Aq}$ . Sol. in cold conc.  $\text{HCl} + \text{Aq}$ . Decomp. by  $\text{HNO}_3 + \text{Aq}$ . (Hermann, J. B. 1861. 258.)

**Uranium telluride,  $\text{U}_2\text{Te}_3$ .**

Violently attacked by conc.  $\text{HNO}_3$ . (Colani, C. R. 1903, 137. 383.)

**Uranosotungstic acid.**

Potassium uranosotungstate,  $9\text{K}_2\text{O}, 6\text{UO}_2, 8\text{WO}_3 + 34\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  and in  $\text{HCl}$  (Gibbs, Am. Ch J. 1895, 17. 175)

Sodium uranosotungstate,  $12\text{Na}_2\text{O}, 6\text{UO}_2, 8\text{WO}_3 + 25\text{H}_2\text{O}$ .

Insol. in cold  $\text{H}_2\text{O}$  (Gibbs.)

**Uranyl bromide,  $\text{UO}_2\text{Br}_2$ .**

Sol in  $\text{H}_2\text{O}$  (de Coninck, C C 1903, I. 693)

Sol in ether (v. Unruh, Dissert. 1909)

$+7\text{H}_2\text{O}$ . Deliquescent. Sol in  $\text{H}_2\text{O}$

**Uranyl bromide ammonia,  $\text{UO}_2\text{Br}_2, 2\text{NH}_3$ .**

(v Unruh, Dissert 1909.)

$\text{UO}_2\text{Br}_2, 3\text{NH}_3$ . (v Unruh)

$\text{UO}_2\text{Br}_2, 4\text{NH}_3$ . (v Unruh.)

**Uranyl chloride,  $\text{UO}_2\text{Cl}_2$ .**

Anhydrous. Very deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether.

Very sol in  $\text{H}_2\text{O}$ .

Sp. gr. of  $\text{UO}_2\text{Cl}_2 + \text{Aq}$  at  $t^\circ$

$t^\circ$	% $\text{UO}_2\text{Cl}_2$	Sp. gr.
14.6	1	1.0056
16.3	2	1.0112
13.7	3	1.0161
13.1	4	1.0215
14.2	5	1.0260
15.2	6	1.0313
14.3	7	1.0366
14.5	8	1.0418
15.0	9	1.0469
14.8	10	1.0517

(de Coninck, A. ch. 1904, (8) 3. 500)

Sol. in conc  $\text{HCl}$ , conc  $\text{HNO}_3$  and in selenic acid.

Decomp by  $\text{H}_2\text{SO}_4$ . (de Coninck, A. ch 1904, (8) 3. 504.)

Sol. in methyl acetate (Naumann, B 1909, 42. 3790), acetone. (Naumann, B 1904, 37. 4328)

$+ \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether  $+ 3\text{H}_2\text{O}$ . Deliquescent.

Very sol. in  $\text{H}_2\text{O}$  1 pt. is sol. in 0.134 pts.  $\text{H}_2\text{O}$  at  $18^\circ$  and solution, which is saturated, contains 76.2%  $\text{UO}_2\text{Cl}_2$  or 88.2%  $\text{UO}_2\text{Cl}_2 + 3\text{H}_2\text{O}$ . Sp. gr of solution = 2.740 The solubility increases with rise in temp.

Sol. in alcohol and in ether. (Mylus and Dietz, B. 1901, 34. 2775)

**Uranyl hydrogen chloride,  $\text{UO}_2\text{Cl}_2, \text{HCl} + 2\text{H}_2\text{O}$ .**

Cryst at  $-10^\circ$  from sat. solution of  $\text{UO}_2\text{Cl}_2$  in  $\text{HCl} + \text{Aq}$ .

Fumes in the air (Aloy, Bull. Soc. 1901, (3) 25. 154.)

**Uranyl chloride ammonia**,  $\text{UO}_2(\text{NH}_4\text{Cl})_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Regelsberger, A. 227. 119.)

$\text{UO}_2(\text{NH}_4\text{NH}_2\text{Cl})\text{NH}_4\text{Cl}$ . Decomp. by  $\text{H}_2\text{O}$ . (Regelsberger.)

$\text{UO}_2(\text{NH}_4\text{NH}_2\text{Cl})_2$ . Decomp. by  $\text{H}_2\text{O}$ . (Regelsberger.)

**Uranyl fluoride**,  $\text{UO}_2\text{F}_2$ .

Very sol. in  $\text{H}_2\text{O}$ . (Smithells, Chem. Soc. 43. 125.)

Insol. in  $\text{H}_2\text{O}$  or dil. acids. Very sl. sol. in  $\text{HF} + \text{Aq}$ . Sol. in  $\text{H}_2\text{SO}_4 + \text{aqua regia}$ . (Ditte, A. ch. (6) 1. 339.)

Insol. in ether and amyl alcohol. (v. Unruh, Dissert. 1909.)

$\text{UOF}_4$ . Very sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 91. 115.)

True composition is  $\text{UO}_2\text{F}_2$ . (Smithells.)

**Uranyl hydrogen fluoride**,  $\text{UO}_2\text{F}_2 \cdot \text{HF} + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Smithells, Chem. Soc. 43. 131.)

**Uranyl fluoride ammonia**,  $\text{UO}_2\text{F}_2 \cdot 2\text{NH}_3$ .

(v. Unruh, Dissert. 1909.)

$\text{UO}_2\text{F}_2 \cdot 3\text{NH}_3$ . (v. Unruh.)

$\text{UO}_2\text{F}_2 \cdot 4\text{NH}_3$ . (v. Unruh.)

**Uranyl iodide**,  $\text{UO}_2\text{I}_2$ .

Ppt. Deliquescent (Aloy, A. ch. 1910, (7) 24. 417.)

Deliquescent

Sol. in alcohol, ether and benzene. (Aloy, Dissert. 1901.)

Sol. in acetone (Eidmann, C. C. 1899, II 1014; Naumann, B. 1904, 37. 4328), methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Uranyl iodide ammonia**,  $\text{UO}_2\text{I}_2 \cdot 2\text{NH}_3$ .

(Aloy, Dissert. 1901.)

$\text{UO}_2\text{I}_2 \cdot 3\text{NH}_3$ . (Aloy.)

$\text{UO}_2\text{I}_2 \cdot 4\text{NH}_3$ . (Aloy.)

**Uranyl selenide**,  $\text{UO}_2\text{Se}$ .

Very slowly decomp. by  $\text{H}_2\text{O}$

Easily sol. in cold  $\text{HCl}$ . Violently attacked by cold  $\text{HNO}_3$ . Not attacked by dil. alkalis. (Mubauer, Z. anorg. 1904, 42. 450.)

**Uranyl sulphide**,  $\text{UO}_2\text{S}$ .

Sl. sol. in pure  $\text{H}_2\text{O}$ . Sol. in dil., insol. in absolute alcohol. Sol. in conc.  $\text{HCl} + \text{Aq}$ , also in dil. acids. Decomp. by caustic alkalis  $+ \text{Aq}$ . Partly sol. in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ .

**Metavanadic acid**,  $\text{HVO}_3$ .

Insol. in  $\text{H}_2\text{O}$ , sol. in acids and alkalis.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

$+ \frac{1}{2}\text{H}_2\text{O}$ .

See **Vanadium pentoxide**.

**Pyrovanadic acid**,  $\text{H}_4\text{V}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids and alkalis.

**Vanadates**.

The alkali, Ba, and Pb metavanadates are sl. sol. in  $\text{H}_2\text{O}$ , the others are more easily sol. Insol. in alcohol.

**Aluminum metavanadate**.

Very sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Aluminum divanadate**.

Very sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Ammonium metavanadate**,  $(\text{NH}_4)\text{VO}_3$ .

(a) Very slowly and sparingly sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in hot  $\text{H}_2\text{O}$ . (Berzelius.)

Easily sol. in  $\text{H}_2\text{O}$  at about  $70^\circ$ . Very sl. sol. at above and below that temperature (Guyard, Bull. Soc. (2) 25. 355.)

10 g. dissolve in 1 litre cold, and 63 g. in 1 litre hot  $\text{H}_2\text{O}$  with partial decomp. (Ditte, C. R. 102. 918.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Solubility, mol. per litre
18	0.03715
25	0.05189
35	0.08980
45	0.13406
55	0.17041
70	0.25994

(Meyer, Z. Elektrochem. 1909, 15. 266.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $t^\circ$

$\text{NH}_4\text{OH} + \text{Aq}$	$t^\circ$	Solubility, mol. per litre
0.0677-N	18	0.04783
0.2452-N		0.06798
0.5872-N		0.1029
0.0677-N	25	0.06026
0.2452-N		0.07303
0.5872-N		0.1080

(Meyer, Z. Elektrochem. 1909, 15. 268.)

Extremely sl. sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (v. Hauer.)

Insol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Solubility in salts + Aq at t°.		
Salt solution	t°	Solubility, mol. per litre
0.05-N $\text{NH}_4\text{Cl}$ + Aq	18	0.01419
	25	0.02246
	35	0.04445
	45	0.07575
	55	0.09544
0.1-N $\text{NH}_4\text{Cl}$ + Aq	18	0.00356
	25	0.00995
	35	0.02347
	45	0.04507
	55	0.06314
0.05-N $\text{NH}_4\text{NO}_3$ + Aq	18	0.01433
	25	0.02364
0.1-N $\text{NH}_4\text{NO}_3$ + Aq	18	0.00497
	25	0.01050

(Meyer, Z Elektrochem, 1909, 15. 267.)

Insol. in alcohol. (v. Hauer)

(b) Sol in cold  $\text{H}_2\text{O}$ , from which it is pptd by alcohol (Berzelius)

**Ammonium divanadate**,  $(\text{NH}_4)_2\text{V}_2\text{O}_{11} + 4\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ , from which it is precipitated by sat  $\text{NH}_4\text{Cl}$  + Aq or alcohol. (v. Hauer, W. A. B. 21. 337.)

Correct formula is  $(\text{NH}_4)_2\text{V}_2\text{O}_{10} + 2\text{H}_2\text{O}$ , according to Rammelsberg (B. A. B. 1883. 3.) +  $3\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 918.)

**Ammonium trivanadate**,  $(\text{NH}_4)_3\text{V}_3\text{O}_{16}$ .

Anhydrous. Nearly insol. in hot or cold  $\text{H}_2\text{O}$ . (Norblad, B. 8. 126.)

15 g dissolve in 1 litre of boiling  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 918.)

+  $5\text{H}_2\text{O}$ . Very sl sol. in  $\text{H}_2\text{O}$ . (Ditte.) +  $6\text{H}_2\text{O}$  (?). Very sol. in  $\text{H}_2\text{O}$ . (v. Hauer, W. A. B. 39. 455.)

Could not be obtained (Norblad; also Rammelsberg, B. A. B. 1883. 3.)

**Ammonium vanadate**,  $(\text{NH}_4)_3\text{V}_3\text{O}_{15} + 2\text{H}_2\text{O}$ .

Correct formula of v. Hauer's divanadate, according to Rammelsberg (B. A. B. 1883. 3.) Sl. sol. in  $\text{H}_2\text{O}$

**Ammonium sesquivanadate**,  $(\text{NH}_4)_4\text{V}_6\text{O}_{17} + 4$  or  $6\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 918.)

**Ammonium pentavanadate**,  $(\text{NH}_4)_5\text{V}_5\text{O}_{27} + 10\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. A. B. 1883. 3.)

**Ammonium hydroxylamine vanadate**,  $\text{VO}_2\text{N}_2\text{H}_4$ .

Rapidly decomp by  $\text{H}_2\text{O}$  (Hofmann and Kohlschütter, Z. anorg 1898, 16. 472.)

$\text{HVO}_3, 3\text{NH}_3\text{O}, 2\text{NH}_3 = \text{VO}_2\text{N}_2\text{H}_4$ . Rapidly decomp by  $\text{H}_2\text{O}$  (Hofmann and Kohlschütter)

**Ammonium potassium vanadate**,  $\text{K}_2\text{V}_4\text{O}_{11}, (\text{NH}_4)_2\text{V}_2\text{O}_{11} + 9\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1844.)

**Ammonium sodium vanadate**,  $\text{Na}_2\text{V}_4\text{O}_{11}, (\text{NH}_4)_2\text{V}_2\text{O}_{11} + 15\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1841.)

**Ammonium uranyl vanadate**,  $(\text{NH}_4)_2\text{O}, 2\text{UO}_2, \text{V}_2\text{O}_5 + \text{H}_2\text{O}$ .

Insol in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$  + Aq, or dil.  $\text{HCl}$  + Aq (Carnot, C. R. 104. 1850.)

**Barium metavanadate**,  $\text{Ba}(\text{VO}_3)_2 + \text{H}_2\text{O}$ .

Somewhat sol in  $\text{H}_2\text{O}$  before ignition Sol in conc  $\text{H}_2\text{SO}_4$  (Berzelius)

**Barium pyrovanadate**,  $\text{Ba}_2\text{V}_2\text{O}_7$ .

Somewhat sol. in  $\text{H}_2\text{O}$ . (Roscoe.)

**Barium vanadate**,  $\text{Ba}_2\text{V}_6\text{O}_{17} + 14\text{H}_2\text{O}$ .

(Ditte, C. R. 104. 1705.)

$\text{Ba}_2\text{V}_{10}\text{O}_{36} + 19\text{H}_2\text{O}$ . 1 pt. is sol. in 5200 pts  $\text{H}_2\text{O}$  at 20-25°. Much more sol. in hot, but decomp by boiling  $\text{H}_2\text{O}$ . (v. Hauer, W. A. B. 21. 344.)

Sol in about 5000 pts.  $\text{H}_2\text{O}$  (Manasse, C. C. 1886. 773.)

$\text{Ba}_4\text{V}_{10}\text{O}_{36} + 2\text{H}_2\text{O}$ . (Norblad.)

**Bismuth vanadate**,  $\text{Bi}_2(\text{VO}_4)_3$ .

Min *Pücherite* Sol. in  $\text{HCl}$  + Aq with evolution of Cl

**Cadmium vanadate**,  $\text{Cd}(\text{VO}_3)_2$ .

(Ditte, C. R. 102. 918.)

$\text{CdV}_2\text{O}_{13} + 24\text{H}_2\text{O}$  Sl. sol in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705.)

**Cadmium potassium vanadate**,  $\text{CdK}_2\text{V}_4\text{O}_{17} + 9\text{H}_2\text{O}$ .

(Radau, A. 251. 148.)

$\text{Cd}_2\text{V}_{10}\text{O}_{36}, \text{K}_6\text{V}_{10}\text{O}_{36} + 27\text{H}_2\text{O}$  1000 pts.  $\text{H}_2\text{O}$  dissolve 5.4 pts. at 18°. (Radau.)

**Cadmium vanadate bromide**,  $3\text{Cd}_3(\text{VO}_4)_2, \text{CdBr}_2$ .

Very sol. in dil. acids. (de Schulten, Bull. Soc. 1900, (3) 23. 160.)

**Cadmium vanadate chloride**,  $3\text{Cd}_3(\text{VO}_4)_2, \text{CdCl}_2$ .

Very sol. in dil. acids. (de Schulten, Bull. Soc. 1900, (3) 23. 159.)

**Cæsium metavanadate**,  $\text{CsVO}_3$ .

(Chabré, A. ch. 1902, (7) 26. 228.)

**Calcium metavanadate**,  $\text{Ca}(\text{VO}_3)_2 + 4\text{H}_2\text{O}$ .

Much more sol. than  $\text{Sr}(\text{VO}_3)_2$ , and solution is not precipitated by alcohol (Berzelius.)

+  $3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}_2$ , insol in alcohol (Scheuer, Z anorg 1898, 16. 304)

**Calcium pyrovanadate**,  $\text{Ca}_2\text{V}_2\text{O}_7 + 5\text{H}_2\text{O}$ 

Precipitate.

+  $2\text{H}_2\text{O}$  Very sol. in dil acids. (Ditte C R. 104. 1705)

+  $2\frac{1}{2}\text{H}_2\text{O}$ . (Roscoe)

**Calcium divanadate**,  $\text{CaV}_2\text{O}_{11} + 9\text{H}_2\text{O}$ .

Easily sol in  $\text{H}_2\text{O}$ . (v Hauer.)

When fused is nearly insol in  $\text{H}_2\text{O}$ . (v Hauer.)

+  $6\text{H}_2\text{O}$ . (Manasse, A. 240. 23.)

**Calcium trivanadate**,  $\text{CaV}_3\text{O}_{17} + 12\text{H}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$ . (Ditte, C R. 104. 1705)

**Calcium vanadate**,  $\text{Ca}_3\text{V}_3\text{O}_{21} + 15\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Manasse, A. 204. 23.)

$\text{Ca}_3\text{V}_3\text{O}_{21} + 7\text{H}_2\text{O}$  (?). Sl. sol in  $\text{H}_2\text{O}$ . Probably a mixture. (Manasse, A. 240. 23.)

$\text{Ca}_3\text{V}_3\text{O}_{21} + 26\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (Manasse, A. 240. 23)

**Calcium copper vanadate**,  $(\text{Ca}, \text{Cu})_4\text{V}_2\text{O}_9 + \text{H}_2\text{O}$ .

Min. *Volborthite* Sol. in  $\text{HNO}_3 + \text{Aq}$

**Calcium potassium vanadate**,  $\text{CaK}_2\text{V}_{20}\text{O}_{66} + 22\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Manasse, A. 240. 23.)

**Calcium vanadate chloride**,  $\text{Ca}_3(\text{VO}_4)_2, \text{CaCl}_2$ .

(Hautefeuille, C. R. 77. 896)

**Chromium vanadate**,  $\text{Cr}_2\text{VO}_4$ .

Absolutely insol in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  and  $\text{HC}_2\text{H}_3\text{O}_2$  (Carnot, C. R. 104. 1850)

**Cobaltous metavanadate**,  $\text{Co}(\text{VO}_3)_2 + 3\text{H}_2\text{O}$ .

Easily sol in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705)

**Cobaltous potassium vanadate**,  $\text{CoKV}_2\text{O}_{14} + 8\text{H}_2\text{O}$ 

1000 pts  $\text{H}_2\text{O}$  dissolve 4.8 pts. of this salt. (Radau, A. 251. 140.)

$\text{Co}_2\text{K}_2\text{V}_2\text{O}_{20} + 2\frac{1}{2}\text{H}_2\text{O}$ . (Radau.)

**Cupric metavanadate**.

Sol in  $\text{H}_2\text{O}$ . (Berzelius.)

**Cupric pyrovanadate**,  $\text{Cu}_2\text{V}_2\text{O}_7 + 3\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705.) Could not be obtained. (Radau, A. 251. 150.)

**Cupric lead vanadate**,  $5(\text{Cu}, \text{Pb})\text{O}, \text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ .

Min *Mottramite*,  $3\text{CuO}, \text{V}_2\text{O}_5, 3(3\text{PbO}, \text{V}_2\text{O}_5), 6\text{CuO}_2\text{H}_2 + 12\text{H}_2\text{O}$ . Min. *Psilacanthite*.

**Cupric potassium vanadate**,  $\text{CuKV}_2\text{O}_{14} + 17\text{H}_2\text{O}$ .

Moderately sol. in warm  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 11.1 pts. at  $18^\circ$ . (Radau, A. 251. 151.)

**Didymium vanadate**,  $\text{Di}_2(\text{VO}_4)_2$ .

Precipitate (Cleve.)

$\text{Di}_2\text{V}_{10}\text{O}_{30} + 28\text{H}_2\text{O}$ . Precipitate. (Cleve, Bull. Soc. (2) 43. 365.)

**Glucinum metavanadate** (?).

Difficultly sol. in  $\text{H}_2\text{O}$  (Berzelius.)

**Glucinum divanadate** (?).

Difficultly sol. in  $\text{H}_2\text{O}$ . (Berzelius)

**Indium metavanadate**,  $\text{In}(\text{VO}_3)_2 + 2\text{H}_2\text{O}$ .

Ppt., (Renz, Dissert. 1902.)

**Iron (ferrous) metavanadate**.

Ppt. Sol. in  $\text{HCl} + \text{Aq}$ . (Berzelius)

**Iron (ferrie) metavanadate**.

Somewhat sol in  $\text{H}_2\text{O}$ . (Berzelius)

**Lead metavanadate**,  $\text{Pb}(\text{VO}_3)_2$ .

Sl sol in  $\text{H}_2\text{O}$ . Easily sol in warm dil.  $\text{HNO}_3 + \text{Aq}$ . Not completely decomp. by  $\text{H}_2\text{SO}_4$  or by boiling with  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Berzelius)

Min. *Dechemite* Easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$ , and decomp. by  $\text{HCl} + \text{Aq}$ .

**Lead pyrovanadate, basic**,  $2\text{Pb}_2\text{V}_2\text{O}_7, \text{PbO}$ .

Insol. in boiling  $\text{H}_2\text{O}$  or  $\text{HC}_2\text{H}_3\text{O}_2$ . Decomp. by  $\text{HNO}_3 + \text{Aq}$  with separation of  $\text{V}_2\text{O}_5$ , which dissolves on warming. (Roscoe)

**Lead pyrovanadate**,  $\text{Pb}_2\text{V}_2\text{O}_7$ .

Sol. in warm dil.  $\text{HNO}_3 + \text{Aq}$ . (Ditte, C. R. 104. 1705.)

Min *Descloizite*. Sol in cold dil.  $\text{HNO}_3 + \text{Aq}$ .

**Lead divanadate**,  $\text{PbV}_4\text{O}_{11}$ .

(Ditte, C. R. 104. 1705)

**Lead orthovanadate**,  $\text{Pb}_2(\text{VO}_4)_2$ .

Insol. in  $\text{H}_2\text{O}$ . (Roscoe, A. suppl. 8. 109.)

**Lead zinc orthovanadate**,  $4\text{Pb}_2(\text{VO}_4)_2,$ 

$3\text{Zn}_2(\text{VO}_4)_2$

Min *Eusynchate* Easily sol. in  $\text{HNO}_3 + \text{Aq}$ .

**Lead zinc vanadate**,  $(\text{Pb}, \text{Zn})_2\text{V}_2\text{O}_7 + \text{H}_2\text{O}$ .

Min. *Desclauszite*. Sol in excess of  $\text{HNO}_3 + \text{Aq}$ .

**Lead vanadate chloride**,  $3\text{Pb}_2(\text{VO}_3)_2, \text{PbCl}_2$ .

Min. *Vanadinite*. Easily sol in  $\text{HNO}_3 + \text{Aq}$ .

**Lithium vanadate, basic**,  $\text{Li}_4\text{V}_2\text{O}_7 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1168.)  
 $\text{Li}_2\text{V}_2\text{O}_7 + \text{H}_2\text{O}$ , and  $14\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$  (Ditte.)

**Lithium metavanadate**,  $\text{LiVO}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius)  
 $+2\text{H}_2\text{O}$  Quite easily sol in  $\text{H}_2\text{O}$ . (Rammelsberg, B. A. B. 1883. 3.)

**Lithium divanadate**,  $\text{Li}_2\text{V}_2\text{O}_{11} + 9\text{H}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$ . (Norblad)  
Correct formula is  $\text{Li}_2\text{V}_2\text{O}_{11} + 12\text{H}_2\text{O}$  (Rammelsberg.)  
 $+8$ , or  $12\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1168)

**Lithium orthovanadate**,  $\text{Li}_2\text{VO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. A. B. 1883. 3)

**Lithium pyrovanadate**,  $\text{Li}_4\text{V}_2\text{O}_7 + 4\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 16. 1676.)  
 $+3\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1168.)

**Lithium vanadate**,  $\text{Li}_4\text{V}_2\text{O}_{14} + 7\text{H}_2\text{O}$ .

Difficultly sol in  $\text{H}_2\text{O}$  (Rammelsberg.)  
 $+12\text{H}_2\text{O}$ . Very efflorescent. Correct formula for v. Hauer's divanadate. (Rammelsberg.)

$\text{Li}_4\text{V}_2\text{O}_{17} + 16\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1168.)

$+15\text{H}_2\text{O}$  (Rammelsberg)

$+11\text{H}_2\text{O}$ . (R.)

$+3\text{H}_2\text{O}$  (R.)

$\text{Li}_4\text{V}_2\text{O}_{13} + 15\text{H}_2\text{O}$  Not very easily sol. in

$\text{H}_2\text{O}$  (Rammelsberg)

$\text{Li}_2\text{V}_2\text{O}_{23} + 12\text{H}_2\text{O}$  Moderately sol. in  $\text{H}_2\text{O}$

(Rammelsberg.)

$\text{Li}_{10}\text{V}_{12}\text{O}_{36} + 30\text{H}_2\text{O}$ . Efflorescent. Very

sol. in  $\text{H}_2\text{O}$  (Rammelsberg.)

**Magnesium metavanadate**,  $\text{Mg}(\text{VO}_3)_2$ .

Very easily sol. in  $\text{H}_2\text{O}$ . (Berzelius)  
 $+6\text{H}_2\text{O}$ . Very sol in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705.)

**Magnesium divanadate**,  $\text{MgV}_2\text{O}_{11} + 8\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ , but much more sol. than barium divanadate. (v. Hauer)

$+9\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705.)

**Magnesium trivanadate**,  $\text{Mg}_3\text{V}_3\text{O}_{17} + 4\frac{1}{2}\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$  (Mansse, A. 240. 23.)

**Magnesium vanadate**,  $\text{Mg}_2\text{V}_{10}\text{O}_{28} + 28\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Sugira and Baker, Chem. Soc. 35. 715)

**Manganous metavanadate**,  $\text{Mn}(\text{VO}_3)_2 + 4\text{H}_2\text{O}$ .

Very sl. sol. in cold, somewhat more sol. in hot  $\text{H}_2\text{O}$ . Easily sol in dil. acids. (Radau, A. 251. 125.)

Sl. sol. in  $\text{H}_2\text{O}_2$ , insol in alcohol (Scheuer, Z. anorg. 1898, 16. 304)

**Manganous pyrovanadate**,  $\text{Mn}_2\text{V}_2\text{O}_7$ .

Sl. sol. in hot dil.  $\text{HNO}_3 + \text{Aq}$  (Ditte, C. R. 96. 1048.)

**Manganous potassium vanadate**,  $\text{MnKV}_2\text{O}_{14} + 8\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 17 pts. salt at  $18^\circ$ .

Easily sol. in acids (Radau, A. 251. 129)

$3\text{Mn}_2\text{V}_2\text{O}_{11} + \text{K}_2\text{V}_2\text{O}_7 + 54\text{H}_2\text{O}$ . (Radau.)

$7\text{Mn}(\text{VO}_3)_2 + 2\text{KVO}_3 + 25\text{H}_2\text{O}$  (Radau)

$11\text{Mn}(\text{VO}_3)_2 + 2\text{KVO}_3 + 48\text{H}_2\text{O}$  (Radau.)

**Mercuric vanadate**.

Sl. sol in  $\text{H}_2\text{O}$ .

**Nickel vanadate**,  $\text{Ni}(\text{VO}_3)_2$ .

Sol in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705.)

**Nickel orthovanadate**,  $\text{Ni}_2(\text{VO}_4)_3$ .

Insol in  $\text{H}_2\text{O}$ , sol. in  $\text{HNO}_3 + \text{Aq}$  (Ditte, C. R. 96. 1049.)

**Nickel divanadate**,  $\text{NiV}_2\text{O}_{11} + 3\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  (Ditte, C. R. 104. 1705.)

**Nickel potassium vanadate**,  $5\text{Ni}(\text{VO}_3)_2$ ,

$2\text{KVO}_3 + 25\text{H}_2\text{O}$ .

$\text{Ni}_2\text{K}_2\text{V}_{10}\text{O}_{28} + 17\text{H}_2\text{O}$ . Very sl. sol. in hot  $\text{H}_2\text{O}$ .

$\text{NiKV}_2\text{O}_{14} + 8\text{H}_2\text{O}$

$2\text{Ni}_2\text{V}_{10}\text{O}_{36} + \text{K}_2\text{V}_{10}\text{O}_{28} + 69\text{H}_2\text{O}$ . 1000 pts.

$\text{H}_2\text{O}$  dissolve 1.7 pts. of salt at  $17.5^\circ$  (Radau,

A. 251. 137.)

**Potassium vanadate, basic**,  $\text{K}_2\text{V}_2\text{O}_7 + 20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Ditte, C. R. 104. 902)

**Potassium metavanadate**,  $\text{KVO}_3$ .

*Anhydrous*. Slowly sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Insol. in alcohol. (Berzelius)

Completely sol. in a little cold  $\text{H}_2\text{O}$  (Norblad)

$+ \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg)

$+1\frac{1}{2}\text{H}_2\text{O}$  (Ditte.)

$+1\frac{1}{2}\text{H}_2\text{O}$ . (Ditte.)

$+2\text{H}_2\text{O}$ . (Ditte.)

$+3\text{H}_2\text{O}$ . (Ditte, C. R. 104. 902.)

$+7\text{H}_2\text{O}$ . (Rammelsberg.)

**Potassium divanadate,  $K_2V_2O_{11} + 4H_2O$ .**

Sol. in cold or lukewarm  $H_2O$ . Decomp. by hot  $H_2O$ . (Rammelsberg)  
 +  $3H_2O$  (Berzelius.)  
 +  $3\frac{1}{2}H_2O$ . Sol. in warm  $H_2O$ . (Norblad)  
 + 8 or  $10H_2O$  (Ditte, C. R. 104. 902)  
 +  $6H_2O$ . (Ephraim, Z. anorg. 1903, 35. 76.)

**Potassium trivanadate,  $K_3V_3O_{18}$ .**

*Anhydrous*. Nearly insol. in  $H_2O$ . (Norblad)  
 +  $6H_2O$  Insol. in cold or hot  $H_2O$  (Norblad)  
 + 1, and  $5H_2O$ . (Ditte, C. R. 104. 902.)

**Potassium orthovanadate,  $K_1VO_4 + 4\frac{1}{2}$  or  $6H_2O$ .**

Deliquescent. Sol. in  $H_2O$  (Ditte, C. R. 104. 902.)  
 Decomp. by  $H_2O$  into  $K_4V_2O_7$  and  $KOH$ . (Rammelsberg, B. A. B. 1883. 3.)

**Potassium pyrovanadate,  $K_4V_2O_7 + 3H_2O$ .**

Deliquescent Easily sol. in  $H_2O$  Insol. in alcohol (Norblad)  
 +  $4H_2O$ . (Ditte, C. R. 104. 902)

**Potassium vanadate,  $K_3V_3O_{14} + 5H_2O$ .**

100 pts.  $H_2O$  dissolve 19.2 pts at  $17.5^\circ$  (Radau, A. 251. 120.)  
 +  $4\frac{1}{2}H_2O$ . (Radau)  
 $K_4V_2O_7 + 2H_2O$ . Slowly sol. in  $H_2O$  (Rammelsberg.)  
 +  $6H_2O$ . (Ditte, C. R. 104. 902.)  
 +  $7H_2O$ . (Friedheim, B. 23. 1526)  
 $K_4V_{10}O_{27} + 12H_2O$  Very sol. in  $H_2O$ . (Manasse, A. 240. 42)  
 $K_{10}V_5O_{23} + 7H_2O$ . Sol. in  $H_2O$ . (Rammelsberg.)  
 $K_2V_2O_7 + 1\frac{1}{2}H_2O$ . Very al. sol. in  $H_2O$  (Ephraim, Z. anorg. 1903, 35. 75.)  
 $K_4V_{10}O_{27}$  (Ephraim, Z. anorg. 1903, 35. 78)

**Potassium sodium vanadate,  $2(K_2O, 3V_2O_5), 3(2Na_2O, 3V_2O_5) + 30H_2O$ .**

(Friedheim, Z. anorg. 1894, 5. 442)  
 $2K_2O, 3V_2O_5, 4(2Na_2O, 3V_2O_5) + 35H_2O$   
 Efflorescent. (Friedheim, Z. anorg. 1894, 5. 441)

**Potassium strontium vanadate,  $K_2Sr_2V_4O_{20} + 20H_2O$ .**

Sol. in  $H_2O$ . (Manasse, A. 240. 23)  
 $K_2Sr_2V_4O_{20} + 30H_2O$  As above (Manasse)  
 $K_2Sr_2V_4O_{20} + 18H_2O$ . As above. (Manasse)

**Potassium zinc vanadate,  $KZnV_4O_{14} + 8H_2O$ .**

1000 pts  $H_2O$  dissolve 4.1 pts of the salt (Radau, A. 251. 145)  
 $2K_4V_{10}O_{27} + 3ZnV_4O_{14} + 90H_2O$  (Radau)

**Potassium vanadate cyanide,  $K_4V_2O_7, 4KCN + 14H_2O$ .**

Easily decomp.  
 Insol. in alcohol (Petersen, Z. anorg. 1904, 38. 343.)

**Samarium vanadate,  $Sm_2O_3, 5V_2O_5 + 28H_2O$ .**

(Cleve.)  
 +  $24H_2O$  (Cleve)

**Samarium orthovanadate.**

Precipitate

**Silver metavanadate,  $AgVO_3$ .**

Sol. in  $HNO_3$  or dil.  $NH_4OH + Aq$ . (Berzelius)  
 Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

**Silver orthovanadate,  $Ag_3VO_4$ .**

Ppt. Easily sol. in  $HNO_3$  or  $NH_4OH + Aq$ . (Roscoe, Proc. Roy. Soc. 18. 316.)

**Silver pyrovanadate,  $Ag_4V_2O_7$ .**

Ppt. (Roscoe.)  
 Sol. in  $NH_4OH + Aq$ . (Ditte, C. R. 104. 1705)

**Silver vanadate,  $Ag_3V_4O_{14}$ .**

Sol. in 21,414 pts  $H_2O$  at  $14^\circ$ , and 13,617 pts. at  $100^\circ$  (Carnelley, A. 166. 155.)

**Silver vanadate ammonia,  $6AgVO_3, 4NH_3 + 8H_2O$ .**

(Ditte, C. R. 104. 1705)

**Sodium vanadate, basic,  $Na_4V_2O_7 + 26$  or  $30H_2O$ .**

Very sol. in  $H_2O$ . (Ditte)

**Sodium metavanadate,  $NaVO_3$ .**

*Anhydrous*. Slowly sol. in cold, very easily in hot  $H_2O$ . (Norblad)

100 g.  $H_2O$  dissolve at:

25°	40°	60°	75°
21.10	26.23	32.97	38.83 g. $NaVO_3$ .

(McAdam and Pierle, J. Am. Chem. Soc. 1912, 34. 606.)

+  $2H_2O$ . Easily sol. in  $H_2O$ .

100 g.  $H_2O$  dissolve at:

25°	40°	60°
15.23	29.93	68.36 g. $NaVO_3$ .

At  $75^\circ$  a value was obtained which showed that the solid phase had changed into the less sol. modification. (McAdam and Pierle, J. Am. Chem. Soc. 1912, 34. 607.)

+  $\frac{1}{2}H_2O$  (Ditte, C. R. 104. 1061)

+ 3, 4, and  $5H_2O$  (Ditte.)

**Sodium divanadate,  $Na_2V_2O_{11}$ .**

*Anhydrous* Sl. sol. even in warm  $H_2O$ , but easily sol. on addition of acids.

+9H<sub>2</sub>O Easily sol in cold H<sub>2</sub>O. Insol in alcohol. (Norblad.)  
 +5H<sub>2</sub>O (Ditte, C. R. 104. 1061.)  
 Not obtained by Rammelsberg (B. A. B. 1883. 3.)

**Sodium trivanadate**, Na<sub>3</sub>V<sub>3</sub>O<sub>10</sub> + 9H<sub>2</sub>O.

Insol. in cold or hot H<sub>2</sub>O. (Norblad.)  
 Composition is Na<sub>3</sub>V<sub>10</sub>O<sub>43</sub> + 24H<sub>2</sub>O. (Rammelsberg.)  
 +3H<sub>2</sub>O (Ditte, C. R. 104. 1061.)

**Sodium orthovanadate**, Na<sub>3</sub>VO<sub>4</sub> + 16H<sub>2</sub>O.

Easily sol in H<sub>2</sub>O, but decomp into Na<sub>2</sub>V<sub>2</sub>O<sub>7</sub> and KOH. Precipitated by an excess of alcohol. (Roscoe, A. suppl. 8. 102.)  
 +7H<sub>2</sub>O. (Hall, Chem. Soc. 51. 96.)  
 +10, and 12H<sub>2</sub>O. Less sol. in dil. NaOH + Aq than in H<sub>2</sub>O. (Baker, A. 229. 286.)

**Sodium pyrovanadate**, Na<sub>4</sub>V<sub>2</sub>O<sub>7</sub> + 18H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O. Insol. in alcohol. (Norblad.)  
 Sol. in alcohol. (Ditte, C. R. 104. 1061.)  
 +8H<sub>2</sub>O. (Ditte.)

**Sodium sesquivanadate**, Na<sub>5</sub>V<sub>3</sub>O<sub>11</sub>.

Anhydrous. Insol. in H<sub>2</sub>O or NH<sub>4</sub>OH + Aq (Rammelsberg.)  
 +10H<sub>2</sub>O (Norblad.)  
 +16H<sub>2</sub>O Efflorescent. (Rammelsberg.)  
 +18H<sub>2</sub>O (Ditte)

**Sodium pentavanadate**, Na<sub>5</sub>V<sub>10</sub>O<sub>37</sub> + 3½H<sub>2</sub>O.

Scarcely sol. in H<sub>2</sub>O (Rammelsberg)

**Sodium vanadate**, Na<sub>3</sub>V<sub>2</sub>O<sub>7</sub> + 6H<sub>2</sub>O.

Difficultly sol. in cold H<sub>2</sub>O. (Carnelley, A. 166. 155.)  
 +2H<sub>2</sub>O (Carnelley.)  
 Na<sub>3</sub>V<sub>10</sub>O<sub>41</sub> + 24H<sub>2</sub>O Correct formula for Norblad's trivanadate. (Rammelsberg.)  
 Na<sub>3</sub>O, 4V<sub>2</sub>O<sub>5</sub> + 7½H<sub>2</sub>O. (Baragola, Dissert. 1902.)  
 +8½H<sub>2</sub>O. (Baragola.)  
 3Na<sub>2</sub>O, 5V<sub>2</sub>O<sub>5</sub> + 22H<sub>2</sub>O. (Prandtl and Lustig, Z. anorg. 1907. 53. 405.)  
 4Na<sub>2</sub>O, 7V<sub>2</sub>O<sub>5</sub> + 33H<sub>2</sub>O. (Friedheim, Z. anorg. 1894. 5. 443.)  
 5Na<sub>2</sub>O, 8V<sub>2</sub>O<sub>5</sub> + 30H<sub>2</sub>O. Sol. in H<sub>2</sub>O (Friedheim, Z. anorg. 1894. 5. 441.)

**Sodium vanadate fluoride**, 2Na<sub>3</sub>VO<sub>4</sub>, NaF + 19H<sub>2</sub>O.

Sol. in H<sub>2</sub>O (Rammelsberg, W. Ann. 20. 928.)

**Strontium metavanadate**, Sr(VO<sub>3</sub>)<sub>2</sub> + 4H<sub>2</sub>O.

Difficultly sol. in cold H<sub>2</sub>O. (Norblad.)

**Strontium divanadate**, SrV<sub>2</sub>O<sub>11</sub> + 9H<sub>2</sub>O.

Sl. sol. in H<sub>2</sub>O, but much more sol. than barium divanadate. (v. Hauer.)

Sol in H<sub>2</sub>O<sub>2</sub> + Aq. free from H<sub>2</sub>SO<sub>4</sub>. Insol in alcohol. (Scheuer, Z. anorg. 1898. 16. 303.)

**Strontium trivanadate**, SrV<sub>3</sub>O<sub>16</sub> + 14H<sub>2</sub>O.

Sol in H<sub>2</sub>O, but decomposes slowly on boiling. Easily sol in hot H<sub>2</sub>O acidified with HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, and crystallizes therefrom without decomp. (v. Hauer, J. pr. 76. 156.)

**Strontium tetraivanadate**, SrV<sub>4</sub>O<sub>21</sub> + 11H<sub>2</sub>O.

Sol in hot H<sub>2</sub>O with partial decomposition. (Manasse, A. 240. 34)

**Strontium vanadate**, Sr<sub>2</sub>V<sub>2</sub>O<sub>23</sub> + 14H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Manasse, A. 240. 23.)  
 Sr<sub>2</sub>V<sub>14</sub>O<sub>51</sub> + 30H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Norblad)

**Thallous metavanadate**, TlVO<sub>3</sub>.

Sol. in 11,534 pts. H<sub>2</sub>O at 11°, and 4756 pts. at 100°. (Carnelley.)

**Thallous orthovanadate**, Tl<sub>2</sub>VO<sub>4</sub>.

Sl. sol in H<sub>2</sub>O. Sol. in 999 pts. H<sub>2</sub>O at 15°, and 574 p.s. at 100° (Carnelley, Chem. Soc. (2) 11. 323.)

**Thallous pyrovanadate**, Tl<sub>2</sub>V<sub>2</sub>O<sub>7</sub>.

Sol in 4996 pts. H<sub>2</sub>O at 14°, and 3840 pts. H<sub>2</sub>O at 100° (Carnelley)

**Thallous vanadate**, Tl<sub>2</sub>V<sub>2</sub>O<sub>23</sub>.

Sol in 3406 pts. H<sub>2</sub>O at 14°, and 533 pts. at 100° (Carnelley.)  
 Tl<sub>2</sub>V<sub>10</sub>O<sub>31</sub>. Sol. in 9372 pts. H<sub>2</sub>O at 11°, and 3366 pts. at 100°. (Carnelley)  
 Tl<sub>2</sub>V<sub>14</sub>O<sub>41</sub> Ppt. (Carnelley)

**Thorium vanadate**, Th<sub>2</sub>O<sub>12</sub>(VO)<sub>4</sub>, 16V<sub>2</sub>O<sub>5</sub> + 24H<sub>2</sub>O (?).

Sol. in H<sub>2</sub>O (Cleve.)  
 ThO<sub>2</sub>, V<sub>2</sub>O<sub>5</sub> + 6H<sub>2</sub>O. Sol. in acids. (Voick, Z. anorg. 1894. 6. 167.)

**Uranyl vanadate**, 2UO<sub>3</sub>, V<sub>2</sub>O<sub>5</sub>, (UO<sub>3</sub>)<sub>2</sub>V<sub>2</sub>O<sub>7</sub>.

Insol in H<sub>2</sub>O. (Carnot, C. R. 104. 1850.)

**Vanadium vanadate**, 2VO<sub>3</sub>, V<sub>2</sub>O<sub>5</sub> = V<sub>4</sub>O<sub>9</sub>.

Insol in H<sub>2</sub>O. Sol in dil H<sub>2</sub>SO<sub>4</sub> or HNO<sub>3</sub> + Aq (Rammelsberg.)  
 Slowly oxidised by HNO<sub>3</sub> + Aq. Slowly sol in NH<sub>4</sub>OH + Aq. Easily sol. in HCl + Aq (Ditte, C. R. 101. 1487.)  
 +2½H<sub>2</sub>O. (Brierley.)  
 2VO<sub>3</sub>, 2V<sub>2</sub>O<sub>5</sub> + 8H<sub>2</sub>O. Insol in H<sub>2</sub>O. (Brierley, Chem. Soc. 49. 31)

**Ytterbium vanadate**, 3Yb<sub>2</sub>O<sub>3</sub>, 5V<sub>2</sub>O<sub>5</sub> + 3H<sub>2</sub>O.

Yb<sub>2</sub>O<sub>3</sub>, 15V<sub>2</sub>O<sub>4</sub>. Ppt. (Cleve, Z. anorg. 1902. 32. 150.)

**Yttrium vanadate.**

Precipitate. (Berzelius.)

**Zinc vanadate**,  $\text{Zn}(\text{VO}_3)_2 \cdot 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705.)

**Zinc pyrovanadate**,  $\text{Zn}_2\text{V}_2\text{O}_7$ .

Appreciably sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 96. 1048.)

**Pervanadic acid**.

See Pervanadic acid.

**Vanadicotungstic acid**.

**Ammonium vanadicotungstate**,

$3(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot 8\text{WO}_3 \cdot 10\text{H}_2\text{O}$ .

Very sol in  $\text{H}_2\text{O}$

Insol in organic solvents. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1227.)

**Vanadicovanadic acid**.

**Ammonium vanadicovanadate**,  $(\text{NH}_4)_2\text{O} \cdot 2\text{VO}_3 \cdot 4\text{V}_2\text{O}_5 \cdot 8\text{H}_2\text{O}$ .

Sl. sol. in cold and warm  $\text{H}_2\text{O}$  (Gibbs, Am. Ch. J. 7. 209.)

$(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 2\text{V}_2\text{O}_5 \cdot 14\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Brierley, Chem. Soc. 49. 30.)

$3(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 4\text{V}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$  (Brierley.)

**Potassium** —,  $2\text{K}_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot \text{V}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$

Sol. in hot  $\text{H}_2\text{O}$ . (Brierley, Chem. Soc. 49. 30.)

$5\text{K}_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 4\text{V}_2\text{O}_5 \cdot \text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$  (Brierley.)

$\text{K}_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot 8\text{V}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$   
Sol. in conc  $\text{H}_2\text{SO}_4$  (Prandtl, B. 1905, 38. 660.)

**Sodium** —,  $2\text{Na}_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot \text{V}_2\text{O}_5 \cdot 13\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in conc solutions of salts, especially acetate. (Brierley, Chem. Soc. 49. 30.)

$2\text{Na}_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot 5\text{V}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in conc  $\text{H}_2\text{SO}_4$ . Not attacked by boiling with conc  $\text{HNO}_3$ . Slowly attacked by hot dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Prandtl, B. 1905, 38. 669.)

**Vanadioarsenic acid**.

See Arseniovanadic acid.

**Vanadioiodic acid**.

See Iodovanadic acid.

**Vanadiomolybdic acid**,  $8\text{MoO}_3 \cdot \text{V}_2\text{O}_5 \cdot 5\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ , and sl. sol. in boiling  $\text{HNO}_3 + \text{Aq.}$  (Ditte, C. R. 102. 757)

Could not be obtained. (Friedheim, B. 24. 1173)

**Ammonium vanadiomolybdate**,

$(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot 2\text{MoO}_3 \cdot 4\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Friedheim and Castendyck, B. 1900, 33. 1615.)

$(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 2\text{MoO}_3 \cdot 8\text{H}_2\text{O}$ . Nearly

insol. in  $\text{H}_2\text{O}$ . (Friedheim and Castendyck.)  
 $2(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot 3\text{MoO}_3 \cdot 6\text{H}_2\text{O}$ . (Euler-Chelpin, Dissert, 1895.)

$(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot 3\text{MoO}_3 \cdot 17\text{H}_2\text{O}$ . (Euler-Chelpin)

$2(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot 4\text{MoO}_3 \cdot 7\text{H}_2\text{O}$  and  $+8\text{H}_2\text{O}$  (Euler-Chelpin.)

$3(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 4\text{MoO}_3 \cdot 7\text{H}_2\text{O}$ . (Milch, Dissert Berlin, 1887.)

$+9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 1019.)

$+11\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Correct composition of above compounds is =

$(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 2(\text{NH}_4)_2\text{O} \cdot 2\text{MoO}_3 \cdot 11\text{H}_2\text{O}$ . (Friedheim, B. 24. 1173.)

Moderately sol. in  $\text{H}_2\text{O}$  and can be recryst. therefrom (Euler-Chelpin, Dissert, 1895.)

$2(\text{NH}_4)_2\text{O} \cdot 3\text{V}_2\text{O}_5 \cdot 4\text{MoO}_3 \cdot 11\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Friedheim and Castendyck, B. 1900, 33. 1615.)

$2(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 5\text{MoO}_3$ . Nearly insol. in cold  $\text{H}_2\text{O}$ . (Euler-Chelpin, Dissert, 1895.)

$+8\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Friedheim and Castendyck, B. 1900, 33. 1615.)

$3(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 5\text{MoO}_3 \cdot 8\frac{1}{2}\text{H}_2\text{O}$ . Very easily sol. in  $\text{H}_2\text{O}$ . (Laebert, Dissert, 1891.)

$4(\text{NH}_4)_2\text{O} \cdot 12\text{V}_2\text{O}_5 \cdot 5\text{MoO}_3 \cdot 24\text{H}_2\text{O}$ . Practically insol. in  $\text{H}_2\text{O}$  (Friedheim and Castendyck, B. 1900, 33. 1615.)

$2(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot 6\text{MoO}_3 \cdot 5\text{H}_2\text{O}$ . Sol. in a large amount of  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 5. 361.)

$+6\text{H}_2\text{O}$ . Rather sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. (Laebert, Dissert, 1891.)

Composition is double the above formula, or—

$4(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 12\text{MoO}_3 \cdot 12\text{H}_2\text{O}$ . Rather difficultly sol. in  $\text{H}_2\text{O}$  Composition is  $(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 3(\text{NH}_4)_2\text{O} \cdot 4\text{MoO}_3$ . (Friedheim.)

$3(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot 6\text{MoO}_3 \cdot 7\text{H}_2\text{O}$ . (Isenburg, Dissert, 1901.)

$5(\text{NH}_4)_2\text{O} \cdot 4\text{V}_2\text{O}_5 \cdot 6\text{MoO}_3 \cdot 12\text{H}_2\text{O}$  and  $+14\text{H}_2\text{O}$ . (Euler-Chelpin, Dissert, 1895.)

$5(\text{NH}_4)_2\text{O} \cdot 3\text{V}_2\text{O}_5 \cdot 7\text{MoO}_3 \cdot 13\text{H}_2\text{O}$  and  $+16\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and can be recryst. therefrom. (Toggenburg, Dissert, 1902.)

$5(\text{NH}_4)_2\text{O} \cdot 3\text{V}_2\text{O}_5 \cdot 8\text{MoO}_3 \cdot 14\text{H}_2\text{O}$ . (Stamm, Dissert, 1905.)

$5(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 12\text{MoO}_3 \cdot 10\text{H}_2\text{O}$ . Quite easily sol. in  $\text{H}_2\text{O}$ . Composition is  $(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 4(\text{NH}_4)_2\text{O} \cdot 3\text{MoO}_3 \cdot 10\text{H}_2\text{O}$ .

$6(\text{NH}_4)_2\text{O} \cdot 3\text{V}_2\text{O}_5 \cdot 12\text{MoO}_3 \cdot 21\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Composition is  $(\text{NH}_4)_2\text{O} \cdot 3\text{V}_2\text{O}_5 \cdot 5(\text{NH}_4)_2\text{O} \cdot 12\text{MoO}_3$  (F.)

$8(\text{NH}_4)_2\text{O} \cdot 4\text{V}_2\text{O}_5 \cdot 13\text{MoO}_3 \cdot 21\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Isenburg, Dissert, 1901.)

$8(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot 18\text{MoO}_3 \cdot 15\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Gibbs.) Could not be obtained. (Friedheim.)

$10(\text{NH}_4)_2\text{O} \cdot 3\text{V}_2\text{O}_5 \cdot 24\text{MoO}_3 \cdot 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Milch.) Could not be obtained. (Friedheim.)

**Ammonium barium vanadiomolybdate,**  
 $5(\text{NH}_4)_2\text{O}, 15\text{BaO}, 6\text{V}_2\text{O}_5, 36\text{MoO}_3.$

(Milch.)

$(\text{NH}_4)_2\text{O}, \text{BaO}, \text{V}_2\text{O}_5, \text{MoO}_3 + 6\text{H}_2\text{O}$   
 (Euler-Chelpin, Dissert, 1895.)

$3(\text{NH}_4)_2\text{O}, \text{BaO}, 3\text{V}_2\text{O}_5, 5\text{MoO}_3 + 9\text{H}_2\text{O}.$   
 Sl sol. in cold and hot  $\text{H}_2\text{O}$  (Euler-Chelpin.)

**Ammonium potassium —,**  $(\text{NH}_4)_2\text{O}, 3\text{K}_2\text{O},$   
 $2\text{V}_2\text{O}_5, 4\text{MoO}_3 + 5\text{H}_2\text{O}.$

Decomp by  $\text{H}_2\text{O}$ . (Euler-Chelpin.)

$(\text{NH}_4)_2\text{O}, 3\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 5\text{MoO}_3 + 9\text{H}_2\text{O}$   
 (Euler-Chelpin.)

$\frac{1}{2}(\text{NH}_4)_2\text{O}, 3\frac{1}{2}\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 5\text{MoO}_3 +$   
 $16\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$  (Jacoby, Dissert. 1900.)

**Ammonium sodium —,**  $(\text{NH}_4)_2\text{O}, \text{Na}_2\text{O},$   
 $2\text{V}_2\text{O}_5, 6\text{MoO}_3 + 12\text{H}_2\text{O}.$

(Euler-Chelpin, Dissert, 1895.)

**Barium —,**  $\text{BaO}, \text{V}_2\text{O}_5, \text{MoO}_3 + 7\text{H}_2\text{O}.$   
 (Euler-Chelpin.)

**Barium —,**  $3\text{BaO}, 2\text{V}_2\text{O}_5, 6\text{MoO}_3.$

(Milch.)

$+ 8\text{H}_2\text{O}$  (Euler-Chelpin.)

$5\text{BaO}, 4\text{V}_2\text{O}_5, 6\text{MoO}_3 + 28\text{H}_2\text{O}.$  Sol in  
 hot  $\text{H}_2\text{O}$  (Euler-Chelpin.)  
 $3\text{BaO}, \text{V}_2\text{O}_5, 8\text{MoO}_3 + 2\text{BaO}, \text{H}_2\text{O}, \text{V}_2\text{O}_5,$   
 $8\text{MoO}_3 + 28\text{H}_2\text{O}$  Sol in hot  $\text{H}_2\text{O}$  (Gibbs,  
 Am. Ch. J. 5. 361.)

$7\text{BaO}, 3\text{V}_2\text{O}_5, 18\text{MoO}_3 + 16\text{H}_2\text{O} = \text{BaO},$   
 $3\text{V}_2\text{O}_5 + 6(\text{BaO}, 3\text{MoO}_3) + 16\text{H}_2\text{O}.$  Sl. sol  
 in  $\text{H}_2\text{O}$   
 $+ 36\text{H}_2\text{O}$  and  $+ 48\text{H}_2\text{O}.$  (Liebert, Dis-  
 sert. 1891.)

**Potassium —,**  $\text{K}_2\text{O}, \text{V}_2\text{O}_5, 3\text{MoO}_3 + 15\text{H}_2\text{O}.$   
 Nearly insol in cold  $\text{H}_2\text{O}$ . (Euler-Chelpin,  
 Dissert, 1895.)

$3\text{K}_2\text{O}, 2\text{V}_2\text{O}_5, 4\text{MoO}_3 + 8\text{H}_2\text{O} = \text{K}_2\text{O}, 2\text{V}_2\text{O}_5$   
 $+ 2(\text{K}_2\text{O}, 2\text{MoO}_3) + 8\text{H}_2\text{O}$

Very sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

$+ 7\text{H}_2\text{O}.$  Easily sol in cold  $\text{H}_2\text{O}$ . (Euler-  
 Chelpin.)

$+ 9\text{H}_2\text{O}.$  Easily sol in cold  $\text{H}_2\text{O}$  (Euler-  
 Chelpin.)

$2\text{K}_2\text{O}, 2\text{V}_2\text{O}_5, 5\text{MoO}_3 + 10\text{H}_2\text{O}.$  Nearly  
 insol. in cold, very sl sol in hot  $\text{H}_2\text{O}$  (Euler-  
 Chelpin.)

$3\text{K}_2\text{O}, \text{V}_2\text{O}_5, 6\text{MoO}_3 + 5\text{H}_2\text{O}.$  (Euler-Chel-  
 pin.)

$2\text{K}_2\text{O}, \text{V}_2\text{O}_5, 6\text{MoO}_3 + 6\text{H}_2\text{O}.$  Very sl sol.  
 in cold, easily sol in hot  $\text{H}_2\text{O}$ . (Liebert.)

$4\text{K}_2\text{O}, 2\text{V}_2\text{O}_5, 12\text{MoO}_3 + 12\text{H}_2\text{O} = \text{K}_2\text{O},$   
 $2\text{V}_2\text{O}_5 + 3(\text{K}_2\text{O}, 4\text{MoO}_3) + 12\text{H}_2\text{O}.$  Sl. sol.  
 in  $\text{H}_2\text{O}$ . (Friedheim.)

$5\text{K}_2\text{O}, 2\text{V}_2\text{O}_5, 12\text{MoO}_3 + 12\text{H}_2\text{O} = \text{K}_2\text{O},$   
 $2\text{V}_2\text{O}_5 + 4(\text{K}_2\text{O}, 3\text{MoO}_3) + 12\text{H}_2\text{O}.$  Rather sl  
 sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

Sl. sol. in 'cold'; easily sol. in hot  $\text{H}_2\text{O}$ .  
 (Liebert, Dissert, 1891.)

$3\text{K}_2\text{O}, \text{V}_2\text{O}_5, 12\text{MoO}_3 + 15\text{H}_2\text{O}.$  (Liebert.)

**Potassium sodium vanadiomolybdate,  $\text{K}_2\text{O},$**   
 $4\text{Na}_2\text{O}, 2\text{V}_2\text{O}_5, 12\text{MoO}_3 + 18\text{H}_2\text{O}.$

(Euler-Chelpin. Dissert 1895.)

**Sodium —,**  $2\text{Na}_2\text{O}, \text{V}_2\text{O}_5, 6\text{MoO}_3 + 16\text{H}_2\text{O}.$   
 (Euler-Chelpin, Dissert, 1895.)

**Vanadiophosphoric acid.**

See Phosphovanadic acid.

**Vanadiouselenious acid,  $3\text{V}_2\text{O}_5, 4\text{SeO}_2 +$**   
 $4\text{H}_2\text{O}.$

$+ 6\text{H}_2\text{O}.$  Difficultly sol. in  $\text{H}_2\text{O}$ . Can be  
 cryst. from  $\text{H}_2\text{O}$ .

$+ 10\text{H}_2\text{O}.$  Difficultly sol. in  $\text{H}_2\text{O}$ . Can be  
 cryst from  $\text{H}_2\text{O}$  (Prandtl, B. 1905, 38,  
 1307.)

**Ammonium vanadiouselenite,**

$4(\text{NH}_4)_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 13\text{H}_2\text{O}.$

Sl sol. in  $\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}.$   
 $3(\text{NH}_4)_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{SeO}_2 + 2\text{H}_2\text{O}.$  Ppt  
 (Prandtl, B. 1905, 38. 1309.)

$(\text{NH}_4)\text{H}_2\text{V}_2\text{O}_7, 12\text{SeO}_2 + 2\text{H}_2\text{O}$  Ppt.  
 $+ 4\text{H}_2\text{O}.$  Ppt (Prandtl, Z anorg 1911,  
 73. 231.)

**Ammonium silver —,**  $2\frac{1}{2}(\text{NH}_4)_2\text{O}, 1\frac{1}{2}\text{Ag}_2\text{O},$   
 $6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 12\text{H}_2\text{O}, + 16\text{H}_2\text{O}$  and  
 $+ 22\text{H}_2\text{O}.$

(Prandtl, Z. anorg 1907, 53. 402.)

**Lithium —,**  $4\text{Li}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 30\text{H}_2\text{O}.$   
 Very sol. in  $\text{H}_2\text{O}$  (Prandtl.)

**Potassium —,**  $4\text{K}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 +$   
 $13\text{H}_2\text{O}.$

$3\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{SeO}_2.$  (Prandtl, B 1905,  
 38. 1309.)

**Sodium —,**  $4\text{Na}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 20\text{H}_2\text{O}.$   
 Verv. sol in  $\text{H}_2\text{O}$ . (Prandtl, Z. anorg  
 1907, 53. 403.)

**Vanadiousulphuric acid,  $\text{V}_2\text{O}_5, 3\text{SO}_3 + 3\text{H}_2\text{O}.$**

Deliquescent Sol in  $\text{H}_2\text{O}$ , but is decomp.  
 by boiling (Ditte, C. R. 102. 757.)

See Sulphate, vanadium.

**Vanadiousulphurous acid.**

**Ammonium vanadiousulphite,**

$3(\text{V}_2\text{O}_5, \text{SO}_3), (\text{NH}_4)_2\text{O}, \text{SO}_2 + 4\text{H}_2\text{O}.$

(Gain, C. R. 1907, 144. 1158.)

**Cæsium —,**  $(\text{V}_2\text{O}_5, \text{SO}_2), 3(\text{Cs}_2\text{O}, \text{SO}_2) +$   
 $8\text{H}_2\text{O}.$

(Gain.)

**Lithium —,**  $(\text{V}_2\text{O}_5, \text{SO}_2), 5(\text{Li}_2\text{O}, \text{SO}_2) +$   
 $8\text{H}_2\text{O}.$

(Gain.)

**Potassium vanadosulphate**,  $3\text{SO}_2(\text{V}_2\text{O}_5)$ ,  $\text{SO}_2(\text{K}_2\text{O})+5\text{H}_2\text{O}$ .

(Gain.)

**Rubidium** —,  $(\text{V}_2\text{O}_5, \text{SO}_2)$ ,  $2(\text{Rb}_2\text{O}, \text{SO}_2)+2\text{H}_2\text{O}$ .

(Gain.)

**Sodium** —,  $5(\text{V}_2\text{O}_5, \text{SO}_2)$ ,  $(\text{Na}_2\text{O}, \text{SO}_2)+2\text{H}_2\text{O}$ .

(Gain.)

**Thallium** —,  $3(\text{V}_2\text{O}_5, \text{SO}_2)$ ,  $(\text{Tl}_2\text{O}, \text{SO}_2)+8\text{H}_2\text{O}$ .

(Gain.)

**Vanadiotungstic acid**,  $6\text{H}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $10\text{WO}_3+16\text{H}_2\text{O}$ .

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$  (Gibbs, Am. Ch. J. 5. 361)

$6\text{H}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $16\text{WO}_3+30\text{H}_2\text{O}$  Readily sol. in  $\text{H}_2\text{O}$  (Gibbs.)

$17\text{H}_2\text{O}$ ,  $4\text{V}_2\text{O}_5$ ,  $16\text{WO}_3+24\text{H}_2\text{O}$  Sl. sol in cold, easily in hot  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 228)

**Aluminum sodium vanadiotungstate**,  $7\text{Al}_2\text{O}_3$ ,  $27\text{Na}_2\text{O}$ ,  $36\text{V}_2\text{O}_5$ ,  $144\text{WO}_3+504\text{H}_2\text{O}=3(\text{Al}_2\text{O}_3, 9\text{Na}_2\text{O}, 48\text{WO}_3)$ ,  $4(\text{Al}_2\text{O}_3, 9\text{V}_2\text{O}_5)+504\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Rothenbach, B. 23. 3055.)

**Ammonium** —,  $(\text{NH}_4)_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $\text{WO}_3+6\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 1. 158)

$2(\text{NH}_4)_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $4\text{WO}_3+4\text{H}_2\text{O}$  (Friedheim and Löwy, Z. anorg. 1894. 6. 24.)

$4(\text{NH}_4)_2\text{O}$ ,  $2\text{H}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $5\text{WO}_3+11\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ . (Gibbs Am. Ch. J. 5. 361)

$2(\text{NH}_4)_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $5\text{WO}_3+10\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (Ditte, C. R. 402. 1019)

$31(\text{NH}_4)_2\text{O}$ ,  $14\text{V}_2\text{O}_5$ ,  $60\text{WO}_3+58\text{H}_2\text{O}=5(5(\text{NH}_4)_2\text{O}, 12\text{WO}_3)$ ,  $2[3(\text{NH}_4)_2\text{O}, 7\text{V}_2\text{O}_5]$ .

Sol in  $\text{H}_2\text{O}$ . (Rothenbach, B. 23. 3051.)

$7(\text{NH}_4)_2\text{O}$ ,  $4\text{V}_2\text{O}_5$ ,  $14\text{WO}_3+16\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 197.)

$8(\text{NH}_4)_2\text{O}$ ,  $4\text{V}_2\text{O}_5$ ,  $16\text{WO}_3$ ,  $9\text{H}_2\text{O}+4\text{H}_2\text{O}$ . Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 216)

**Barium** —,  $19\text{BaO}$ ,  $10\text{V}_2\text{O}_5$ ,  $36\text{WO}_3+94\text{H}_2\text{O}=3(5\text{BaO}, 12\text{WO}_3)$ ,  $2(2\text{BaO}, 5\text{V}_2\text{O}_5)+94\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Rothenbach, B. 23. 3052.)

$8\text{BaO}$ ,  $4\text{V}_2\text{O}_5$ ,  $16\text{WO}_3$ ,  $9\text{H}_2\text{O}+44\text{H}_2\text{O}$ . Efflorescent. Not very sol. in  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 218.)

$23\text{BaO}$ ,  $12\text{WO}_3$ ,  $3\text{V}_2\text{O}_5+$

$63\text{BaO}$ ,  $3\text{V}_2\text{O}_5$ ,  $12\text{WO}_3+34\text{H}_2\text{O}$ . Not easily sol. in  $\text{H}_2\text{O}$ . (Friedheim and Löwy, Z. anorg. 1894. 6. 18)

$4\text{BaO}$ ,  $4\text{V}_2\text{O}_5$ ,  $12\text{WO}_3+4\text{H}_2\text{O}$ . Less sol.

than preceding salt. Decomp. by boiling or by mineral acids (Rosenheim)

Composition is  $4\text{BaO}$ ,  $12\text{WO}_3$ ,  $3\text{V}_2\text{O}_5+30\text{H}_2\text{O}$ . (Friedheim)

**Calcium vanadiotungstate**,  $2\text{CaO}$ ,  $\text{V}_2\text{O}_5$ ,  $2\text{WO}_3+12\text{H}_2\text{O}$ .

(Friedheim and Löwy, Z. anorg. 1894. 6. 20.)

**Magnesium sodium** —,  $\text{MgO}$ ,  $6\text{Na}_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $12\text{WO}_3+42\text{H}_2\text{O}=5\text{Na}_2\text{O}$ ,  $12\text{WO}_3+\text{MgO}$ ,  $\text{Na}_2\text{O}$ ,  $3\text{V}_2\text{O}_5+42\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$  (Rothenbach, B. 23. 3054.)

**Potassium** —,  $4\text{K}_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $12\text{WO}_3+30\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

Composition is potassium metatungstate vanadate,  $3(\text{K}_2\text{O}, 4\text{WO}_3)+\text{K}_2\text{O}$ ,  $3\text{V}_2\text{O}_5+30\text{H}_2\text{O}$  (Friedheim, B. 23. 1515.)

$8\text{K}_2\text{O}$ ,  $4\text{V}_2\text{O}_5$ ,  $16\text{WO}_3$ ,  $9\text{H}_2\text{O}+24\text{H}_2\text{O}$  Very efflorescent. Easily sol in  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 214.)

Formula is  $6\text{K}_2\text{O}$ ,  $12\text{WO}_3$ ,  $3\text{V}_2\text{O}_5+24\text{H}_2\text{O}$ , which as a double salt,  $5\text{K}_2\text{O}$ ,  $12\text{WO}_3+\text{K}_2\text{O}$ ,  $3\text{V}_2\text{O}_5$  (Friedheim, B. 23. 1505.)

**Potassium sodium** —,  $(5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3+22\text{H}_2\text{O})$ ,  $4(5\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3+22\text{H}_2\text{O})$  or  $\text{Na}_2\text{O}$ ,  $4\text{K}_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $6\text{WO}_3+22\text{H}_2\text{O}$

(Friedheim and Löwy, Z. anorg. 1894. 6. 22.)

$4(5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3+24\text{H}_2\text{O})$ ,  $3(5\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3+24\text{H}_2\text{O})$  (Friedheim and Löwy)

$5(5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3+24\text{H}_2\text{O})$ ,  $5\text{K}_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $6\text{WO}_3+24\text{H}_2\text{O}$  (Friedheim and Löwy.)

**Silver** —,  $8\text{Ag}_2\text{O}$ ,  $4\text{V}_2\text{O}_5$ ,  $16\text{WO}_3$ ,  $9\text{H}_2\text{O}$ .

Somewhat sol in cold  $\text{H}_2\text{O}$ , more easily upon addition of little  $\text{HNO}_3$ . Decomp. by warm  $\text{H}_2\text{O}$  (Rosenheim, A. 251. 224.)

$3\text{Ag}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $6\text{WO}_3+3\text{H}_2\text{O}$  Nearly insol in cold  $\text{H}_2\text{O}$ . Decomp by addition of  $\text{HNO}_3$  or upon warming (Rosenheim.)

**Sodium** —,  $5\text{Na}_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $6\text{WO}_3+36\text{H}_2\text{O}$ .

Sol in  $\text{H}_2\text{O}$ .

Composition is  $3(\text{Na}_2\text{O}, 2\text{WO}_3)+2(\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5)+36\text{H}_2\text{O}$ . (Friedheim, B. 23. 1527)

$+38\text{H}_2\text{O}$ . Sol in 125 pts.  $\text{H}_2\text{O}$  at  $13.8^\circ$ . (Friedheim and Löwy.)

$2\text{Na}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $3\text{WO}_3+20\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ .

Composition is  $\text{Na}_2\text{O}$ ,  $3\text{WO}_3+\text{Na}_2\text{O}$ ,  $2\text{V}_2\text{O}_5+20\text{H}_2\text{O}$ , double salt of sodium tritungstate and divanadate. (Friedheim, B. 23. 1523.)

$4\text{Na}_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $12\text{WO}_3+38\text{H}_2\text{O}=3(\text{Na}_2\text{O}, 4\text{WO}_3)+\text{Na}_2\text{O}$ ,  $3\text{V}_2\text{O}_5+38\text{H}_2\text{O}$  Sol. in  $\text{H}_2\text{O}$ . (Rothenbach, B. 23. 3050.)

$8\text{Na}_2\text{O}$ ,  $4\text{V}_2\text{O}_5$ ,  $16\text{WO}_3$ ,  $9\text{H}_2\text{O}+48\text{H}_2\text{O}$ .

Efflorescent. Easily sol. in  $H_2O$ . (Rosenheim, A 251. 210.)

Formula is  $6Na_2O, 12WO_3, 3V_2O_5 + 42H_2O$ , and is a double salt of sodium paratungstate,  $5Na_2O, 12WO_3$ , and sodium trivanadate,  $Na_2O, 3V_2O_5$ . (Friedheim, B 23. 1505.)

$7Na_2O, V_2O_5, 12WO_3 + 29H_2O$ . Easily sol in  $H_2O$ . (Friedheim and Löwy, Z anorg. 1894, 8. 15.)

$8Na_2O, V_2O_5, 14WO_3 + 60H_2O$  and  $+66H_2O$  (Friedheim and Löwy.)

Strontium vanadiotungstate,  $19SrO, 36WO_3, 10V_2O_5 + 122H_2O = 3(58SrO, 12WO_3, 2(2SrO, 5V_2O_5) + 122H_2O$ .

Sol. in  $H_2O$ . (Rothenbach, B. 23. 3053.)

Vanadious acid.

See Hypovanadic acid.

Vanadovanadicomolybdic acid.

Ammonium vanadovanadicomolybdate,  $11(NH_4)_2O, 4V_2O_5, VO_3, 28MoO_3 + 48H_2O$ .

Sl. sol in cold, sol. in hot  $H_2O$  without decomp. (Gibbs, Am. Ch. J 5. 391)

Barium —,  $14BaO, 2V_2O_5, 3VO_3, 30MoO_3 + 48H_2O$ .

Precipitate. Very sl. sol in cold, decomp by hot  $H_2O$  (Gibbs)

Vanadovanadicotungstic acid.

Ammonium vanadovanadicotungstate,  $6(NH_4)_2O, 2V_2O_5, 3VO_3, 12WO_3 + 12H_2O$ .

Sol. in  $H_2O$ . (Gibbs, Am. Ch. J. 5. 391.)

Silver —,  $6Ag_2O, 2V_2O_5, 3VO_3, 12WO_3 + 8H_2O$ .

Precipitate. Very sl. sol. in cold, sol in much warm  $H_2O$ . (Gibbs.)

Sodium —,  $6Na_2O, 2V_2O_5, 3VO_3, 12WO_3$ .

Very sol in  $H_2O$ . (Gibbs)

Vanadium, V.

Insol. in  $H_2O$ , HCl, dil.  $H_2SO_4 + Aq$ , and cold conc.  $H_2SO_4$ . Sol. in hot conc.  $H_2SO_4$ . Slowly sol. in HF + Aq. Easily sol. in dil or conc.  $HNO_3 + Aq$ . Not attacked by hot or cold NaOH or KOH + Aq. (Roscoe, A. suppl. 7. 85.)

Does not alter in the air; not acted upon by HCl and very slowly by  $H_2SO_4$ . (Moissan, C. R. 1896, 122. 1299.)

Vanadium boride, VB.

Sol in HF and  $HNO_3$ . Decomp. by fused alkalis. (Wedekind, B. 1913, 46. 1203.)

Vanadium tribromide, VBr<sub>3</sub>.

Very deliquescent; quickly decomposes (Roscoe, A. suppl. 8. 99)

$+6H_2O$ . Sol in  $H_2O$  with decomp. (Loeke and Edwards, Am Ch J 1898, 20. 600.)

Sol. in  $H_2O$ , alcohol and ether. Insol in HBr. (Piccini, Z. anorg. 1899, 19. 398)

Vanadium carbide, VC.

Insol. in HCl and  $H_2SO_4$ .

Sol in  $HNO_3$  in the cold, and in fused  $KNO_3$  and  $KClO_3$ . (Moissan, C. R. 1896, 122. 1300)

Vanadium dichloride, VCl<sub>2</sub>.

Very deliquescent. Sol. in  $H_2O$ , alcohol, and ether. (Roscoe, A. suppl. 7. 79)

Vanadium trichloride, VCl<sub>3</sub>.

Deliquescent. Sol. in  $H_2O$ , absolute alcohol, and ether

$+6H_2O$ . Sol in  $H_2O$ , sl. sol. in conc. HCl + Aq.

Sol. in alcohol and ether. (Piccini, Z. anorg. 1899, 19. 395.)

Vanadium tetrachloride, VCl<sub>4</sub>.

Sol. with decomp. in  $H_2O$ , alcohol, and ether. (Roscoe)

Sol in  $H_2O$  with decomp.

Sol in fuming HCl with decomp

Sol. in anhydrous  $CHCl_3$  or glacial acetic acid apparently without chemical change (Koppell, Z. anorg. 1905, 45. 346.)

Vanadium difluoride, VF<sub>2</sub>.

Sol. in HF with evolution of  $H_2$  and formation of VF<sub>3</sub>. (Manchot, A. 1907, 357. 135)

Vanadium trifluoride, VF<sub>3</sub>.

Nearly insol. in  $H_2O$  and organic solvents. (Ruff, B 1911, 44. 2544.)

$+3H_2O$ . Efflorescent. Easily sol. in cold, extremely sol. in hot  $H_2O$  with decomp. Can be recryst. from HF + Aq. Insol. in strong alcohol. (Petersen, J. pr (2) 40. 48.)

Vanadium tetrafluoride, VF<sub>4</sub>.

Very hygroscopic.

Easily sol. in  $H_2O$

Difficultly sol. in  $SO_2Cl_2$  and  $SiCl_4$

Sol. in  $POCl_3$  with evolution of gas.

Sol. in acetone and acetic acid.

Difficultly sol. in alcohol and  $CHCl_3$ . (Ruff, B. 1911, 44. 2545)

Vanadium pentafluoride, VF<sub>5</sub>.

Easily sol in  $H_2O$ .

Easily sol. in alcohol,  $CHCl_3$ , acetone, and ligroin. Insol. in  $CS_2$ . Decomp. toluene and ether. (Ruff, B. 1911, 44. 2549.)

Vanadium trifluoride with MF.

See Fluovanadate, M.

**Vanadium hydride,**

Stable Does not react with boiling  $H_2O$ .  
Not attacked by boiling  $HCl$ , but oxidized  
by hot  $H_2SO_4$ .  
Sol in boiling  $HNO_3$ . (Muthmann, A.  
1907, 355. 88.)

**Vanadium dihydroxide,  $VO, xH_2O$ .**

Insol in  $KOH$  or  $NaOH + Aq$   
 $V(OH)_3$ . Sol. in  $HCl$  (Locke and Ed-  
wards, Am. Ch. J. 1898, 20. 598.)

**Vanadium trihydroxide,  $V_2O_3, xH_2O$ .**

Easily sol. in all acids. (Petersen, J. pr  
(2) 40. 49.)

**Vanadium tetrahydroxide (Hypovanadic hydroxide),  $V_2O_3(OH)_4 + 6H_2O$ .**

Easily sol. in acids or alkalis. (Crow,  
Chem Soc 30. 453)

**Vanadium triiodide,  $VI_3 + 6H_2O$ .**

Very hygroscopic, sol in  $H_2O$ . Only sl  
sol. in cold conc  $HI + Aq$   
Sol in alcohol (Picman, Z. anorg 1899,  
19. 399)

**Vanadium nitride,  $V_2N$ .**

Insol. in  $H_2O$ ,  $HCl$ , and  $KOH + Aq$  Sol  
in  $HNO_3 + H_2SO_4$ .

Decomp by fusing with  $KOH$ . (Muth-  
mann, A. 1907, 355. 93.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J  
1898, 20. 830)

$VN$ . (Roscoe, A. suppl. 6. 114.)

$VN_2$ . Not attacked by cold  $HNO_3 + Aq$   
(Uhrlaub, Pogg. 103. 134)

**Vanadium dioxide,  $VO$ .**

Insol. in  $H_2O$ ; easily sol in dil. acids  
(Roscoe, A. suppl. 6. 95.)

**Vanadium trioxide,  $V_2O_3$ .**

Oxidized in  $H_2O$  in contact with air and  
then dissolves. Insol. in acids, except  $HNO_3$ ,  
and in alkalis +  $Aq$  (Roscoe, A. suppl. 6.  
99)

Easily sol. in  $HF$  (Petersen, J. pr (2) 40.  
48)

**Vanadium tetroxide,  $VO_2$ .**

Sol in acids and alkalis +  $Aq$ .

**Vanadium pentoxide,  $V_2O_5$ .**

Sol. in about 2000 pts.  $H_2O$  (Berzelius.)  
Sol in acids, alkali hydrates, and carbon-  
ates +  $Aq$  Insol. in absolute, very sl. sol.  
in dil. alcohol.

Insol. in glacial  $HC_2H_3O_4$

Sol in conc.  $KF + Aq$ . (Ditte, C. R. 105.  
1087)

Sol. in  $H_2O_2 + Aq$  and alkali oxalates +  
 $Aq$ . (Haberstadt, Z. anal. 22. 1)

Three modifications.—(a) Forms hydrates

with 2, and  $5H_2O$ : Sol in  $H_2O$ . 1 l of sat.  
solution contains 8 g.  $V_2O_5$ .

( $\beta$ )  $V_2O_5, 2H_2O$ . Very sl sol in  $H_2O$  1 l.  
of sat. solution contains 0.5 g.  $V_2O_5$ .

( $\gamma$ )  $V_2O_5, 5H_2O$  Less sol in  $H_2O$  than  
 $\beta$  1 l.  $H_2O$  contains 0.05 g.  $V_2O_5$  when sat-  
urated (Ditte, C. R. 101. 698.)

See Vanadic acid.

**Vanadium oxide,  $V_2O_5 = 2VO_3, V_2O_5$ .**

See Vanadate, vanadium.

$V_2O_5, V_2O_5 + \frac{2}{3}H_2O$ . (Brierley, Chem  
Soc 49. 30.)

See also Vanadiovanadic acid.

$V_2O_5, 2V_2O_5 + 8H_2O$ .

See Vanadate, vanadium.

**Vanadium pentoxide with MF.**

See Fluoxyvanadate, M.

**Vanadium oxy compounds.**

See Vanadyl compounds.

**Vanadium silicide,  $V_2Si$ .**

Insol. in  $H_2O$ .

Not attacked by  $HCl$ ,  $HNO_3$  or  $H_2SO_4$ .  
Readily attacked by  $HF$

Not attacked by  $KOH + Aq$ ,  $NaOH + Aq$   
or  $NH_4OH$ . Decomp by fused  $KOH$ .

Insol in alcohol, ether and benzene.  
(Moissan, C. R. 1902, 135. 496)

$VSi_3$  Sol. in  $HF$ ; insol. in acids and al-  
kalis.

Decomp by fused  $KOH$ . (Moissan, C. R.  
1902, 135. 78)

**Vanadium disulphide,  $V_2S_3$ .**

Insol in boiling dil or conc.  $HCl$ , dil  
 $H_2SO_4 + Aq$ , or cold conc  $H_2SO_4$ . Easily  
sol. in hot dil or conc.  $HNO_3 + Aq$ , or in  
boiling conc.  $H_2SO_4$ . Insol in alkalis +  $Aq$ .  
Sl sol in  $KSH + Aq$ ; sol. in  $NH_4SH + Aq$ .  
(Kay, Chem Soc. 37. 728.)

**Vanadium trisulphide,  $V_2S_5$ .**

Insol. in cold  $HCl$  or dil.  $H_2SO_4 + Aq$ . Very  
sl. sol. in hot  $HCl$  or dil.  $H_2SO_4 + Aq$ . More  
sol. in  $HNO_3 + Aq$  or conc.  $H_2SO_4$ . Sl. sol  
in  $NaOH$  or  $NH_4OH + Aq$ . Easily sol in  
 $(NH_4)_2S$  or  $NH_4SH + Aq$ , also in  $K_2S + Aq$   
(Kay, Chem Soc 37. 728.)

**Vanadium pentasulphide,  $V_2S_5$ .**

Sl. attacked by hot conc.  $HCl$  or hot dil.  
 $H_2SO_4 + Aq$ ; sol. in hot conc.  $H_2SO_4$ . Sol. in  
hot dil.  $HNO_3 + Aq$ . Sl. sol. in  $NH_4OH + Aq$ ,  
but easily dissolved by  $NaOH + Aq$ . Sl. sol  
in  $Na_2S + Aq$  Sol. in  $NH_4SH + Aq$  (Kay.)

**Vanadium sulphochloride sulphur chloride,  
 $4VSCl_3, S_2Cl_2$ .**

Decomp. in the air. (Koppel, Z. anorg  
1905, 45. 357.)

**Vanadous acid.****Ammonium vanadite, basic,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{V}_2\text{O}_4$ .**

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 1310.)

**Ammonium vanadite,  $(\text{NH}_4)_2\text{V}_2\text{O}_6 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Crow, Chem. Soc. 30. 460.)  
 $+x\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$ .  
 Insol in alcohol, ether and ammonia (Koppel, Z anorg 1903, 36. 297.)  
 $+3\text{H}_2\text{O}$  Easily sol. in  $\text{H}_2\text{O}$ . (Mawrow, Z. anorg. 1907, 55. 150.)

**Barium vanadite,  $\text{BaV}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Ppt (Koppel, Z anorg. 1903, 36. 300.)  
 $+5\text{H}_2\text{O}$ . Precipitate Easily sol in  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ . (Crow, Chem Soc. 30. 460.)

**Lead vanadite,  $\text{PbV}_2\text{O}_6$ .**

Ppt. (Crow.)

**Potassium vanadite,  $\text{K}_2\text{V}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Sol in  $\text{H}_2\text{O}$ .  
 Insol in alcohol, ether and ammonia (Koppel, Z. anorg 1903, 36. 300.)  
 $+7\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Insol. in cold, sol. in hot  $\text{KOH} + \text{Aq}$  Insol. in alcohol. (Crow.)  
 $+ \text{H}_2\text{O}$  (Ditte, C. R. 102. 1310.)

**Silver vanadite,  $\text{Ag}_2\text{V}_2\text{O}_6$ .**

Ppt. (Crow)

**Sodium vanadite,  $\text{Na}_2\text{V}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ .  
 Insol in alcohol, ether and ammonia. (Koppel, Z. anorg. 1903, 36. 299.)  
 $+7\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Crow, Chem. Soc. 30. 459.)

**Vanadosotungstic acid.****Ammonium vanadosotungstate,  $5(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $14\text{WO}_3 + 13\text{H}_2\text{O}$ .**

Very sol in  $\text{H}_2\text{O}$  (E. F. Smith, J Am. Chem. Soc. 1903, 25. 1228)

**Vanadous acid.**

See Hypovanadic acid.

**Vanadovanadic acid.**

See Vanadicovanadic acid.

**Vanadyl bromide,  $\text{VOBr}$ .**

Very sl sol. in  $\text{H}_2\text{O}$ , acetic anhydride, ethyl acetate, and acetone.  
 Insol. in alcohol, ether, acetic acid,  $\text{CHCl}_3$ , toluene and  $\text{CCl}_4$ . (Ruff, B. 1911, 44. 2537.)

**Vanadyl dibromide,  $\text{VOBr}_2$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Roscoe)

**Vanadyl tribromide,  $\text{VOBr}_3$ .**

Very deliquescent, and quickly decomposes in moist air Sol in  $\text{H}_2\text{O}$ . (Roscoe.)

**Vanadyl bromide,  $\text{V}_2\text{O}_5\text{Br}_2$ ,  $2\text{HBr} + 7\text{H}_2\text{O}$ .**

Very deliquescent (Ditte, C. R. 102. 1310.)

**Vanadyl semichloride,  $\text{V}_2\text{O}_5\text{Cl}$ .**

Insol in  $\text{H}_2\text{O}$ . Easily sol in  $\text{HNO}_3 + \text{Aq}$ . (Roscoe, A. suppl 6. 114.)

**Vanadyl monochloride,  $\text{VOCl}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol in  $\text{HNO}_3 + \text{Aq}$ . (Roscoe.)

**Vanadyl dichloride,  $\text{VOCl}_2$ .**

Deliquescent Slowly decomp. by  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$  (Roscoe)

**Vanadyl trichloride,  $\text{VOCl}_3$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol with decomp. (Bedson, A 180. 235.)  
 Sol in ether with combination.

**Divanadyl chloride,  $\text{V}_2\text{O}_5\text{Cl}_2 + 5\text{H}_2\text{O}$ .**

Deliquescent, and sol in  $\text{H}_2\text{O}$ , fuming  $\text{HCl}$ , or alcohol (Crow, Chem. Soc. 30. 457.)

**Vanadyl chloride,  $\text{V}_2\text{O}_5\text{Cl}_2 + 4\text{H}_2\text{O}$ .**

Very deliquescent (Ditte, C. R. 102. 1310)

**Vanadyl platinum chloride.**

See Chloroplatinate, vanadyl.

**Vanadyl trichloride ammonia,  $\text{VOCl}_3, x\text{NH}_3$ .**

Decomp by  $\text{H}_2\text{O}$ . (Roscoe)

**Vanadyl difluoride,  $\text{VOF}_2$ .**

Insol in  $\text{H}_2\text{O}$ . Insol. in alcohol, ether,  $\text{CHCl}_3$ . Sl. sol. in acetone. (Ruff, B. 1911, 44. 2546.)

**Vanadyl trifluoride,  $\text{VOF}_3$ .**

Very hygroscopic Easily sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{POCl}_3$  with evolution of gas. Difficultly sol. in  $\text{PCl}_3$  and  $\text{AsCl}_3$ . Sol. in hot  $\text{CHCl}_3$  and acetic anhydride. (Ruff, B. 1911, 44. 2547)

**Vanadyl fluoride with MF.**

See Fluoxyvanadate, and Fluoxhypovanadate, M.

**Vanadyl iodide,  $\text{V}_2\text{O}_5\text{I}_2, 3\text{HI} + 10\text{H}_2\text{O}$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 1310.)

$\text{V}_2\text{O}_5\text{I}_2, 2\text{HI} + 8\text{H}_2\text{O}$  As above

**Vanadyl sulphide,  $\text{VOS}$  (?).**

(a) Insol. in  $\text{H}_2\text{O}$ , alkalis, alkali sulphides +  $\text{Aq}$ . Sol. in acids, except nitric acid and aqua regia. (Berzelius)

(b) Sol. in alkalis, alkali carbonates, and sulphides + Aq. Insol. in acids. (Berzelius.)

### Water, H<sub>2</sub>O.

Water is the most universal solvent. It absorbs all gases, usually with an increase of volume, seldom, as in the case of NH<sub>3</sub>, with a diminution of volume. It dissolves almost all solids in greater or less quantity, and mixes with or dissolves considerable amounts of many liquids.

Miscible with alcohol. Sol. in 36 pts. ether. Sol. in 30-33 vols. ethyl acetate. (Beckér.)

Sol. in 5 vols. iodhydrin

Sl. sol. in most of the fatty oils

### Solubility in organic solvents at t°.

Solvent	t°	g H <sub>2</sub> O in 100 g of the solution
Benzene	+3	0 030
	23	0 060
	40	0 114
	55	0 184
	68	0 255
	77	0 337
Petroleum bpt. 190-250° at atmos. pressure	-2	0 0012
	+18	0 005
	23	0 007
	30	0 008
	36	0 012
	53	0 026
	59	0 031
	61	0 035
	66	0 043
	79	0 063
	85	0 075
	94	0 097
Paraffin oil bpt. 200-300° at 10 mm. pressure	+16	0 003
	50	0 013
	65	0 022
	73	0 030
	77	0 035
	94	0 055

(Groschuff, Z. Elektrochem, 1911, 17, 350.)

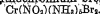
### White precipitate, fusible.

See Mercuridiammonium chloride.

### White precipitate, infusible.

See Mercuris chloramide.

### Xanthochromium bromide,



Sol. in H<sub>2</sub>O. Resembles the chloride (Christensen, J. pr. (2) 24, 74.)

### Carbonate, Cr(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>.

Easily sol. in H<sub>2</sub>O. (Christensen.)

### Xanthochromium chloride,



More sol. in H<sub>2</sub>O than the roseo, but less than the purpleo salt.

Solution decomp. by light or boiling. Decomp. by dil. acids. Sol. in NaOH + Aq and in NH<sub>4</sub>OH + Aq (sp. gr. 0.91). Insol. in alcohol (Christensen, J. pr. (2) 24, 74.)

### chloroplatinate, Cr(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>PtCl<sub>6</sub>.

Insol. in pure H<sub>2</sub>O, but sol. when warmed with H<sub>2</sub>O containing HCl, with formation of a new double salt. (Christensen)

### mercuric chloride, Cr(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>Cl<sub>2</sub>, 2HgCl<sub>2</sub>.

Precipitate. Decomp. by long contact with H<sub>2</sub>O (Christensen.)

### chromate, Cr(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>CrO<sub>4</sub>.

Difficultly sol. in H<sub>2</sub>O. (Christensen)

### dichromate, Cr(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>.

Difficultly sol. in H<sub>2</sub>O (Christensen.)

### dithionate, Cr(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub>.

Insol. in cold H<sub>2</sub>O. (Christensen)

### hydroxide, Cr(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>(OH)<sub>2</sub>.

Known only in solution. (Christensen.)

### iodide, Cr(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>I<sub>2</sub>.

Quite difficultly sol. in H<sub>2</sub>O. (Christensen.)

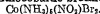
### nitrate, Cr(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.

Sol. in about 150 pts H<sub>2</sub>O. (Christensen.)

### sulphate, Cr(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> + H<sub>2</sub>O.

Sol. in H<sub>2</sub>O and (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> + Aq (Christensen.)

### Xanthocobaltic bromide,



Easily sol. in cold H<sub>2</sub>O. (Werner and Miolati, Gazz. ch. it 23, 2, 140)

### bromonitrate, Co(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>(NO<sub>2</sub>)Br.

Sl. sol. in cold, more easily in hot H<sub>2</sub>O. (Gibbs)

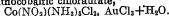
### chloride, Co(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>Cl<sub>2</sub>.

Sl. sol. in cold H<sub>2</sub>O, and decomp. by boiling therewith. Insol. in HCl + Aq and alkali chlorides + Aq. Easily decomp. by boiling with acids, even dilute (Gibbs and Genth)

Sol. in 50 pts cold H<sub>2</sub>O. (Joigensen, Z. anorg. 5, 172.)

### mercuric chloride, Co(NO<sub>2</sub>)(NH<sub>4</sub>)<sub>2</sub>Cl<sub>2</sub>, 2HgCl<sub>2</sub> + H<sub>2</sub>O.

Insol. in cold, sl. sol. in hot H<sub>2</sub>O without decomp. More sol. in acidified H<sub>2</sub>O. (Gibbs and Genth)

**Xanthocobaltic chloraurate,**

Can be easily crystallised out of hot  $\text{H}_2\text{O}$  (Gibbs and Genth, *Sill Am J* (2) **24**, 90.)

— chloronitrate,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2(\text{NO}_2)_2\text{Cl}$ .  
Sl. sol in cold, more easily in hot  $\text{H}_2\text{O}$ .

— chloronitrate gold chloride,  
 $\text{Co}(\text{NO}_2)(\text{NH}_3)_2(\text{NO}_2)_2\text{Cl}$ ,  $\text{AuCl}_3$ .

— chloronitrate platinic chloride,  
 $2\text{Co}(\text{NO}_2)(\text{NH}_3)_2(\text{NO}_2)_2\text{Cl}$ ,  $\text{PtCl}_4$ .

— chloroplatinate,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{Cl}_3$ ,  
 $\text{PtCl}_4 + \text{H}_2\text{O}$ .

Scarcely sol. in hot or cold  $\text{H}_2\text{O}$ . Can be recryst. from dil.  $\text{HNO}_3 + \text{Aq}$ . Sol. in hot dil.  $\text{HCl} + \text{Aq}$ . (Gibbs and Genth, *Sill Am. J* (2) **24**, 91.)

— chromate,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{CrO}_4 + \text{H}_2\text{O}$   
Very sl. sol. in cold, and but slightly sol. in hot  $\text{H}_2\text{O}$ . (Gibbs)

— dichromate,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{Cr}_2\text{O}_7$ .  
Easily sol. in hot  $\text{H}_2\text{O}$

— ferrocyanide,  $[\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{Fe}(\text{CN})_6] + 7\text{H}_2\text{O}$ .  
Nearly insol in cold, decomp. by warm  $\text{H}_2\text{O}$  +  $6\text{H}_2\text{O}$ . (Braun, A. **132**, 47.)

— iodide,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{I}_3$ .  
Sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— iodosulphate,  
 $[\text{Co}(\text{NO}_2)(\text{NH}_3)_2]_2(\text{SO}_4)_2\text{I}_2$   
Sol. in  $\text{H}_2\text{O}$

— periodosulphate,  
 $[\text{Co}(\text{NO}_2)(\text{NH}_3)_2]_2(\text{SO}_4)_2\text{I}_4$ .  
Easily decomp. by hot  $\text{H}_2\text{O}$

— nitrate,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2(\text{NO}_3)_2$ .  
Sl. sol. in cold, moderately sol. in hot  $\text{H}_2\text{O}$ . Decomp. by boiling. Much less sol. than  $\text{NH}_4\text{Cl}$  or  $(\text{NH}_4)_2\text{SO}_4$  in cold  $\text{H}_2\text{O}$ . Insol. in  $\text{HNO}_3$ . (Gibbs and Genth.)

— nitrite,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2(\text{NO})_2 + 2\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Gibbs)

— cobaltic nitrite,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2(\text{NO}_2)_2 + 2\text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs, *Proc Am. Acad.* **11**, 8.)  
Is nitratopurpureocobaltic cobaltic nitrite,

$[\text{Co}(\text{NO}_2)(\text{NH}_3)_2]_2[\text{Co}(\text{NO}_2)_2]_2 + 2\text{H}_2\text{O}$  (Jørgensen, *Z. anorg.* **5**, 175.)

$[\text{Co}(\text{NO}_2)(\text{NH}_3)_2]_2[\text{Co}(\text{NO}_2)_2]_2$ . Not so difficultly sol. as the luteo salt. (Jørgensen.)

**Xanthocobaltic tetramine cobaltic nitrite,**  
 $\text{Co}_2(\text{NO}_2)_2(\text{NH}_3)_{12}[\text{Co}_2(\text{NH}_3)_4(\text{NO}_2)_8]_2$ .

Can be recryst. from hot  $\text{H}_2\text{O}$ . (Gibbs, *Proc. Am Acad.* **11**, 8.)

$= (\text{NO}_2)_2\text{Co}(\text{NH}_3)_4[(\text{NO}_2)_2(\text{NH}_3)_2\text{Co}(\text{NO}_2)_2]_2$ .  
Xanthocobaltic diamine cobaltic nitrite.  
Very sl. sol. in cold  $\text{H}_2\text{O}$  (Jørgensen, *Z anorg.* **5**, 180.)

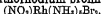
— oxalate,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{C}_2\text{O}_4$ .

Nearly insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$

— sulphate,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{SO}_4$ .

Moderately sol. in hot, much less in cold  $\text{H}_2\text{O}$ . Sol. without decomp. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Gibbs and Genth)

Sol. in 25 pts hot  $\text{H}_2\text{O}$  acidified with  $\text{HC}_2\text{H}_3\text{O}_2$  (Jørgensen, *Z. anorg.* **5**, 172)  
 $4\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{SO}_4, 3\text{H}_2\text{SO}_4$ . Decomp. by  $\text{H}_2\text{O}$ , not by absolute alcohol (Jørgensen.)

**Xanthorhodium bromide,**

Moderately sol. in  $\text{H}_2\text{O}$ . (Jørgensen, *J pr* (2) **34**, 394)

— chloride,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_2\text{Cl}_3$ .

Much more sol. in  $\text{H}_2\text{O}$  than the nitrate

— chloroplatinate,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_2\text{PtCl}_3$ .  
Ppt. Extremely sl. sol. in cold  $\text{H}_2\text{O}$

— dithionate,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_2\text{S}_2\text{O}_6 + \text{H}_2\text{O}$ .  
Nearly insol. in  $\text{H}_2\text{O}$ .

— fluosilicate,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_2\text{SiF}_6$ .  
Ppt.

— hydroxide,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_2(\text{OH})_2$ .

— nitrate,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_2(\text{NO}_3)_2$ .

Moderately sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Insol. in alcohol. Less sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$

Insol. in dil.  $\text{HNO}_3 + \text{Aq}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$  of 1.4 sp. gr.

— oxalate,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_2\text{C}_2\text{O}_4$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . Very sl. sol. in warm  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ .

— sulphate,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_2\text{SO}_4$ .

Slowly sol. in cold, quite easily in hot  $\text{H}_2\text{O}$   
 $4(\text{NO}_2)\text{Rh}(\text{NH}_3)_2\text{SO}_4, 3\text{H}_2\text{SO}_4$ . Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Can be recrystallized from dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

**Xenon, Xe.**Absorption by  $H_2O$  at  $t^\circ$ .

$t^\circ$	Absorption coefficient
0	0 2189
10	0 1500
20	0 1109
30	0 0900
40	0 0812
50	0 0878

(Antropoff, Roy. Soc. Proc. 1910, **83**, A, 480.)**Ytterbium, Yb.****Ytterbium bromide,  $YbBr_2 \cdot 8H_2O$ .**Very sol. in  $H_2O$  Hydroscopic. (Cleve, Z. anorg. 1902, **32**, 135.)**Ytterbium chloride,  $YbCl_3 \cdot 6H_2O$ .**Very sol. in  $H_2O$ . (Cleve, Z. anorg 1902, **32**, 134.)Mpt. 150-155°. Anhydrous salt is sol in  $H_2O$  and in alcohol. (Matignon, A ch 1906, (8) 8. 442.)**Ytterbium oxide,  $Yb_2O_3$ .**

Slowly attacked by cold or warm acids, but easily sol at 100°

**Ytterbium oxychloride,  $YbOCl$ .**Ppt. (Cleve, Z. anorg. 1902, **32**, 135.)**Yttrium, Y**Decomposes  $H_2O$ . (Cleve, Bull. Soc. (2) **21**, 344.) Decomp.  $H_2O$  slightly at ord. temp., more rapidly by boiling. Easily sol. in dil acids, even acetic acid. Slightly acted upon by conc.  $H_2SO_4$ . Decomposes hot  $KOH$  + Aq and cold  $NH_4Cl$  + Aq. Not attacked by  $NH_4OH$  + Aq (Popp, A **131**, 179.)

Popp's yttrium contained erbium

**Yttrium bromide,  $YBr_3$ .**Sol in  $H_2O$  with evolution of heat (Duboin, C. R. **107**, 243.)+  $9H_2O$ . Deliquescent. Easily sol in  $H_2O$  and alcohol. Insol. in ether. (Cleve)**Yttrium carbide,  $YC_2$ .**Decomp by  $H_2O$  and by dil acids; very slowly attacked by conc. acids. (Moissan, C. R. **1896**, **122**, 575.)Decomp by  $H_2O$  and dil. acids. (Pettersson, B. **1895**, **28**, 2421.)**Yttrium chloride,  $YCl_3$ .**Anhydrous. Sol. in  $H_2O$  with evolution of heat. (Cleve.)+  $6H_2O$ . Deliquescent. Very sol in  $H_2O$ . Sl. sol. in alcohol. Insol. in ether. (Cleve.) Mpt. 156-160°; sol. in alcohol.

60.1 grams anhydrous salt are sol. in 100 grams of abs. alcohol at 15°.

6.5 grams are sol in 100 grams pyridine. (Matignon, A ch. 1906, (8) 8. 437.)

**Yttrium fluoride,  $YF_3 \cdot \frac{1}{2}H_2O$ .**

Nearly insol. in dil. acids (Cleve.)

**Yttrium hydroxide,  $Y_2O_3$ ,  $6H_2O$  or  $Y_2O_3H_2O + 3H_2O$ .**Insol in  $H_2O$ .Insol in  $KOH$  or  $NaOH$  + Aq. Easily sol. in acids. Sol. in alkali carbonates + Aq. When freshly pptd., easily sol. in  $NH_4Cl$  + Aq**Yttrium iodide,  $YI_3$ .**Very deliquescent. Easily sol. in  $H_2O$  and alcohol

Sl. sol. in ether (Cleve)

**Yttrium oxide,  $Y_2O_3$ .**Insol. in  $H_2O$  Sl. sol. in cold  $HCl$ ,  $HNO_3$ , or dil  $H_2SO_4$  + Aq, but gradually completely sol. on warming. Insol. in  $NH_4OH$  and sl sol in  $KOH$  + Aq Sol. in  $HCl$ ,  $H_2O_2$  + Aq Somewhat sol in  $K_2CO_3$  + Aq**Yttrium peroxide,  $Y_2O_5$ .**(Cleve, Bull. Soc. (2) **43**, 53.)**Yttrium oxychloride,  $Y_2O_2Cl_2$ .**Insol in  $H_2O$ . (Popp.)**Yttrium sulphide,  $Y_2S_3$ .**Not prepared in pure state. Impure is insol. in  $H_2O$ , and partially decomp. thereby. Easily sol in acids with decomp (Popp.)**Zinc, Zn.**Not attacked by pure cold  $H_2O$ . Slowly oxidised by boiling  $H_2O$  Pure  $H_2O$  free from  $O$  dissolved nothing from 2500 sq. mm. Zn Presence of air containing  $CO_2$  caused a solution of 3.5 mg. Zn, which maximum was reached in 2 days Air without  $CO_2$  also caused a slight action (Snyders, B. **11**, 936.)100 ccm distilled  $H_2O$  dissolved 14 mg Zn from 11.8 sq cm in one week, during which air free from  $CO_2$  was passed through the liquid, and 19 mg. when air containing  $CO_2$  was used. (Wagner, Dngl. **221**, 260.)Filtered rain water was found to contain 20 mg. Zn per l (Burg, Isis, **1873**, 119.)Very pure  $H_2O$ , when conducted through a great length of galvanized iron pipe, contained 1.7 pts. Zn to 100,000 pts  $H_2O$ . (Davies, J. Soc. Chem. Ind. **1899**, **18**, 102.)Action of  $H_2O$  on Zn in galvanized pipes is caused by electrolysis (Smetham, C. N. **1879**, **39**, 236.)All kinds of  $H_2O$  attack Zn, rain water the leastIn distilled  $H_2O$  exposed to air Zn is abun-

dantly coated with  $\text{ZnCO}_3 \cdot 2\text{ZnO} + 3\text{H}_2\text{O}$ . By allowing 32 g Zn to stand in 270 cc. distilled  $\text{H}_2\text{O}$  in a flask loosely stoppered with filter paper, 12 pts. Zn to 100,000 pts  $\text{H}_2\text{O}$  was found in solution in 1-2 days (Smith, J. Soc Chem Ind 1904, 23, 475.)

Sol in all acids. Very slowly sol in dil HCl or  $\text{H}_2\text{SO}_4 + \text{Aq}$  in glass vessels if Zn is pure. According to Jacquelin, 24 hours were necessary to dissolve 6 g. pure zinc. When fused at the lowest possible temperature, it is much more slowly sol than when heated to a red heat. In both cases it is much more rapidly dissolved if cooled quickly. (Bolley, A. 95, 294, Rammelsberg.)

Dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  dissolves given % zinc in the same length of time (B=according to Bolley, R=according to Rammelsberg)

	Slowly cooled		Rapidly cooled	
	B	R	B	R
Cast at the melting point	42.5	74.1	13.0	0.9
Cast at a red heat	100.0	69.4	85.5	9.5

50 ccm.  $\text{H}_2\text{SO}_4 + \text{Aq}$  dissolved in 2 hours the following amts from 1 sq. cm Zn at t°.

t°	Strength of acid	Grms dissolved
20	$\text{H}_2\text{SO}_4$	0.000
130	"	0.075
150	"	0.232
20	$\text{H}_2\text{SO}_4 + \text{H}_2\text{O}$	0.002
130	"	0.142
150	"	0.345
20	$\text{H}_2\text{SO}_4 + 2\text{H}_2\text{O}$	0.002
130	"	4.918
150	"	5.450
20	$\text{H}_2\text{SO}_4 + 3\text{H}_2\text{O}$	0.005
130	"	3.080
20	$\text{H}_2\text{SO}_4 + 4\text{H}_2\text{O}$	0.049
130	"	0.456
20	$\text{H}_2\text{SO}_4 + 5\text{H}_2\text{O}$	0.027
130	"	0.337
20	$\text{H}_2\text{SO}_4 + 6\text{H}_2\text{O}$	0.018
100	"	3.16

(Calvert and Johnson, Chem Soc. 19, 437.)

C P. zinc is more quickly sol. in dil acids in vacuo than under normal pressure, the ratio being about 1:6.5. The rate of solubility increases slowly with rise of temp from 0° to 98°, when it amounts to about 4 times that at 0°, but from 98°-100° the increase is thirteenfold. Thus, as an average of 6 experiments, dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  (1:20) dissolves in 30 minutes 2.1 mg. Zn at 0°; 4.9 mg. at 20°; 7.4 mg. at 60°; 9.3 mg. at 98°; but 122.1 mg. at 100°. If, however, the acid was prevented from boiling by increasing the pressure, the sudden increase between 98° and 100° does not take place.

The rate of solubility in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (1:20) is also increased 175 times by the addition of  $\text{CrO}_3$  and 306 times by the addition of  $\text{H}_2\text{O}_2$ . The above phenomena are explained by assuming the formation of a condensed hydrogen atmosphere around the metal, which prevents the further action of the acid. (Weeren, B. 24, 1785.)

Not attacked by  $\text{HNO}_3 + \text{Aq}$  of 1.512 to 1.419 sp. gr. at a temp of -18° or less, but violently attacked if temp is raised.  $\text{HNO}_3 + \text{Aq}$  of 1.419-1.401 sp. gr. does not attack Zn at temp of a freezing mixture, but violently at 0°. More dil  $\text{HNO}_3 + \text{Aq}$  attacks Zn even at -20°. (Millon, A. ch. (3) 6, 99.)

Sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ . (Berzelius.)

Solubility of Zn in acids is very much affected by the presence of small quantities of various metallic salts. Small amts. of  $\text{PtCl}_4 + \text{Aq}$  accelerated the action of  $\text{H}_2\text{SO}_4 + \text{Aq}$  149 times, and  $\text{As}_2\text{O}_3$  123 times.  $\text{HgCl}_2$  has a strong retarding action owing to pptn of Hg on the Zn.

The rate of solution of Zn in acids and the effect of changes in concentration and temperature and of the presence of inorganic salts and organic substances on this rate has been studied. 26 Tables are given. (Ericson-Aurén, Z. anorg. 1901, 27, 209-253.)

Speed of solution in  $\text{H}_2\text{SO}_4$  and in HCl (Centnerszwei, Z. phys. Ch. 1914, 87, 692.)

Various saline solutions have a strong solvent power in presence of  $\text{PtCl}_4$ , i.e. KCl, NaCl,  $\text{Na}_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{MgSO}_4 + \text{Aq}$ .  $\text{PtCl}_4$  also causes Zn to decompose distilled  $\text{H}_2\text{O}$ .  $\text{CuSO}_4$  has a similar but less energetic effect.

In all the above cases the disengagement of hydrogen is slower in the dark than in the light. (Millon, C. R. 21, 37.)

According to Baieswill (C. R. 21, 292) the above reactions are all caused by galvanic action due to pptd metal, and a piece of Pt in contact with the Zn causes the same action as the  $\text{PtCl}_4$  in solution.

\* Easily sol. in alkalis + Aq, even  $\text{NH}_4\text{OH} + \text{Aq}$ , especially when the Zn is in contact with Fe. Sol. in NaCl + Aq with pptn of ZnO. (Siersch, J. B. 1867, 257.)

Sol. in sat alkali and alkali-earth chlorides + Aq. (Post, 1872.)

Sol. in  $\text{NH}_4$  salts + Aq. (Lorm, J. B. 1865, 124.)

Sol in sat  $\text{Na}_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{MgSO}_4$ ,  $\text{NaNO}_3$ ,  $\text{KNO}_3$ ,  $\text{Ba(NO}_3)_2$ ,  $\text{CaCl}_2$ ,  $\text{MgCl}_2$ , and  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . Chlorides and sulphates (especially  $\text{Na}_2\text{SO}_4$  and  $\text{MgCl}_2$ ) have strongest action,  $\text{MgSO}_4$  and nitrates the least. The action was greatly increased by heat. (Snyders, B. 11, 936.)

Sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in neutral  $\text{FeCl}_3 + \text{Aq}$  with pptn. of Fe, especially easily at 100°. (Capitaine, C. R. 9, 737.)

Sol. in  $\text{NiSO}_4 + \text{Aq}$  with pptn of NiO. (Tupputu.)

Sol. in conc hot  $\text{ZnCl}_2 + \text{Aq}$ , but Zn oxy-

chloride is pptd on diluting. (Ordway, Am J. Sci (2) 23. 222.)

Sol. in  $\text{GISO}_4 + \text{Aq.}$  (Debray)

Solubility of Zn in dilute solutions of salts. 100 cem. of solutions of the given salts were allowed to act one week on 11.8 sq cm. Zn while a current of air with or without  $\text{CO}_2$  was passed through the solution

Salt	G salt in 100 cem solution	Mg. Zn dissolved without $\text{CO}_2$	Mg. Zn dissolved with $\text{CO}_2$
NaCl or KCl	0.5	7	38
$\text{NH}_4\text{Cl}$	1.0	51	36
$\text{MgCl}_2$	0.83	18	54
$\text{K}_2\text{SO}_4$	1.0	30	53
$\text{KNO}_3$	1.0	9	37
$\text{Na}_2\text{CO}_3$	1.0	13	
$\text{NaOH}$	0.923	60	
$\text{CaO}_2\text{H}_2$	Sat	3	

(Wagner, Dingl. 221. 260.)

Action of dil. salt solutions (1%) on Zn. The following amts. of Zn in mg. were dissolved from 2500 sq mm Zn in 14 days by 400 cem. 1% solution of the given salts:

Salt	Mg Zn	Salt	Mg. Zn
NaCl	11.2	$\text{NaNO}_3$	6
KCl	14.8	$\text{Ba(NO}_3)_2$	8
$\text{CaCl}_2$	15.2	$\text{NH}_4\text{Cl}$	24.0
$\text{MgCl}_2$	17.2	$(\text{NH}_4)_2\text{SO}_4$	31.6
$\text{BaCl}_2$	13.2	$\text{NH}_4\text{NO}_3$	26.0
$\text{K}_2\text{SO}_4$	12.0	$\text{NaHCO}_3$	0
$\text{MgSO}_4$	8.8	$\text{K}_2\text{CO}_3$	0
$\text{KNO}_3$	6.8	$\text{Na}_2\text{CO}_3$	0

Sl. attacked by  $\text{H}_2\text{O}$  at  $80^\circ$ , by hot conc.  $\text{NH}_4\text{OH}$ ; attacked by  $\text{H}_3\text{PO}_4$  or  $\text{NaCl} + \text{Aq.}$  very al. attacked by  $\text{NaNO}_3 + \text{Aq.}$  or  $\text{KNO}_3 + \text{Aq.}$  at  $100^\circ$ . (Smith, J. Soc. Chem Ind. 1904, 23. 476.)

$\frac{1}{2}$  cem. oleic acid dissolves 0.0240 g. Zn in 6 days. (Gates, J. phys. Chem 1911, 15. 143.)

Attacked by cane sugar + Aq. at  $115^\circ$  (Klein and Berg, C. R. 102. 1170.)

#### Zinc amide, $\text{Zn(NH}_2)_2$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol. Insol. in ether (Frankland, Phil Mag (4) 15. 149)

#### Zinc antimonide, $\text{ZnSb}_2$ .

Does not decomp boiling  $\text{H}_2\text{O}$  except slightly. Not attacked by dil. mineral acids, but decomp by conc.  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$  (Cooke, Proc Am Acad. 5. 348)

$\text{ZnSb}_2$  Decomp.  $\text{H}_2\text{O}$  rapidly at  $100^\circ$

Violently decomp. by dil  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq.}$  also by  $\text{HNO}_3 + \text{Aq.}$  Completely sol. in  $\text{HCl} + \text{Aq.}$  mixed with a little  $\text{HNO}_3$  (Cooke)

#### Zinc azoimide, basic, $\text{Zn(OH)N}_3$ .

Very al. sol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Curtius, J. pr. 1898, (2) 58. 293)

#### Zinc azoimide ammonia, $\text{ZnN}_6 \cdot 2\text{NH}_3$ .

Insol. in  $\text{H}_2\text{O}$ ; but gradually decomp. thereby. (Dennis, J. Am. Chem. Soc. 1907 29. 20.)

#### Zinc bromide, $\text{ZnBr}_2$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

Sat.  $\text{ZnBr}_2 + \text{Aq}$  contains at:

$-20^\circ$   $+4^\circ$   $22^\circ$   $97^\circ$   
66.3 68.8 77.5 83.6%  $\text{ZnBr}_2$

$107^\circ$   $170^\circ$   $210^\circ$   $375^\circ$  (mpt.)  
83.8 85.0 89.3 100%  $\text{ZnBr}_2$

(Ftard, A. ch. 1894, (7) 2. 541.)

#### Solubility in $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

$35^\circ$   $40^\circ$   $60^\circ$   $80^\circ$   $100^\circ$   
85.45 85.53 86.08 86.57 87.05 g.  $\text{ZnBr}_2$   
(Dietz, Z. anorg. 1899, 20. 250.)

See also below under hydrated salts

Sp. gr. of  $\text{ZnBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing

18.3 31.7 43.2 %  $\text{ZnBr}_2$   
1.1849 1.3519 1.5276

52.6 59.1 68 %  $\text{ZnBr}_2$   
1.7082 1.8525 2.1027

(Kremers, Pogg. 108. 117.)

Sp. gr. of  $\text{ZnBr}_2 + \text{Aq}$  at  $19.5^\circ$ .

% $\text{ZnBr}_2$	Sp. gr	% $\text{ZnBr}_2$	Sp. gr.	% $\text{ZnBr}_2$	Sp. gr
5	1.045	25	1.265	45	1.560
10	1.093	30	1.330	50	1.650
15	1.196	35	1.400	55	1.755
20	1.204	40	1.475	60	1.875

(Kremers, calculated by Gerlach, Z. anal. 8. 285)

Sol in conc  $\text{HCl}$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  also in  $\text{NH}_4\text{OH} + \text{Aq.}$

Sol in  $\text{AlBr}_3$ . (Isbekow, Z anorg 1913. 84. 27)

Very sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830)

Sol in alcohol and ether. (Berthelot, J. Pharm 14. 610)

Sol in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B 1910, 43. 314.)

More sol. in anhydrous ether than in abs alcohol. Insol in  $\text{CS}_2$ . (Hampe, Ch. Z. 1887, 11. 846.)

Sol in quinoline (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, 15. 22.)

+  $\text{H}_2\text{O}$ . (Lescœur, A. ch. 1894, (7) 2. 78.)

+  $2\text{H}_2\text{O}$ . Very hygroscopic

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

-8° 0° 13° 25° 30° 37° (mpt.)  
79.06 79.55 80.76 82.46 84.08 86.20 g.  $\text{ZnBr}_2$ .  
(Dietz, Z. anorg. 1899, 20. 250.)

+  $3\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

-15° -10° -5° (mpt.)  
77.13 78.45 80.64 g.  $\text{ZnBr}_2$   
(Dietz, Z. anorg. 1899, 20. 250.)

Zinc bromide ammonia,  $\text{ZnBr}_2 \cdot 2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in cold, more easily in warm  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rammelsberg, Pogg. 55. 240.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{ZnO}$ . (André C. R. 96. 703.)

+  $\text{H}_2\text{O}$  Above salt of Rammelsberg's has this composition. (André.)

$3\text{ZnBr}_2 \cdot 8\text{NH}_3 + 2\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . (André.)

$3\text{ZnBr}_2 \cdot 10\text{NH}_3 + \text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . (André.)

$2\text{ZnBr}_2 \cdot 10\text{NH}_3$  Efflorescent. Decomp. by  $\text{H}_2\text{O}$ . (André.)

Zinc bromide cupric oxide,  $\text{ZnBr}_2 \cdot 3\text{CuO} + 2\text{H}_2\text{O}$ .

+  $4\text{H}_2\text{O}$  (Mailhe, C. R. 1901, 133. 227.)

Zinc bromide hydrazine,  $\text{ZnBr}_2 \cdot 2\text{N}_2\text{H}_4$ .

Decomp. by  $\text{H}_2\text{O}$ .

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z. anorg. 1908, 60. 277.)

Zinc chloride,  $\text{ZnCl}_2$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$

Sol in 0.333 pt  $\text{H}_2\text{O}$  at 18.75° Abl.)

$\text{ZnCl}_2 + \text{Aq}$  sat. at 12.5° contains 78.5%  $\text{ZnCl}_2$  (Hassenfratz, A. ch. 28. 291.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

15° 20° 41° 60° 100°  
79.12 81.19 82.21 83.51 86.01 g.  $\text{ZnCl}_2$ .  
(Dietz, Z. anorg. 1899, 20. 245.)

$\text{ZnCl}_2 + \text{Aq}$  containing 1 pt  $\text{ZnCl}_2$  in 1.8205 pts.  $\text{H}_2\text{O}$  at 18° has sp. gr. = 1.3666. (Hit-  
torf, Z. phys. Ch. 1902, 39. 628.)

Solubility in  $\text{H}_2\text{O}$  at t°.  
100 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{ZnCl}_2$ .

t°	Solid phase	% $\text{ZnCl}_2$	
-5	ice	14	
-10		25	
-40		83	
-62	ice 4aq	104	cryohydrate point
-50	$\text{ZnCl}_2 + 4\text{H}_2\text{O}$	113	
-40		127	
-30	4aq 3aq	180	transition point
-10	$\text{ZnCl}_2 + 3\text{H}_2\text{O}$	189	
0		208	
+5		230	
8.5		252	mpt
5		282	
0	3aq 1½aq	309	eutectic point
	$\text{ZnCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$	255	
6.5	2½aq 3aq	262	transition point
10	$\text{ZnCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$	272	
12.5		303	mpt
11.5	2½aq 1½aq	335	eutectic point
9	2½aq 1aq	360	eutectic point
6	$\text{ZnCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$	385	
-6	$\text{ZnCl}_2 + 1\frac{1}{2}\text{H}_2\text{O}$	298	
+10		330	
20		368	
28	1½aq 1aq	423	transition point
28.3	1½aq $\text{ZnCl}_2$	433	transition point
0	$\text{ZnCl}_2 + \text{H}_2\text{O}$	342	
10		364	
20		366	
28	1aq $\text{ZnCl}_2$	436	transition point
31	$\text{ZnCl}_2 + \text{H}_2\text{O}$	477	
25	$\text{ZnCl}_2$	432	
40		462	
60		488	
80		543	
100		615	
202			mpt.

(Mylius and Dietz, Z. anorg. 1905, 44. 217.)

See also below under hydrated salts

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$  at 19.5°

% $\text{ZnCl}_2$	Sp. gr.	% $\text{ZnCl}_2$	Sp. gr.
13.8	1.1275	37.5	1.3859
25.8	1.2466	49.2	1.5551

(Kremers, Pogg. 105. 360.)

• Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$  at 19.5°.

% $\text{ZnCl}_2$	Sp. gr.	% $\text{ZnCl}_2$	Sp. gr.	% $\text{ZnCl}_2$	Sp. gr.
1	1.010	25	1.238	45	1.488
5	1.045	30	1.291	50	1.566
10	1.091	35	1.352	55	1.650
15	1.137	40	1.420	60	1.740
20	1.186				

(Gerlach, Z. anal. 8. 283, calculated from Kremers)

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$  at t°.

t°	15°	15°	15°	15°
% $\text{ZnCl}_2$	2.5	4.89	10.0	20.0
Sp. gr.	1.024	1.046	1.094	1.190
t°	15°	15°	15°	
% $\text{ZnCl}_2$	20.86	40.0	58.88	
Sp. gr.	1.297	1.423	1.728	

(Long, W. Ann. 1880, 11. 38.)

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$  at room temp. containing:

15 334	23 487	33 752%	$\text{ZnCl}_2$ .
1 1459	1 2288	1 3431	

(Wagner, W. Ann. 1883, 18. 267)

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$  at 25°.

Concentration of $\text{ZnCl}_2 + \text{Aq}$	Sp. gr.
1—normal	1 0590
1/2—"	1 0302
1/3—"	1 0152
1/4—"	1 0077

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$

1/2 $\text{ZnCl}_2$ g. in 1000 g. of solution	Sp. gr. 16°/16°
0	1 000000
0 5994	1 000560
2 3163	1 002163
5 0406	1 004708
9 8988	1 009243
19 4914	1 018228

(Dyken, Z. phys. Ch. 1897, 24. 108.)

Insol. in  $\text{SbCl}_3$  (Klemensiewicz, C. C. 1908, II 1850)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Easily sol. in hot absolute alcohol, and ether. Sol. in 1 pt. strong alcohol at 12.5° (Wenzel)

Sol in 0.35 pt absolute alcohol. (Graham)

Sol in butyl (Wurtz), and hexyl (Bouis) alcohol at ord. temp., but decomp. on heating

Very sol in acetic ether with evolution of heat. (Cann, C. R. 102. 363)

Easily sol in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

1 g.  $\text{ZnCl}_2$  is sol in 2.3 g acetone at 18°.

Sp. gr. of sat solution 18°/4° = 1.14 (Naumann, B. 1904, 37. 4338.)

Sol in acetone and in methylal (Eidmann, C. C. 1899, II 1014)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Sol. in hot benzonitrile, also in other aromatic nitriles.

Sol. in methyl sulphide and in ethyl sulphide. Very sol. in piperidine. (Werner, Z. anorg. 1897, 15. 7.)

Sol. in benzylalcohol, furfural, methylpropylketone, acetophenone, ethyl monochloracetate, ethyl cyanacetate, ethyl acetoacetate, ethyl benzoate, ethyl oxalate, amyl nitrite, pyridine, piperidine, and quinoline.

Insol. in salicylic aldehyde, ethyl nitrate, and nitrobenzene. (Lincoln, J. phys. Chem. 1899, 3. 460)

Sol. in quinoline (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Sol. in 2 pts. glycerine at ord temp. (Clever, Bull. Soc. 1872, (2) 18. 372)

100 g. glycerol dissolve 50 g.  $\text{ZnCl}_2$  at 15.5°. (Ossendowski, Pharm. J. 1907, 79. 575.)

Insol in  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257)

Sol. in urethane. (Castoro, Z. anorg. 1899, 20. 61)

Mol weight determined in piperidine; pyridine and methyl sulphide. (Werner, Z. anorg. 1897, 15. 18.)

+ $\text{H}_2\text{O}$ . Very deliquescent. Contains 1 1/2  $\text{H}_2\text{O}$  (Engel, C. R. 102. 1111.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

0°	11°	27° (mpt)
74 33	78 25	84 61 g. $\text{ZnCl}_2$ .

(Dietz, Z. anorg. 1899, 20. 245.)

+1 1/2  $\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

0°	10°	20°	26° (mpt)
67 45	73 65	80 08	83 43 g. $\text{ZnCl}_2$ .

(Dietz, Z. anorg. 1899, 20. 245.)

+2 $\text{H}_2\text{O}$ . Sat. aq. solution contains at.

-20°	-14°	-10°	-4°	-1°
54 7	55 4	56 5	57.4	57.9% salt,

+5°	9°	15°	33°	49°
59 1	60 2	62 0	66 8	68 3% salt.

(Etard, A. ch. 1894, (7) 2. 536.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

0°	10°	19° (mpt)
67 56	73.70	79 07 g. $\text{ZnCl}_2$ .

(Dietz, Z. anorg. 1899, 20. 245)

+2 1/2  $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

0°	8°	13° (mpt.)
67.42	71 96	75 14 g. $\text{ZnCl}_2$ .

(Dietz, Z. anorg. 1899, 20. 245.)

+3 $\text{H}_2\text{O}$ . Sol in 12.5 pts.  $\text{H}_2\text{O}$  at 0°.

(Engel)

Solubility in  $\text{H}_2\text{O}$

100 g. of the sat. solution contain at:

-5°	0°	+7° (mpt.)
64 5	67 58	71.57 g. $\text{ZnCl}_2$ .

(Dietz, Z. anorg. 1899, 20. 245.)

Zinc hydrogen chloride,  $2\text{ZnCl}_2, \text{HCl} + 2\text{H}_2\text{O}$ .

Deliquescent. (Engel, C. R. 102. 1068)

$\text{ZnCl}_2, \text{HCl} + 2\text{H}_2\text{O}$ . (Engel)

Zinc hydrazine chloride,  $\text{ZnCl}_2, \text{N}_2\text{H}_4, \text{HCl}$ .

Very hygroscopic

Sol in  $\text{H}_2\text{O}$ . (Curtius, J. pr. 1894, (2) 50. 338.)

$\text{ZnCl}_2 \cdot 2(\text{N}_2\text{H}_4, \text{HCl})$  Hydroscopic; very sol. in  $\text{H}_2\text{O}$ .

Sol. in hot alcohol and  $\text{NH}_4\text{OH} + \text{Aq.}$  (Curtius, J. pr: 1894, (2) 50. 338.)

**Zinc chloride ammonia,  $\text{ZnCl}_2 \cdot 5\text{NH}_3 + \text{H}_2\text{O}$ .**

Easily sol. in little, but decomp. by much  $\text{H}_2\text{O}$ . Still more sol. in  $\text{ZnCl}_2 + \text{Aq}$  with decomp. (Divers, C. N. 18. 13)

$\text{ZnCl}_2 \cdot 4\text{NH}_3 + \text{H}_2\text{O}$ . (Kane.)

$\text{ZnCl}_2 \cdot 2\text{NH}_3$ . Not completely sol. in  $\text{H}_2\text{O}$ , can be recryst. from hot  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Ritt-  
hansen, J. pr. 60. 473.)

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Thomas, B. 20. 743.)

$+ \frac{1}{2}\text{H}_2\text{O}$   
 $+ \frac{1}{2}\text{H}_2\text{O}$   
 $+ \frac{1}{2}\text{H}_2\text{O}$   
 $+ \text{H}_2\text{O}$  } Decomp. by  $\text{H}_2\text{O}$ .

(André, C. R. 1882, 94. 904.)

$\text{ZnCl}_2 \cdot \text{NH}_3$ . • Decomp. by  $\text{H}_2\text{O}$ . (Kane, A. ch. 72. 290)

**Zinc chloride cupric oxide,  $\text{ZnCl}_2 \cdot 3\text{CuO} + 4\text{H}_2\text{O}$ .**

(Malhe, C. R. 1901 134. 226)

**Zinc chloride hydrazine,  $\text{ZnCl}_2 \cdot 2\text{N}_2\text{H}_4$ .**

Ppt (Franzen, Z. anorg. 1908, 60. 275.)

$\text{ZnCl}_2 \cdot 2\text{N}_2\text{H}_4$  Insol. in  $\text{H}_2\text{O}$ .

Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Curtius, J. pr. 1894, (2) 50. 345)

**Zinc chloride hydroxylamine,  $\text{ZnCl}_2 \cdot 2\text{NH}_2\text{OH}$ .**

Sl. sol. in cold, somewhat more in warm  $\text{H}_2\text{O}$ . Very sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Very sl. sol. in alcohol and other organic solvents. (Crismer, Bull. Soc. (3) 3. 116.)

1 pt. is dissolved in 100 pts. aq. solution sat. at  $20^\circ$ . (Antonoff, C. C. 1906, II. 810)

**Zinc fluoride,  $\text{ZnF}_2$ .**

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Insol. in 95% alcohol. Sol. in boiling  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4$ . (Poulenc, C. R. 116. 581.)

Contrary to older statements,  $\text{ZnF}_2$  is quite sol. in  $\text{H}_2\text{O}$ . (Kohlrausch, Z. phys. Ch. 1903, 44. 213.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790)

$+ 4\text{H}_2\text{O}$  Difficultly sol. in  $\text{H}_2\text{O}$  Somewhat more sol. in  $\text{H}_2\text{O}$  containing  $\text{HF}$ ,  $\text{HCl}$ , or  $\text{HNO}_3$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Berzelius, Pogg. 1. 26.)

1 l.  $\text{H}_2\text{O}$  dissolves 16 g. at  $18^\circ$ . (Dietz)

**Zinc hydrogen fluoride.**

Known only in solution.

**Zinc zirconium fluoride.**

See Fluozirconate, zinc.

**Zinc hydrophosphide,  $\text{Zn}_3\text{H}_2\text{P}_2$ .**

Decomp. by cold  $\text{H}_2\text{O}$  and by dil  $\text{HCl} + \text{Aq.}$  (Drechsel and Finkelstein, B. 1871, 4. 353)

**Zinc hydroxide,  $\text{ZnO} \cdot \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  Sol. in acids Sol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$

1 l.  $\text{H}_2\text{O}$  dissolve 0.01 g.  $\text{ZnO} \cdot \text{H}_2\text{O}$  at  $25^\circ$ . (Bodlander, Z. phys. Ch. 1898, 27. 66)

Solubility in  $\text{H}_2\text{O}$  is calculated to be  $2.6 \times 10^{-4}$  g. moles. per l. (Herz, Z. anorg. 1900, 23. 227)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0042 g.  $\text{ZnO} \cdot \text{H}_2\text{O}$  at  $18^\circ$ . (Dupre and Bialas, Z. angew. Ch. 1903, 16. 55)

See also Zinc oxide.

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

$\text{ZnO} \cdot \text{H}_2\text{O}$ used	$\text{NH}_3$ norm	G $\text{ZnO}$ per l.
prepared from $\text{ZnSO}_4$	1 287	7 28
	0.825	3 84
	0 311	0.85
prepared from $\text{Zn}(\text{NO}_3)_2$	0 321	0 34
	0 643	0 845
	1 215	2 70
	1 928	5 07
	2.570	7 01
	3 213	10 16

(Bonsdorff, Z. anorg. 1904, 41. 189)

Solubility of  $\text{ZnO} \cdot \text{H}_2\text{O}$  in  $\text{NH}_4\text{OH}$  and ammonium bases  $+ \text{Aq}$  at  $17^\circ - 19^\circ$ .

Normality of the base	% $\text{ZnO}$ in 20 cc. of the solution
0.0942 $\text{NH}_3$	0.00185
0.236 $\text{NH}_3$	0.01795
0.707 $\text{NH}_3$	0.0959
0.0944 $\text{NH}_3\text{CH}_3$	0.0008
0.472 $\text{NH}_3\text{CH}_3$	0.01325
0.944 $\text{NH}_3\text{CH}_3$	0.0484
0.068 $\text{NH}_3\text{C}_2\text{H}_5$	0.0005
0.51 $\text{NH}_3\text{C}_2\text{H}_5$	0.0074
0.68 $\text{NH}_3\text{C}_2\text{H}_5$	0.01605
$\text{NH}(\text{C}_2\text{H}_5)_2$	insol.
$\text{NH}(\text{CH}_3)_2$	"

(Herz, Z. anorg. 1902, 30. 280.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  increases with increasing concentration of  $\text{NH}_4\text{OH}$ . (Euler, B. 1903, 36. 3401.)

2 pts.  $\text{ZnO} \cdot \text{H}_2\text{O}$  dissolve in 5 pts.  $\text{KOH} + \text{Aq.}$  (sp. gr = 1.3) (Bonnet.)

Solubility of  $\text{ZnO}_2\text{H}_2$  in  $\text{NaOH} + \text{Aq}$ 

* G. Na in 20 ccm	G. Zn in 20 ccm
0 1012	0 0040
0 1978	0.0150
0.4278	0.0442
0 6670	0.1771
0 9660	0.9630
1.4951	0 2481
2 9901	0 3700

When zinc hydroxide is treated with alkali, more dissolves at first than corresponds with the true equilibrium under the prevailing conditions, for such solutions spontaneously deposit more or less zinc hydroxide according to the concentration (Rubenbauer, Z. anorg 1902, 30. 333)

Solubility of  $\text{ZnO}_2\text{H}_2$  in  $\text{NaOH} + \text{Aq}$  at  $25^\circ$ .

G mol per l.	
Na	Zn
0 2636	0 00311
0 3871	0 0057
0 5414	0 0129
0 9280	0 0425

(Wood, Chem. Soc. 1910, 97. 881.)

Freshly pptd  $\text{ZnO}_2\text{H}_2$  is easily sol. in  $\text{KOH} + \text{Aq}$ , but it gradually goes over into a stable form which is difficultly sol. in  $\text{KOH} + \text{Aq}$ . (Herz, Z. anorg 1901, 28. 474)

Freshly pptd  $\text{ZnO}_2\text{H}_2$  is sol. in dil. salt solutions (1 %) as follows. The given ams in mg (calculated as Zn) were dissolved per l. at  $t^\circ$ .

Salt	Mg Zn	$t^\circ$
$\text{NaCl}$	51	18
$\text{KCl}$	43	20
$\text{CaCl}_2$	57 5	16
$\text{MgCl}_2$	65	16
$\text{BaCl}_2$	38	18
$\text{K}_2\text{SO}_4$	37 5	20
$\text{MgSO}_4$	27	21
$\text{KNO}_3$	17 5	15
$\text{NaNO}_3$	22	15
$\text{Ba(NO}_3)_2$	25	21
$\text{K}_2\text{CO}_3$	0	15
$\text{NH}_4\text{Cl}$	95	20
$\text{NH}_4\text{NO}_3$	77	20
$(\text{NH}_4)_2\text{SO}_4$	88	20

(Snyders, B. 11. 936)

+  $\text{H}_2\text{O}$ .

See also Zinc oxide.

Zinc hydrosulphide,  $\text{Zn}(\text{SH})_2$ 

Very unstable. Decomp. by  $\text{H}_2\text{O}$ . (Zotta, M. 19. 807)

Sol in  $\text{NaSH} + \text{Aq}$ . (Thomsen, B. 11. 2044.)

$\text{Zn}_2\text{H}_2\text{S}_4$ . (Zotta.)

Zinc iodide,  $\text{ZnI}_2$ .

Deliquescent Easily sol in  $\text{H}_2\text{O}$ .

Sat.  $\text{ZnI}_2 + \text{Aq}$  contains at:

$-18^\circ$   $-5^\circ$   $+17^\circ$   $47^\circ$   $62^\circ$   $73^\circ$   
 70 9 74 0 80 4 80 4 81 3 81 2 %  $\text{ZnI}_2$ ,  
 97 100 107 138 140  
 82 1 83.0 82 6 83.8 %  $\text{ZnI}_2$ .  
 (Étard, A. ch. 1894, (7) 2. 544)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

$0^\circ$   $18^\circ$   $40^\circ$   $60^\circ$   $80^\circ$   $100^\circ$   
 81 11 81.20 81.66 82.37 83.05 83.62 g.  $\text{ZnI}_2$ .  
 (Dietz, Z. anorg 1899, 20. 251.)

See also under  $+2\text{H}_2\text{O}$

Sp. gr. of  $\text{ZnI}_2 + \text{Aq}$  at  $19.5^\circ$  containing:

23 1 42 6 56 3 63 5 76.0 %  $\text{ZnI}_2$ .  
 1 2340 1.5121 1 7871 1.9746 2 3976  
 (Kremers, Pogg. 111. 61.)

Sp. gr. of  $\text{ZnI}_2 + \text{Aq}$  at  $19.5^\circ$  containing:

5 10 15 20 25 %  $\text{ZnI}_2$ ,  
 1.045 1 091 1.140 1 196 1 255  
 30 35 40 45 50 %  $\text{ZnI}_2$ ,  
 1.368 1.390 1 420 1 560 1 650  
 55 60 65 70 75 %  $\text{ZnI}_2$ ,  
 1.754 1 875 2 020 2 180 2 360  
 (Kremers, calculated by Gerlach, Z. anal. 8. 285)

Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ .

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830)

Sol. in alcohol.

100 pts. glycerine dissolve 40 pts at ord. temp. (Klever, Bull. Sdc. 1872, (2) 18. 372.)

100 g. glycerol dissolve 40 g.  $\text{ZnI}_2$  at  $15.5^\circ$ . (Ossendowski, Pharm. J. 1907, 79. 575.)

More sol. in anhydrous ether than in abs. alcohol. Insol. in  $\text{CS}_2$ . (Hampe, Ch. Z. 1887, 11. 846.)

Sol. in methyl acetate (Naumann, B. 1909, 42. 3790); acetone. (Eidmann, C. C. 1899, II 1014, Naumann, B. 1904, 37. 4328)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg 1906, 51. 236)

Mol weight determined in methyl sulphate (Werner, Z. anorg 1897, 15. 25.)

$+2\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:  
 $-10^\circ$   $-5^\circ$   $0^\circ$   $+10^\circ$   $22^\circ$   $27^\circ$  (mpt.)  
 80 50 80.77 81.16 82.06 83.12 89.52 g.  $\text{ZnI}_2$ .  
 (Dietz, Z. anorg. 1899, 20. 251)

$+4\text{H}_2\text{O}$  (Lubarski, Z. anorg 1898, 18. 387.)

Zinc tetraiodide,  $\text{ZnI}_4$ .

Known only in aqueous solution. (Baup, Repert. 14. 412.)

Sol. in fenchone (Rimini and Ohvari, C. C. 1907, II. 241.)

**Zinc iodide ammonia,  $\text{ZnI}_2 \cdot 4\text{NH}_3$** 

Decomp by cold  $\text{H}_2\text{O}$ . Easily sol in acids and  $\text{NH}_4\text{OH} + \text{Aq.}$  (Rafnsmelsberg, Pogg 48, 152.)

$\text{ZnI}_2 \cdot 5\text{NH}_3$ . Decomp. by cold  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Rammelsberg.)

$3\text{ZnI}_2 \cdot 5\text{NH}_3 + 3\text{H}_2\text{O}$ . (Tassily, C R. 1896, 122, 324.)

**Zinc iodide hydrazine,  $\text{ZnI}_2 \cdot 2\text{N}_2\text{H}_4$** 

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Franzen, Z anorg. 1908, 60, 277.)

**Zinc nitride,  $\text{Zn}_3\text{N}_2$** 

Decomp by  $\text{H}_2\text{O}$  with the greatest violence (Fränkland, Phil Mag (4) 15, 149.)

Easily decomp by  $\text{H}_2\text{O}$  when finely powdered (Rosell, C R 1895, 121, 942.)

Sol in  $\text{HCl}$  (Fischer, B. 1910, 43, 1468.)

**Zinc oxide,  $\text{ZnO}$** 

Insol. in  $\text{H}_2\text{O}$ . Some preparations of  $\text{ZnO}$  are sl. sol in  $\text{H}_2\text{O}$ , never, however, in less than 1 million pts  $\text{H}_2\text{O}$ . (Bineau, C R 41, 510.)

Calculated from electrical conductivity of  $\text{ZnO} + \text{Aq}$  1 pt  $\text{ZnO}$  is sol. in 286,000 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Dupre and Bialas, Zeit. angew. Ch 1903, 16, 55.)

See also Zinc hydroxide.

Easily sol in acids, even after ignition. Easily sol in acids, even  $\text{H}_2\text{SO}_4$ , or  $\text{H}_2\text{CO}_3 + \text{Aq.}$

Solubility of  $\text{ZnO}$  in  $\text{CrO}_3 + \text{Aq}$  at  $25^\circ$

1 l. of the solution contains.

G $\text{CrO}_3$	G $\text{ZnO}$	G $\text{CrO}_3$	G $\text{ZnO}$
0.010	0.013	101	44.9
0.010	0.013	151	66.1
0.010	0.013	192	83.8
0.604	0.409	192	83.6
2.14	1.16	285	123
4.19	2.24	392	168
11.4	5.84	450	193
11.5	5.89	461	196
22.2	10.7	463	197
31.4	14.9	475	202
43.1	20.1	574	240
57.5	26.7	660	274
66.5	30.3	769	318
66.7	30.4	879	354
70.6	32.2	970	389
93.3	41.5	...	..

(Grbger Z. anorg 1911, 70, 136.)

When moist is easily sol in  $\text{KOH}$ ,  $\text{NaOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq.}$  but only sl sol therein after ignition. Partially reprecipitated from solution in  $\text{NH}_4\text{OH} + \text{Aq}$  by dilution with  $\text{H}_2\text{O}$ .

Anhydrous  $\text{ZnO}$  is insol in dil., but sol. in conc. alkali hydrates +  $\text{Aq.}$  but the hydroxide is easily sol., even in dil. alkalis +  $\text{Aq.}$  (Fremy, A. ch. (3) 23, 390.)

Very sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  After igni-

tion its solubility is greatly increased by traces of  $\text{K}$  and  $\text{NH}_4$  salts. Phosphates have the strongest action, then, in the following order: arsenates, chlorides, sulphites, nitrates, acetates, carbonates, tartrates, citrates, and sulphates. Succinates and benzoates increase the solubility in  $\text{NH}_4\text{OH} + \text{Aq.}$  only when it is very dil., borates, iodides, chlorates, arsenites, gallates, and oxalates do not increase the solubility (Schundler)

$\text{ZnO}$  is sol in  $\text{NH}_4\text{OH} + \text{Aq.}$  only in presence of  $\text{NH}_4$  salts (Brandhorst, Zeit. angew. Ch 1904, 17, 513.)

Solubility in  $\text{KOH}$ ,  $\text{NaOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq.}$

An excess over 4 mols  $\text{KOH}$  to 1 mol  $\text{ZnO}$  is necessary for solution, but that excess may be neutralised after solution, until only 4 mols are left, without pptn. of  $\text{ZnO}$ . Solution is pptd by addition of 12 vols  $\text{H}_2\text{O}$ .  $\text{KOH} + \text{Aq}$  containing 16.5 g.  $\text{KOH}$  to a litre  $\text{H}_2\text{O}$  is the weakest solution which will dissolve  $\text{ZnO}$ . Three times as much alkali are necessary for solution at  $50^\circ$  as at  $16-17^\circ$ . Less excess of  $\text{NaOH}$  than of  $\text{KOH}$  is necessary. 3 mols  $\text{NH}_4\text{OH}$  will dissolve 1 mol.  $\text{ZnO}$ , and the temp and dilution are in this case of little influence. (Prescott)

100 cc of 20%  $\text{NaOH} + \text{Aq}$  dissolve in many hours at most 2.97 g. ignited  $\text{ZnO}$ . Pptd  $\text{ZnO}$  is more quickly dissolved but the action becomes very slow after 100 cc of the solution contain 3.87 g. of  $\text{Zn}$ . (Forster and Günther, Z. Elektrochem 1900, 6, 301.)

Solubility of ignited  $\text{ZnO}$  in  $\text{NaOH} + \text{Aq}$  gradually decreases. (Kunscheit, Z anorg. 1904, 41, 343.)

Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ , either when moist or dry.

Somewhat less sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq.}$

Somewhat sol in water glass +  $\text{Aq.}$  (Ordway.)

Slowly sol in cold, easily in hot  $\text{NaCl} + \text{Aq.}$  (Siersch, J B 1887, 255.)

Solubility of  $\text{ZnO}$  in  $\text{ZnCl}_2 + \text{Aq}$  at room temp.

G $\text{ZnCl}_2$ per 100 g. $\text{H}_2\text{O}$	G $\text{ZnO}$ per 100 g. $\text{H}_2\text{O}$
8.22	0.0137
23.24	0.138
45.95	0.497
51.50	0.604
56.90	0.723
62.85	0.884
96.00	1.792
124.70	3.213
144.80	2.640
203.00	1.590

The solubility curve has a maximum at a point corresponding to about 125 g.  $\text{ZnCl}_2$  per 100 g.  $\text{H}_2\text{O}$ . On the first branch of the curve the solid phase in equilibrium with the solution is  $\text{ZnCl}_2 \cdot 4\text{ZnO} \cdot 6\text{H}_2\text{O}$ ; on the second branch it is  $\text{ZnCl}_2 \cdot \text{ZnO} \cdot 1.5\text{H}_2\text{O}$ .

(Dnot, C R 1910, 150, 1427.)

Sol. in boiling  $\text{Fe}(\text{NO}_3)_3$  and  $\text{Pb}(\text{NO}_3)_2$  + Aq with pptn of oxides. Not attacked by  $\text{Co}(\text{NO}_3)_2$ ,  $\text{Ni}(\text{NO}_3)_2$ , and  $\text{Ce}(\text{NO}_3)_3$  + Aq. (Persoz.)

Sol in boiling  $\text{KCN}$  + Aq

Insol. in boiling K tartarate + Aq (Kahlenberg and Hülyer, *Am. Ch. J.* 1894, 16, 101.)

Insol in liquid  $\text{NH}_3$ . (Franklin, *Am Ch J.* 1898, 20, 830.)

Tartaric acid somewhat hinders the pptn. of  $\text{ZnO}_2\text{H}_2$

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol in acetone. (Naumann, B. 1904, 37, 4329, Eidmann, C. C. 1899, II 1014.)

Sol in methyl amine, but insol. in amyl amine + Aq. (Wartz.)

1 l solution containing 174.4 g. sugar and 14.1 g.  $\text{CaO}$  dissolves 0.24 g.  $\text{ZnO}$ .

(Bodenbender, J. B. 1866, 600) ;  
Min. *Zincite*. Sol in acids

### Zinc peroxide.

1 pt. sol. in 45,000 pts  $\text{H}_2\text{O}$ .

Very sol. in acids. (Foregger and Philipp, J. Soc. Chem. Ind. 1906, 26, 300.)

$\text{ZnO}_2$  (?) Ppt Decomp. by acids with evolution of  $\text{H}_2\text{O}_2$ . (Haass, B. 17, 2249.)

$\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{O}_2$  (de Forcrand, A. ch. 1902, (7) 27, 58.)

$3\text{ZnO}$ ,  $2\text{H}_2\text{O}_2$ . (de Forcrand)

$3\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $2\text{H}_2\text{O}_2$ . (de Forcrand.)

$4\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $3\text{H}_2\text{O}_2$ . (de Forcrand)

$\text{ZnO}_2$ ,  $\text{ZnO}_2\text{H}_2$  Insol. in  $\text{NH}_4\text{OH}$  + Aq. (Kouriloff, A. ch. (6) 23, 431.)

$3\text{ZnO}_2$ ,  $\text{Zn}(\text{OH})_2$ . Sol. in  $\text{NaOH}$  + Aq with evolution of  $\text{O}$  (Ejman, C. C. 1906, I 1628.)

$\text{Zn}_2\text{O}_7$ ,  $3\text{ZnO}$  +  $4\text{H}_2\text{O}$ . Completely sol. in dil  $\text{H}_2\text{SO}_4$  (de Forcrand.)

$10\text{ZnO}$ ,  $4\text{ZnO}$  +  $5\text{H}_2\text{O}$  Ppt (Teletow, C. C. 1911, I. 1799)

### Zinc oxybromide, $\text{ZnBr}_2$ , $\text{ZnO}$ + $13\text{H}_2\text{O}$ .

$\text{ZnBr}_2$ ,  $4\text{ZnO}$  + 10, 13, and  $19\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into—

$\text{ZnBr}_2$ ,  $6\text{ZnO}$  +  $35\text{H}_2\text{O}$ . (André)

$\text{ZnBr}_2$ ,  $5\text{ZnO}$  +  $6\text{H}_2\text{O}$  (André.)

All oxybromides are sol in  $\text{KOH}$  and  $\text{NH}_4\text{OH}$  + Aq. (André, C. R. 96, 703.)

### Zinc oxybromide ammonia, $\text{ZnBr}_2$ , $3\text{ZnO}$ , $2\text{NH}_3$ + $5\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (André, C. R. 96, 703)

### Zinc oxychloride, $\text{ZnO}$ , $3\text{ZnCl}_2$ + $\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ .

Very sol in dil. acids. (Ephraim, Z. anorg. 1908, 59, 87.)

+  $4\text{H}_2\text{O}$ . Sl sol in  $\text{H}_2\text{O}$ ; more sol. in  $\text{ZnCl}_2$  + Aq.

Easily sol. in acids, or  $\text{NH}_4\text{OH}$ , or  $\text{KOH}$  + Aq. (Schindler, *Mag. Pharm* 36, 45.)

+  $5\text{H}_2\text{O}$  and  $8\text{H}_2\text{O}$ . (André, A. ch. (6) 3, 94.)

$\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $1\frac{1}{2}\text{H}_2\text{O}$ . (Driest, C. R. 1910, 150, 1427.)

$3\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $2\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ , more easily sol. in  $\text{ZnCl}_2$  + Aq. Easily sol. in acids and in  $\text{NH}_4\text{OH}$  or  $\text{KOH}$  + Aq. (Schindler, *Mag. Pharm* 36, 45.)

+  $3\text{H}_2\text{O}$  (Werner, B. 1907, 40, 4443.)

+  $5\text{H}_2\text{O}$  (Mailhe, A. ch. 1902, (7) 27, 367.)

$3\text{ZnO}$ ,  $2\text{ZnCl}_2$  +  $11\text{H}_2\text{O}$ . (André, C. R. 1888, 106, 854)

$4\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $6\text{H}_2\text{O}$  (André, C. R. 1888, 106, 854)

+  $11\text{H}_2\text{O}$ . (André, A. ch. (6) 8, 94.)

$5\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $6\text{H}_2\text{O}$  (Perrot, *Bull. Soc.* 1895, (3) 13, 976)

+  $8\text{H}_2\text{O}$  (André, C. R. 1882, 94, 1524.)

$5\text{ZnO}$ ,  $2\text{ZnCl}_2$  +  $26\text{H}_2\text{O}$  Sol. in  $\text{KOH}$  or  $\text{NH}_4\text{OH}$  + Aq. Decomp. by  $\text{H}_2\text{O}$  into—

$6\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $26\text{H}_2\text{O}$ . Sol. in  $\text{KOH}$  or  $\text{NH}_4\text{OH}$  + Aq. Decomp. by  $\text{H}_2\text{O}$  into—

$6\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Kane, A. ch. 72, 296.)

$8\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $10\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27, 367)

$9\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $3\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ . Less sol in  $\text{NH}_4\text{OH}$  + Aq than  $\text{ZnCl}_2$ ,  $3\text{ZnO}$  +  $2\text{H}_2\text{O}$ , but easily sol. in +  $14\text{H}_2\text{O}$ .

$9\text{ZnO}$ ,  $2\text{ZnCl}_2$  +  $12\text{H}_2\text{O}$  Insol. in hot or cold  $\text{H}_2\text{O}$ . (Habermann, M. 5, 432.)

### Zinc oxychloride ammonia, $6\text{ZnCl}_2$ , $\text{ZnO}$ , $12\text{NH}_3$ + $4\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  and boiling alcohol. (André, A. ch. (6) 3, 90.)

$\text{ZnCl}_2$ ,  $3\text{ZnO}$ ,  $2\text{NH}_3$  +  $5\text{H}_2\text{O}$  Decomp. by  $\text{H}_2\text{O}$ . (André.)

$\text{ZnCl}_2$ ,  $2\text{ZnO}$ ,  $2\text{NH}_3$  +  $3\text{H}_2\text{O}$  (André.)

$6\text{ZnCl}_2$ ,  $3\text{ZnO}$ ,  $10\text{NH}_3$  +  $13\text{H}_2\text{O}$ . (André.)

$4\text{ZnCl}_2$ ,  $\text{ZnO}$ ,  $8\text{NH}_3$  +  $2\text{H}_2\text{O}$ . (André.)

### Zinc oxydioxide, $\text{ZnI}_2$ , $3\text{ZnO}$ + $2\text{H}_2\text{O}$ .

Insol in cold. sl. sol in boiling  $\text{H}_2\text{O}$  (Müller, J. pr. 26, 441)

$\text{ZnI}_2$ ,  $9\text{ZnO}$  +  $24\text{H}_2\text{O}$ . Insol. in cold  $\text{H}_2\text{O}$ .

$\text{ZnI}_2$ ,  $5\text{ZnO}$  +  $11\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  (Tassully, C. R. 1896, 122, 324)

### Zinc oxyphosphide, $\text{ZnP}_2\text{O}$ .

(Renault, A. ch. (4) 9, 182.)

Probably is a mixture of zinc phosphate and phosphorus. (Vigier, *Bull. Soc.* 1861, 5.)

### Zinc oxysulphide, $\text{ZnO}$ , $\text{ZnS}$ .

Sol. in  $\text{HCl}$  + Aq (Arfvedson, *Pogg.* 1, 59.)

$4\text{ZnS}$ ,  $\text{ZnO}$ . Not decomp. by boiling  $\text{HCl}$  +  $\text{H}_2\text{O}$  + Aq (Kersten, *Schw. J.* 67, 186.)

Min. *Volante* Sol in  $\text{HCl}$  + Aq.

### Zinc phosphide, $\text{ZnP}$ .

Less easily attacked by  $\text{HCl}$  + Aq than  $\text{Zn}_3\text{P}_2$ .

$\text{ZnP}_2$ . Not attacked by hot  $\text{HCl}$  + Aq. (Hvoslef, A. 100, 99)

$\text{ZnP}$ . Insol. in dil  $\text{HCl}$  + Aq. (Renault.)

$\text{Zn}_3\text{P}_2$ . Insol in  $\text{H}_2\text{O}$ . Sol. in dil  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3$ +Aq, with evolution of  $\text{PH}_3$ . (Renault, A. ch. (4) 9. 162.)

$\text{Zn}_3\text{P}_4$ . Insol. in  $\text{HCl}$ +Aq (Renault)

### Zinc selenide, $\text{ZnSe}$ .

Cold dil  $\text{HNO}_3$ +Aq dissolves out Zn, and Se separates out, which dissolves on warming as  $\text{H}_2\text{SeO}_3$ . (Berzelius.)

+ $\text{zH}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$ . (Berzelius.)

### Zinc sulphide, $\text{ZnS}$ .

Anhydrous. Insol in  $\text{H}_2\text{O}$ . Sol in  $\text{HCl}$ +Aq, insol. in  $\text{H}_2\text{C}_2\text{H}_3\text{O}_2$ +Aq (Ebelmen, A. ch. (3) 25. 97.)

Sol. in  $\text{H}_2\text{S}$ +Aq under pressure in a sealed tube. (Sonarmon, A. ch. (3) 32. 168.)

Min. *Blende*, *Sphalerite*. Sl. attacked by acids, expecting aqua regia

1 l.  $\text{H}_2\text{O}$  dissolves  $6.65 \times 10^{-6}$  mols. zinc blende at  $18^\circ$

1 l.  $\text{H}_2\text{O}$  dissolves  $6.63 \times 10^{-4}$  mols. artificial cryst.  $\text{ZnS}$  at  $18^\circ$ . (Wiegel, Z. phys. Ch. 1907, 58. 294.)

Sol. in an alkaline solution of  $\text{NaClO}$  (Sadtler, Trans. Am. Electrochem. Soc. 1902, 1. 142.)

Insol. in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20. 830.)

+ $\frac{1}{2}$ ,  $\frac{2}{3}$ , or  $\frac{1}{2}\text{H}_2\text{O}$

Pptd.  $\text{ZnS}$ .

1 l.  $\text{H}_2\text{O}$  dissolves  $70.60 \times 10^{-4}$  mols. pptd  $\text{ZnS}$  at  $18^\circ$ . (Wiegel, Z. phys. Ch. 1907, 58. 294.)

Insol. in alkali hydrates, carbonates, and sulphides+Aq. Insol in  $\text{NH}_4\text{OH}$ ,  $\text{HCl}$ , or  $(\text{NH}_4)_2\text{CO}_3$ +Aq. Easily sol. in very dil.  $\text{HCl}$  and  $\text{HNO}_3$ +Aq, but  $\text{H}_2\text{S}$  ppts.  $\text{ZnS}$  in presence of very dil.  $\text{HCl}$ +Aq, or  $\text{H}_2\text{SO}_4$ +Aq. (Eliot and Storer.)

More easily sol. in  $\text{HNO}_3$ +Aq than in  $\text{HCl}$ +Aq (Fresenius.)

Only sl. sol. in acetic acid. (Wackenroder.)

When still moist is sol. in  $\text{H}_2\text{SO}_4$ +Aq.

Insol. in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3$ +Aq

$\text{K}_2\text{S}$ +Aq when added to  $\text{ZnSO}_4$ +Aq produces a ppt. in presence of 10,000 pts  $\text{H}_2\text{O}$ , and a slight opalescence with 20,000 pts. (Lassaigne.)

Slowly sol. in conc  $\text{KCN}$ +Aq. (Halm, J. B. 1870. 1008.)

Sl. sol. in  $\text{Na}_2\text{S}$ +Aq; sol. in  $\text{NaSH}$ +Aq (Becker, Sil. Am. J. (3) 83. 199.)

### Zinc pentasulphide, $\text{ZnS}_5$ .

Sol. in acids, with separation of S (Schiff, A. 115. 74.)

### Zinc sulphosilicide, $\text{ZnSiS}$ .

Decomp. by acids and by alkalis. (Fraenkel, Metall. 1909, 6. 683.)

### Zinc telluride, $\text{ZnTe}$ .

Decomp. by acids. Sol. in  $\text{Bi}_2$ +Aq. (Fabre, C. R. 105. 277.)

### Zincic acid.

Zinc hydroxide shows weak acid properties, and forms the following salts.

**Ammonium zincate**,  $3\text{ZnO} \cdot 4\text{NH}_3 + 12\text{H}_2\text{O} = 3\text{ZnO} \cdot 2(\text{NH}_4)_2\text{O} + 10\text{H}_2\text{O}$ .

Decomp. by much  $\text{H}_2\text{O}$

**Barium zincate**,  $\text{BaH}_2\text{Zn}_2\text{O}_4 + 7\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Bertrand, C. R. 115. 939.)

**Calcium zincate**,  $\text{CaH}_2\text{Zn}_2\text{O}_4 + 4\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$ +Aq. (Bertrand, C. R. 115. 939.)

**Cobaltous zincate**,  $x\text{CoO} \cdot y\text{ZnO}$ .

*Rinman's green*. Sol. in acids  $\text{H}_2\text{CO}_3$ +Aq dissolves out  $\text{ZnO}$  (Corney.)

**Potassium zincate**,  $\text{ZnO} \cdot \text{K}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. (Laux, A. 9. 183.)

$2\text{ZnO} \cdot \text{K}_2\text{O}$ . Decomp. immediately by cold  $\text{H}_2\text{O}$  (Fremy, C. R. 15. 1106.)

**Sodic zincate**,  $\text{Na}_2\text{O} \cdot 2\text{ZnO} + 3\text{H}_2\text{O}$ , or  $2\text{NaHZnO}_2 + 7\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  or alcohol (Corney and Jackson, Am. Ch. J. 11. 145.) + $7\text{H}_2\text{O}$ . (Förster and Günther, Z. Elektrochem., 1899, 6. 301.)

$2\text{Na}_2\text{O} \cdot 3\text{ZnO} + 18\text{H}_2\text{O}$  or  $\text{Zn}_3\text{O}_2\text{Na}_4\text{H}_2 + 17\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  or alcohol. Insol. in ether. (Corney and Jackson.)

**Strontium zincate**,  $\text{SrH}_2\text{Zn}_2\text{O}_4 + 7\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Bertrand.)

### Zirconic acid.

See Zirconium hydroxide.

**Barium zirconate**,  $\text{BaZrO}_3$ .

Insol. in acids. (Ouvrard, C. R. 113. 80.)

**Calcium zirconate**,  $\text{CaZrO}_3$ .

Insol. in acids. (Ouvrard, C. R. 113. 80.)

**Calcium zirconate**, acid.

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl}$ +Aq. (Hiordthal, A. 137. 237.)

**Calcium potassium zirconate**,  $(\text{Ca}, \text{K})\text{LaO}_3$  (small quantity of  $\text{CaO}$  substituted by  $\text{K}_2\text{O}$ ).

Sol. in  $\text{HCl}$ . (Venable, J. Am. Chem. Soc. 1896, 18. 444.)

**Cupric zirconate**.

(Berthier, A. ch. 59. 195.)

**Lithium zirconate,  $\text{Li}_2\text{ZrO}_3$** 

Easily attacked by acids (Ouvrard, C. R. 112. 1444.)

**Magnesium zirconate.**

Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ . (Hiordthal, C. R. 61. 215.)

**Potassium zirconate.**

Decomp by  $\text{HCl} + \text{Aq}$ . (Knop, A. 159. 44)

**Sodium zirconate,  $\text{Na}_2\text{ZrO}_3$** 

Decomp by  $\text{H}_2\text{O}$   
 $\text{Na}_4\text{ZrO}_4$  Decomp. by  $\text{HCl} + \text{Aq}$ , and is dissolved by subsequent addition of  $\text{H}_2\text{O}$   
 $\text{Na}_2\text{O}$ ,  $8\text{ZrO}_2 + 12\text{H}_2\text{O}$ . (Hiordthal)

**Strontium zirconate,  $\text{SrZrO}_3$** 

As  $\text{CaZrO}_3$  (Ouvrard.)

**Zirconium,  $\text{Zr}$ .**

*Crystallized.* Attacked by conc  $\text{HCl} + \text{Aq}$  above  $50^\circ$ , but very slowly even at  $100^\circ$ ; rapidly by hot aqua regia. Sol. in cold conc.  $\text{HF} + \text{Aq}$ . (Troost, C. R. 61. 109.)

Very violently attacked by a mixture of  $\text{HNO}_3$  and  $\text{HF}$ . (Berzelius, Pogg. 4. 117.)

*Amorphous.* Slowly attacked by boiling aqua regia,  $\text{H}_2\text{SO}_4$ , or conc.  $\text{HCl} + \text{Aq}$ . (Berzelius.)

Easily sol. in  $\text{HF}$  or  $\text{HNO}_3 + \text{HF}$

**Zirconium bromide,  $\text{ZrBr}_4$** 

Very hygroscopic. Violently decomp. by  $\text{H}_2\text{O}$  to form oxybromide (Mellus, Zeit. Cli (2) 6. 296.)

Sl sol. in organic solvents (Matthews, J. Am. Chem. Soc. 1898, 20. 840)

**Zirconium bromide ammonia,  $\text{ZrBr}_4 \cdot 4\text{NH}_3$** 

Ppt Insol in organic solvents. (Matthews, J. Am. Chem. Soc. 1898, 20. 840.)

$\text{ZrBr}_4 \cdot 10\text{NH}_3$ . Very hygroscopic.  
 Decomp by  $\text{H}_2\text{O}$  (Stähler, B. 1905, 38. 2612)

**Zirconium carbide,  $\text{ZrC}$** 

Insol. in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$  and  $\text{HCl}$  Aq even when heated. Sol. in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and fused alkali nitrates, chlorates, or hydroxides. (Moissan, C. R. 1896, 122. 653.)

**Zirconium chloride,  $\text{ZrCl}_4$** 

Sol in  $\text{H}_2\text{O}$  with evolution of much heat to form  $\text{ZrOCl}_2$ . Sol in alcohol (Hinsberg, A. 239. 253.)

Very unstable.

Probably substances so described in the literature by Nylander and others were oxychlorides. (Venable, J. Am. Chem. Soc. 1894, 16. 471.)

Sol. in ether. (Matthews, J. Am. Chem. Soc. 1898, 20. 821.)

**Zirconium chloride ammonia,  $\text{ZrCl}_4 \cdot 2\text{NH}_3$** 

Fumes in the air. Decomp. by  $\text{H}_2\text{O}$ . (Matthews, J. Am. Chem. Soc. 1898, 20. 821.)  
 $\text{ZrCl}_4 \cdot 3\text{NH}_3$ . (Stähler, B. 1905, 38. 2611.)  
 $\text{ZrCl}_4 \cdot 4\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Paykull)

Unstable. Decomp. by  $\text{H}_2\text{O}$  (Matthews, J. Am. Chem. Soc. 1898, 20. 821)

$\text{ZrCl}_4 \cdot 8\text{NH}_3$ . Stable in the air. Decomp. by  $\text{H}_2\text{O}$ . Insol. in ether. (Matthews, J. Am. Chem. Soc. 1898, 20. 821.)

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Stähler, B. 1905, 38. 2611.)

**Zirconium fluoride,  $\text{ZrF}_4$** 

*Anhydrous.* Insol in  $\text{H}_2\text{O}$  and acids. (Deville, A. ch. (3) 49. 84.)

Only sl. sol. in  $\text{H}_2\text{O}$ .

1388 g. dissolve in 100 cc  $\text{H}_2\text{O}$  without hydrolysis. On warming the solution, zirconium hydrate begins to ppt. out at about  $50^\circ$ . (Wolter, Ch. Z. 1908, 32. 606.)

+  $3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , but solution decomposes on diluting, with pptn of an insol. basic salt. Sol. in dil.  $\text{HF} + \text{Aq}$ . (Berzelius.)

**Zirconium fluoride ammonia,  $5\text{ZrF}_4 \cdot 2\text{NH}_3$** 

(Wolter, Ch. Z. 1908, 32. 607.)

**Zirconium hydride,  $\text{ZrH}_3$** 

Not attacked by acids. (Winkler, B. 24. 873)

**Zirconium hydroxide,  $\text{Zr}(\text{OH})_4$** 

Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol in 5000 pts.  $\text{H}_2\text{O}$ . (Mellus.)

Sol. in acids, even oxalic or tartaric acid, when precipitated cold. If precipitated hot, it is slowly dissolved upon heating with conc. acids.

Sol. in dil or conc. min acids except  $\text{HI}$ . Readily sol. in oxalic, only sl sol. in acetic acid.

Much less sol when pptd. from hot solution than when pptd. from cold solution (Venable, J. Am. Chem. Soc. 1898, 20. 274)

Sl. sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Insol. in  $\text{K}_2\text{CO}_3$  and  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Insol. in  $\text{NaOH}$ ,  $\text{KOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ .

Sol in  $(\text{NH}_4)_2\text{C}_2\text{H}_3\text{O}_6 + \text{NH}_4\text{OH} + \text{Aq}$ . Insol in  $\text{NH}_4$  salts +  $\text{Aq}$ .

**Zirconium iodide,  $\text{ZrI}_4$** 

Fumes in the air.

Sol in  $\text{H}_2\text{O}$  and acids with violent reaction.

Decomp by alcohol. Sol in abs. ether. Sl sol. in benzene and  $\text{CS}_2$ . (Stähler, B. 1904, 37. 1137)

Insol in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ , aqua regia, and  $\text{CS}_2$ .

Sol. in  $\text{H}_2\text{SO}_4$  with decomp; unchanged by boiling  $\text{H}_2\text{O}$ . (Dennis, J. Am. Chem. Soc. 1896, 18. 678.)

Zirconium iodide ammonia,  $ZrI_4 \cdot 6NH_3$ ,  
 $ZrI_4 \cdot 7NH_3$ ;  $ZrI_4 \cdot 8NH_3$ ;  $ZrI_4 \cdot 10NH_3$ .

All above compds are hygroscopic and lose  $NH_3$  in the air (Stahler, B. 1905, 38. 2615).

### Zirconium nitride.

Scarcely attacked by acids, aqua regia, and caustic alkalis. Slowly decomp. by long contact with  $H_2O$ . (Mallett, Sil. Am. J. (2) 28. 346.)

$Zr_2N_3$ . Decomp. when heated in the air; sol in  $HF$ , insol. in other min. acids. (Matthews, J. Am. Chem. Soc. 1898, 20. 844.)

$Zr_3N_8$ . Decomp. when heated in the air. Sol. in  $HF$ , insol. in other min. acids. (Matthews, J. Am. Chem. Soc. 1898, 20. 844.)

### Zirconium oxide, $ZrO_2$ .

When ignited, is insol. in all acids except  $HF$  and  $H_2SO_4$ . Sl. sol. in  $HF$ ; sol. in  $H_2SO_4$  only when very finely powdered and heated with a mixture of 2 pts.  $H_2SO_4$  and 1 pt.  $H_2O$  until the  $H_2SO_4$  volatilises. (Berzelius.)

### Zirconium peroxide, $ZrO_3$ .

(Cleve, Bull. Soc. (2) 43. 53), or  $Zr_2O_5$ , according to Bailey (Chem. Soc. 49. 150).

Not attacked by cold dil.  $H_2SO_4$  + Aq. (Bailey.)

### Zirconium silicon oxide.

Min. Zircon. See Silicate, zirconium.

### Zirconium oxy-compounds.

See Zirconyl compounds.

### Zirconium phosphide, $ZrP_3$ .

Insol. in dil. or conc. acids and alkalis

Sl. sol. in aqua regia. (Gewecke, A. 1908, 361. 85.)

### Zirconium silicide, $ZrSi_2$ .

Sol in  $HF$ , insol. in other min. acids

Not acted upon by 10%  $KOH$  + Aq or  $NaOH$  + Aq

Decomp. by fusion with  $KOH$ . (Honigsmid, C. R. 1906, 143. 225)

### Zirconium sulphide.

Insol. in  $H_2O$ . Sol in  $HF$ ; slowly sol in aqua regia. Insol. in  $HNO_3$ ,  $HCl$ ,  $H_2SO_4$ , or  $KOH$  + Aq. (Berzelius.)

Insol. in dil. acids. Sol in conc.  $HNO_3$  + Aq (perhaps an oxysulphide). (Fremy.)

### Zirconomolybdic acid.

Ammonium zirconomolybdate,

$2(NH_4)_2O \cdot ZrO_2 \cdot 12MoO_3 \cdot 10H_2O$ .

Sol. in  $H_2O$  (Pechard, C. R. 1893, 117. 790.)

Potassium zirconomolybdate,  
 $2K_2O \cdot ZrO_2 \cdot 12MoO_3 \cdot 18H_2O$

Sol. in  $H_2O$  (Pechard)

### Zirconotungstic acid.

Ammonium zirconodecatungstate,

$3(NH_4)_2O \cdot ZrO_2 \cdot 10WO_3 \cdot 13H_2O$

Very sol. in  $H_2O$ .

Efflorescent (Hallopeau, Bull. Soc. 1898, (3) 15. 921)

$3(NH_4)_2O \cdot H_2O \cdot ZrO_2 \cdot 10WO_3 \cdot 13H_2O$ .

Sol. in  $H_2O$ , unstable; effloresces in the air. (Hallopeau.)

Potassium zirconotungstate,  $4K_2O \cdot ZrO_2 \cdot WO_3 \cdot 20H_2O$ .

Sol. in hot  $H_2O$ . (Hallopeau.)

$4K_2O \cdot ZrO_2 \cdot 10WO_3 \cdot 15H_2O$  More sol. in hot than in cold  $H_2O$

Sol. in fused alkali carbonates. (Hallopeau)

Potassium dizirconodecatungstate,

$4K_2O \cdot 2ZrO_2 \cdot 10WO_3 \cdot 20H_2O$ .

More sol. in hot than in cold  $H_2O$

Sol. in fused alkali carbonates (Hallopeau.)

Zirconyl bromide,  $ZrOBr_2 \cdot 3H_2O$ .

Deliquescent. Decomp. in moist air.

Very sol. in  $H_2O$  (Venable, J. Am. Chem. Soc. 1898, 20. 324)

+  $7H_2O$  Sol. in  $H_2O$ . (Melliss.)

+  $8H_2O$ . Deliquescent. Decomp. in moist air. Very sol. in  $H_2O$  (Venable, J. Am. Chem. Soc. 1898, 20. 324)

+  $13H_2O$ . Deliquescent. Decomp. in moist air

Very sol. in  $H_2O$ . (Venable.)

+  $14H_2O$  Deliquescent Decomp. in moist air. (Venable.)

Very sol. in  $H_2O$ . (Venable.)

•  $ZrBr(OH)_2 \cdot H_2O$ , and +  $2H_2O$  Deliquescent, and decomp. in moist air. (Venable.)

Zirconyl chloride,  $ZrOCl_2$ .

Sol. in  $H_2O$ , insol. in  $HCl$ . (Venable, J. Am. Chem. Soc. 1894, 16. 475.)

+  $2H_2O$ . (Chauvenet, C. R. 1912, 154. 822.)

+  $3H_2O$ . Sol. in  $H_2O$ . (Venable.)

+  $3.5H_2O$ . (Chauvenet, C. R. 1912, 154. 822.)

+  $6H_2O$  (Chauvenet.)

Sol. in  $H_2O$

Insol. in  $HCl$  (Venable.)

+  $4\frac{1}{2}H_2O$ ,  $6\frac{1}{2}H_2O$ , and  $8H_2O$

Efflorescent Easily sol. in  $H_2O$  and alcohol Very sol. in conc.  $HCl$  + Aq. (Berzelius)

+  $8H_2O$ . Sol. in  $H_2O$ . (Venable, J. Am. Chem. Soc. 1898, 20. 321)

Effloresces in the air.

Sol. in  $H_2O$ . Less sol. in  $HCl$  + Aq. and nearly insol. in conc.  $HCl$  (Chauvenet, C. R. 1912, **154**, 822.)

$Zr_2OCl_2$ . Sol. in  $H_2O$  and alcohol. (Endemann, J. pr (2) **11**, 219.)

Not decomp. by  $H_2O$

Sol. in dil  $HCl$ . (Chauvenet, C. R. 1912, **154**, 1236.)

+  $H_2O$ . (Chauvenet, C. R. 1912, **154**, 1236.)

+  $3H_2O$ . Decomp. by  $H_2O$ . Sol. in dil  $HCl$  (Chauvenet)

$8ZrO_3 \cdot 7HCl$ . Sol. in  $H_2O$ . (E.)

$Zr_2OCl_2$ . (Troost and Hautefeuille, C. R. **73**, 563.)

$Zr_2OCl_2 = ZrCl_4 \cdot 2ZrO_2$ . Insol. in  $H_2O$  (Hermann.)

**Zirconyl iodide**,  $ZrOI_2 \cdot 8H_2O$ .

Very sol. in  $H_2O$  and alcohol.

Very hygroscopic. (Stähler, B. 1904, **37**, 1138.)

$ZrI(OH)_2 \cdot 3H_2O$ . Easily sol. in  $H_2O$ . (Hinsberg, A **239**, 253.)

Ppt. Sol. in  $HI$  + Aq. (Venable, J Am Chem Soc 1898, **20**, 328.)

**Zirconyl sulphide** (?)

Decomp. by  $HNO_3$  with separation of S. (Fiemy, A. ch (3) **38**, 326.)